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| THE OFFICIAL 2019 OFFSHORE TECHNOLOGY CONFERENCE NEWSPAPER | DAY 1

## Leading Offshore into a Changing Future

■ OTC's chairman sees another 50 years of success for offshore energy.

BY JENNIFER PRESLEY

To prepare for the future, one must be present today. Attendees of the 2019 Offshore Technology Conference (OTC) will be better prepared to face the decade ahead. After kicking off its 50<sup>th</sup> year in 2018 with a host of events focused on its history, this year's OTC will continue the celebration as it is set to explore the future of offshore energy. To accomplish this, conference organizers prepared a program of events to highlight the latest in technology innovations, cutting-edge designs and visionary thinking.

The first event in that program is Monday's opening general session. Its theme is "OTC's Golden Anniversary Opening Session: The Next 50 Years of Offshore Developments." Industry leaders from BP, Equinor, Total and more will share how their companies are preparing for a world that now includes automation, digitalization, machine learning and robotics.



Wafik Beydoun

"We recognized the achievements of the past 50 years in last year's opening ceremony," said OTC Chairman Wafik Beydoun. "This year, we asked that the distinguished speakers think to the future and to share their vision for offshore developments."

Scott Tinker, director of the Bureau of Economic Geology at the University of Texas in Austin, will moderate the opening session. Joining the discussion as a special guest speaker is Malcolm Frank, executive vice president of strategy and marketing for Cognizant and co-author of the book "What to Do When Machines Do Everything".

"Digital technologies will have a major impact on the offshore industry," Beydoun said. "Malcolm Frank will try to give the first view of that; he is someone I think is quite exceptional."

Beydoun sees a clear place for offshore operations as long as they can remain competitive in terms of technical cost for exploring and producing offshore resources. "There is a future for offshore E&P operations," he said.

See **OFFSHORE**  
continued on page 26

## Mission Transition

■ A solid year is ahead for the offshore sector as it continues its transformation.

BY JENNIFER PRESLEY

It is that time of the year again. The gates to NRG Park have swung open, the parking lot is purring with the sounds of people arriving en masse, and the registration clerks and door attendants are all ready for action for the first day of the Offshore Technology Conference (OTC).

As those who have been to OTC know, preparation and comfortable shoes will carry one far this week. Between the excellent papers, project updates, new technologies on display in the exhibition halls and the myriad of networking opportunities, there is much to see, do and hear.

Speaking of time, the offshore sector has been on a mission the last few years transforming itself, and it is starting to show. People are once again dipping their "toes back in the water," according to a recent report by the same name published by Barclays Equity Research.

Analysts expect 2019 to be a transition year with 2020 setting up to be the start of a multiyear growth trajectory. Structurally, the offshore market is very different today as the economic breakevens for deepwater projects now fall under \$50/bbl in many cases versus the \$80/bbl once required, the report noted. Barclays cites reductions in costs through standardization, design simplification and phased development plans as key to delivering the lower breakevens.

Modest increases in offshore activity are expected by Barclays, with its floater rig count forecast increasing from 116 at year-end 2018 to 130 at year-end 2019.

Among the many good signs that indicate an improving market is an increase in seismic activity, with pricing up 35% this year and higher exploration budgets, Barclays noted.

Chevron, for example, increased its 2019 exploration capex budget to \$1.3 billion, up 18% over 2018's \$1.1 billion. Other exploration highlights noted by Barclays include the 17% increase in Hess' budget to primarily drill exploratory/appraisal wells in Guyana and Aker BP's 40% increase to drill 15 exploration wells.

All signs point to a good 2019, an even better 2020 and a fantastic 50th anniversary celebration for OTC. ■

## Renewables, HP/HT Topics Highlight Technical Program

■ The results of digitalization efforts will be showcased.

BY BRIAN WALZEL



Donald Burris

in subsea and HP/HT environments—as well as analysis

No matter what their typical fields of interests may be, attendees at this year's Offshore Technology Conference (OTC) will have a wide variety of technical program sessions from which to choose as they make the most out of their week. This year's programs offer insight into new offshore technologies—particularly

of regional offshore development in places like South America and Mexico.

Similar to previous years, the technical program committee sought to implement a continuous theme throughout the week's sessions.

"Many of the operating companies are starting to move away from strictly being oil and gas companies and into renewable energies and alternative energy sources," said Donald Burris, OTC program committee chairman. "So we wanted to make sure that we capture that in the program this year."

See **RENEWABLES** continued on page 26

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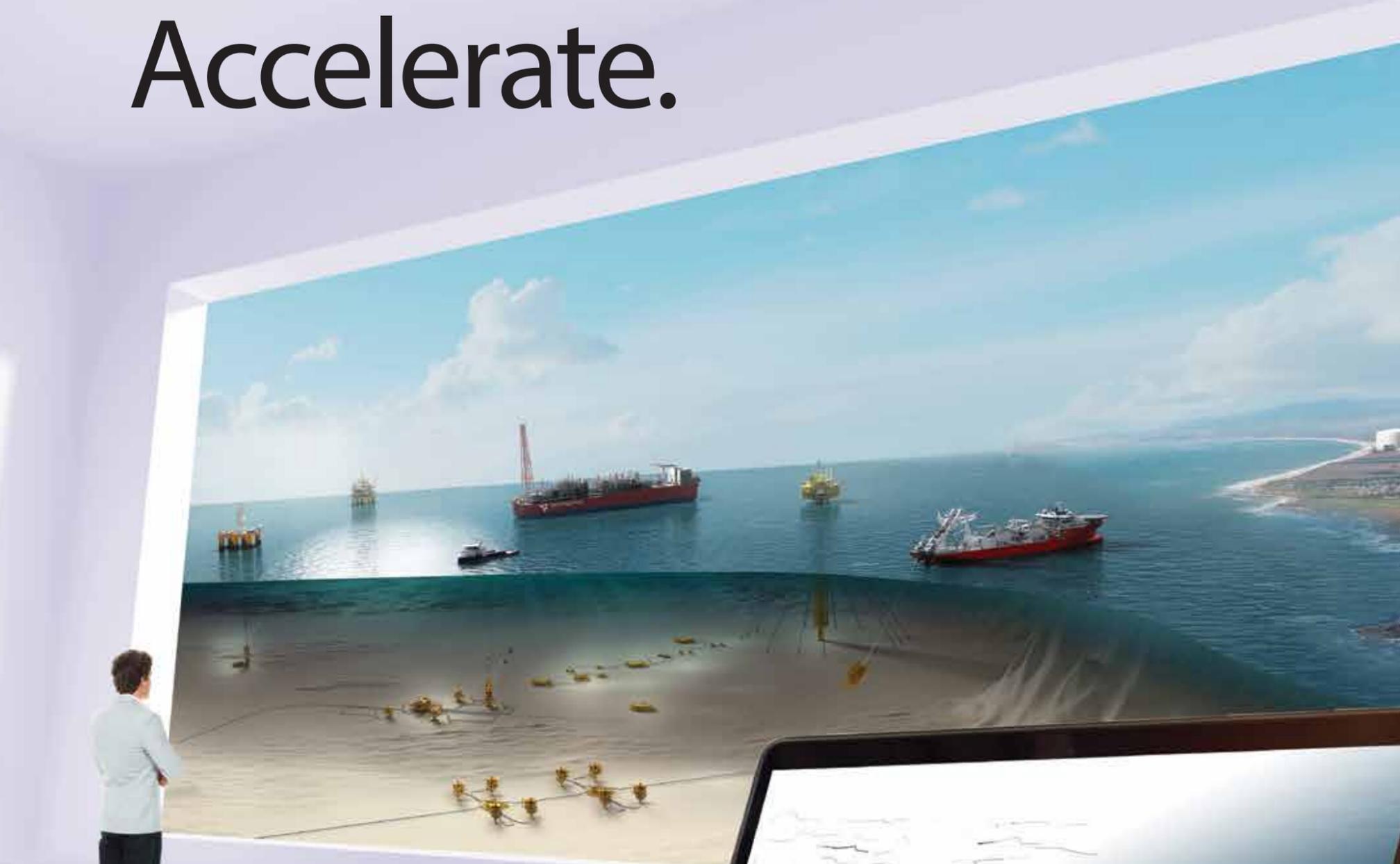


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All events in conjunction with OTC 2019 will be held at NRG Park in Houston, Texas, unless noted otherwise.

**Monday, May 6**

7 a.m. to 5 p.m.	Registration
7:30 a.m. to 9 a.m.	Topical Breakfasts
9 a.m. to 10 a.m.	Coffee on Arena Exhibit Floor
9 a.m. to 12 p.m.	Golden Anniversary Opening Session
9 a.m. to 4 p.m.	International Trade Center
9 a.m. to 5 p.m.	Exhibition
9 a.m. to 5 p.m.	University R&D Showcase
9:30 a.m. to 12 p.m.	Panel Sessions
9:30 a.m. to 12 p.m.	Technical Sessions
9:30 a.m. to 2:30 p.m.	Poster Lounge
12:15 p.m. to 1:45 p.m.	Topical Luncheons
1:30 p.m. to 5 p.m.	Rice Alliance Startup Roundup
2 p.m. to 4:30 p.m.	Topical Panel
2 p.m. to 4:30 p.m.	Technical Sessions
2 p.m. to 5 p.m.	Around the World Series   Norway
2 p.m. to 5 p.m.	Around the World Series   Australia
3 p.m. to 5:30 p.m.	Around the World Series   Israel
4 p.m. to 5 p.m.	Spotlight on New Technology Awards Presentation
4 p.m. to 6 p.m.	Networking Event

**Tuesday, May 7**

7:30 a.m. to 5 p.m.	Registration
7:30 a.m. to 9 a.m.	Topical/Ethics Breakfasts
8 a.m. to 11 a.m.	OTC Energy Challenge
9 a.m. to 10 a.m.	Coffee on Arena Exhibit Floor
9 a.m. to 12 p.m.	Around the World Series   Mexico
9 a.m. to 4 p.m.	International Trade Center
9 a.m. to 5 p.m.	Exhibition
9 a.m. to 5 p.m.	University R&D Showcase
9:30 a.m. to 12 p.m.	Panel Session
9:30 a.m. to 12 p.m.	Technical Sessions
9:30 a.m. to 3 p.m.	Poster Lounge
12:15 p.m. to 1:45 p.m.	Topical Luncheons
2 p.m. to 4:30 p.m.	Panel Session
2 p.m. to 4:30 p.m.	Technical Sessions
2 p.m. to 5 p.m.	Around the World Series   Canada
2 p.m. to 5 p.m.	Around the World Series   France
4 p.m. to 6 p.m.	Networking Event

**Wednesday, May 8**

7:30 a.m. to 5 p.m.	Registration
7:30 a.m. to 9 a.m.	Topical/Industry Breakfasts
7:30 a.m. to 9 a.m.	WISE: Diversity Drives Innovation: Start the Conversation
9 a.m. to 10 a.m.	Coffee on Arena Exhibit Floor
9 a.m. to 12 p.m.	Around the World Series   U.K.
9 a.m. to 4 p.m.	International Trade Center
9 a.m. to 5 p.m.	University R&D Showcase
9 a.m. to 5 p.m.	Exhibition
9:30 a.m. to 12 p.m.	Panel Discussion
9:30 a.m. to 12 p.m.	Technical Sessions
9:30 a.m. to 2:30 p.m.	Poster Lounge
12:15 p.m. to 1:45 p.m.	Topical Luncheons
2 p.m. to 4:30 pm.	Technical Sessions
2 p.m. to 4:30 p.m.	Panel Discussion
2 p.m. to 5 p.m.	Around the World Series   Ghana
2 p.m. to 5 p.m.	Around the World Series   Guyana
4 p.m. to 6 p.m.	Networking Event

**Thursday, May 9**

7:30 a.m. to 2 p.m.	Registration
7:30 a.m. to 9 a.m.	Topical Breakfasts
8 a.m. to 3 p.m.	Energy Education: Teacher Workshop
8:30 a.m. to 1:30 p.m.	Energy Education: High School STEM Event
9 a.m. to 10 a.m.	Coffee on Arena Exhibit Floor
9 a.m. to 2 p.m.	Exhibition
9 a.m. to 3 p.m.	1-on-1 Mock Interview Session
9:30 a.m. to 12 p.m.	Panel Discussions
9:30 a.m. to 12 p.m.	Technical Sessions
12:15 p.m. to 1:45 p.m.	Topical Luncheons
2 p.m. to 4:30 p.m.	Panel Discussion
2 p.m. to 4:30 p.m.	Technical Sessions

# Propelling the Future of the Offshore Industry

■ Innovative research projects will offer constructive solutions during OTC's University R&D Showcase.

BY FAIZA RIZVI

With research projects revolving around new ideas, impactful solutions and efficient technologies, universities from all over the world are set to give a glimpse into future offshore operations. This year's University R&D Showcase will offer presentations from the University of Texas at Austin (UT), Rice University and the University of Houston (UH). The University of Oklahoma (OU), New Mexico Institute of Mining and Technology (NMT) and the University of Tokyo will also showcase their research projects.

## Subsea operations

To overcome constraints of subsea and downhole applications, researchers from UH will share their findings

on advanced power converter topologies using high frequency magnetics to reduce the footprint of subsea and downhole drive systems. Their research aims to enable high frequency switching of the power converters using wide bandgap devices. This includes advanced switching techniques to reduce the switching loss of the converter, increasing its efficiency, which is ideal for downhole adjustable speed drivers (ASDs). The UH research team wants to develop a power converter topology with redundancy in power flow paths to ensure fault tolerant operation of the ASDs.

This project also targets development of a solid-state DC circuit breaker and connector, the technology of which could be used in subsea systems.

NMT's research project, which also focuses on subsea operations, includes an approach for single-point gas-

lift unloading. The purpose of the study is to look for an alternative high-density unloading fluid for a more reliable single-point gas-lift method. According to NMT researchers, Supercritical CO<sub>2</sub> is the most suitable fluid among other potential candidates due to cost, existing availability and application in petroleum operations. The presentation will highlight how this new approach offers higher reliability than the conventional multivalve gas-lift system and meets the zero intervention philosophy in subsea operations.

## ROVs and AUVs

UH will also highlight two technologies that the research team has developed to increase efficiency of subsea operations. The first is aimed at collision avoidance of ROVs and AUVs, which is of concern to

protect both subsea assets and the underwater robots. The Robotic Swarm Control Lab and collaborators have designed and tested tri-axial antennas for underwater robots. The main goal is to lay theoretical foundations and validate a hardware prototype for a multisensor navigation aid system that will efficiently and economically provide collision avoidance for multiple robots deployed for high-risk subsea inspection jobs.

In addition, UH researchers will showcase the SmartTouch inspection tool designed for use by subsea ROVs and AUVs to easily inspect connections with a simple touch. Using conventional inspection tools via remotely controlled robotic manipulators involves difficulty and uncertainty if the structural work performed by the robot is viable. For instance, a bolt may not be tightened adequately at a key connection. The Smart-Touch technology can also be adapted for use in humanized robots.

## Well control and completion

UT's research team will present key findings on fracture containment and propagation of water injection in offshore fields.

"We have developed a new 3-D model that estimates the injectivity of wells while modeling particulate plugging, fracture growth, thermal and poro-elastic stress in the sand and bounding shales," said Mukul M. Sharma, professor, and "Tex" Moncrief, chair of UT's Hildebrand department of petroleum and geosystems engineering.

In addition, UT researchers will showcase a project aimed at achieving uniform proppant placement in wells with multiple fractures propagating simultaneously. In many vertical and horizontal wells, several perforation clusters are created and many fractures propagate at the same time. Almost all the proppant tends to be placed in the heel side fractures.

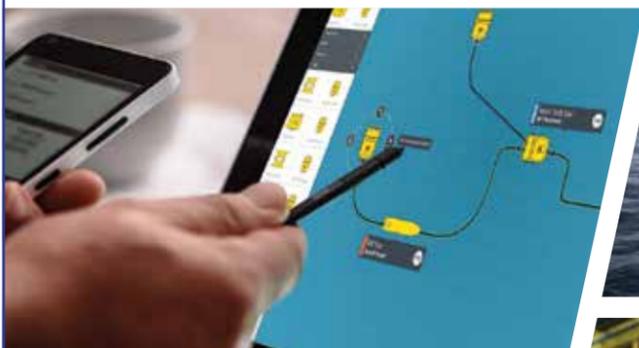
"We will show why this happens and also propose ways in which this can be prevented by modifying the completion design," Sharma said.

OU will showcase its research project on the application of virtual reality in offshore operations. One of the key objectives of the project is developing well control scenarios for offshore using virtual reality and DrillSIM-50, which is a mid-sized console-based simulator. In addition, the project aims to evaluate potential human factors that contribute to blowouts and develop protocols to enhance expert risk assessment and decision making.

See **SHOWCASE** continued on page 20

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- 11:00 - 11:30 Optimizing Subsea Design Solutions through Digital Collaboration
- 13:00 - 13:30 Driving Project Delivery with Reporting and Analytics
- 14:00 - 14:30 The New Amazon, J-Lay with Ultra-Deepwater Capability
- 15:00 - 15:30 Starting with the End in Mind: a FEL 0 Digital Twin
- 16:00 - 16:30 Optimizing Subsea Design Solutions through Digital Collaboration

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# OTC Honors FPSO Pioneer Mastrangelo

■ The award winner's involvement spans more than three decades in the FPSO arena.

BY FAIZA RIZVI

More than 30 years of work in design and adoption of cost-efficient FPSOs has earned Carlos Mastrangelo the OTC Distinguished Achievement Award for Individuals. He is the founder and managing partner of B-in Partners for investment solutions and has previously held executive and advisory positions at Petrobras and SBM Offshore. Mastrangelo will be recognized at OTC's Golden Anniversary Gala Dinner on 5 May.

"I feel a mix of joy and gratitude on being recognized by OTC on their 50<sup>th</sup> anniversary," Mastrangelo said. "Although it is an individual award, the work was carried out as a team. This recognition, therefore, is for the whole generation of Brazilians who dedicated themselves to the promotion of these activities."

When Mastrangelo began his career in the 1980s, FPSOs were not as the industry knows them today. They were seen as small units to exploit marginal oil fields. His team's challenges were not limited to regulatory and technical restrictions but also included legislation in force at the time as well as the lack of information for safety assurance working in harsh subsea environments. Over the years, Mastrangelo's efforts have resulted in advanced



Carlos Mastrangelo

design and application of the offshore units. In the early 1990s, he started working with the Brazilian Navy, port authorities and class societies toward the standardization and development of regulations for fully classed FPSOs. In 2001, following an accident on Petrobras' semisubmersible platform P-36 that resulted in the death of 11 crew members, the

company appointed Mastrangelo as the executive coordinator of the operational excellence program.

The program aimed to establish, implement and audit new guidelines for all Petrobras' offshore units. He is also credited with establishing the foundation for the general technical description of Petrobras' leased unit contract that is still in effect.

Mastrangelo said that in 2006, when the FPSO market was relatively new to the U.S. industry, he moved to the U.S. to liaise with government authorities to work on the strategy, design and requirements of the first FPSO approved for use in the Gulf of Mexico. He was also involved in the successful implementation of strategy

and conceptual requirements for the first purpose-built Jones Act shuttle tanker. His ability to overcome obstacles and his innovative work and contribution to the industry paved the way for the introduction of FPSOs in the U.S. and all over the world.

"FPSOs have a big role to play in future deepwater exploitation because of their flexibility and efficiency," he said. "They're one of the best, if not the most convenient way, to exploit oil fields."

Mastrangelo used his expertise to establish consultancy firm B-in Partners, headquartered in Houston. The company's objective is to provide investors with information about market players, regulations, technical characteristics of the prospects and the business environment to reduce investment risks in the Brazilian oil and gas industry.

Mastrangelo serves on the OTC Houston and OTC Brasil program committees, and he has authored and presented numerous papers. In 2005 the Brazilian Navy recognized his contribution to the offshore industry and the Society of Petroleum Engineers (SPE) named him Engineer of the Year in Brazil. In 2012 SPE honored Mastrangelo with the international award for his pioneering contributions regarding the introduction of FPSOs in the U.S. ■

# Baldwin Awarded Hoover Medal for Outstanding Humanitarian Service

■ The awardee raised \$13 million in two months to support those with intellectual and developmental disabilities.

BY FAIZA RIZVI



David Baldwin

Co-president of SCF Partners David Baldwin will be recognized at OTC's Golden Anniversary Gala Dinner on 5 May as the 2019 recipient of ASME's Hoover Medal. Established in 1929, the Hoover Medal commemorates the civic and humanitarian achievements of engineers whose professional accomplishments and personal endeavors have

advanced the well-being of humankind.

"I'm honored and grateful that besides professional accomplishments, my commitment to support people with intellectual and developmental disabilities [IDDs] has also been recognized," Baldwin said. "This has been such a team effort, and the award reflects the dedication of hundreds of volunteers who have supported me."

Earning his degree in petroleum engineering from the University of Texas at Austin, Baldwin began his career in the 1980s as a drilling and production engineer with Union Pacific Resources, one of the early pioneers of horizontal drilling. Intrigued with the entrepreneurial and business aspect of the energy industry, he returned to his alma mater to earn his MBA. While in graduate school, Baldwin started an energy consulting business and worked for General Atlantic Partners, a global venture capital firm and early investor of SCF Partners. He met SCF Partners founder L. E. Simmons through General Atlantic and joined the company after graduating in 1991. SCF Partners has invested in more than 400 oil and gas businesses and created 17 public companies through investments worldwide.

Baldwin also has been credited for creating numerous investment platforms around emerging energy trends, and he is currently overseeing SCF Partners' U.S.-based investments for unconventional.

"Despite its challenges, the energy industry is an exciting and diverse community and is the backbone of economic growth all over the world," he said. "It's a

great industry [in which] to build a career and make lifelong friends."

Shortly after marriage, Baldwin and his wife, Marie, decided to dedicate their lives to serving charitable organizations. In the early 1990s, they actively started volunteering and raising funds for The Center, a Houston-based organization that provides residential facilities, vocational training, employment and several other beneficial services to adults with IDD. This association was the beginning of Baldwin's philanthropic journey and a long-standing commitment to helping the disabled through The Center, where he served as president and is currently a board member.

One of his most significant achievements occurred in 2016 when he and his wife founded the Pursuit campaign and led a 6,437-km (4,000-mile) bike journey across the U.S. for two months, raising \$13 million and helping to advance awareness, collaboration and knowledge to support people with IDD. Part of the funds was used to purchase land from the City of Houston to build facilities for The Center.

"The most spectacular part was that 300 volunteers signed up to execute the project, supporting us at every step of the event," Baldwin said. "It was a challenge yet a monumental accomplishment for our team."

Baldwin is also a member of the board of directors of Forum Energy Technologies, Nine Energy Service and Select Energy Services. He is a trustee of the Baylor College of Medicine and Baylor St. Luke's Medical Center Hospital as well as for the Kay Bailey Hutchinson Center for Energy, Law and Business at The University of Texas at Austin.

Baldwin credits his achievements to his mentor and former Society of Petroleum Engineers' president, Dr. Nathan Meehan, and SCF Partners owner Simmons, both of whom encouraged Baldwin to be involved in volunteer and civic activities.

"They have shown me a pathway to be successful in business while devoting time to community services and how those two can be harmonious and beneficial to each other," Baldwin said.

Baldwin hopes to continue his philanthropic activities and suggests future generations do the same.

"Career and philanthropy are so well-integrated that I encourage everyone to stay involved in the community even while working hard in the industry," he said. "Being ambitious is fine, but life is richer when you can help others overcome obstacles and reach their potential." ■

## Safe and secure at OTC

For security purposes, attendees are required to wear their OTC name badge and badge holder at all times. According to OTC, use of a badge by a person not named on the badge is grounds for confiscation. If you lose your conference badge, please return to Registration for a replacement.

An adult must accompany attendees 15 to 18 years of age. No one under 15 years of age will be admitted to OTC.

Also expect additional security measures as you approach each entrance of NRG Park. Security personnel will be positioned at the entrances and may ask you to open your backpack or boxes for a visual inspection.

If you observe any suspicious activity or have any security concerns, please contact OTC Headquarters on site so we may investigate the matter. OTC wants all patrons to have a safe and secure experience. We appreciate your cooperation and support in making this possible.



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# Attracting New Investment in the U.S. Offshore

■ Several factors are bringing investment dollars back to the U.S. Gulf of Mexico.

BY RICHARD CLARK, NOIA

The devastating impact of the commodity price slide on the energy industry operating in the U.S. Gulf of Mexico (GoM) cannot be overstated. Between 2014 and 2018, offshore development investment dropped by 30%, offshore exploration investment dropped by 80% and the offshore rig count fell by 50%. In the face of the lingering market downturn, offshore energy companies cut costs and improved efficiency, and remarkably, pushed offshore oil production to record highs.

Today, with oil prices hovering between \$50/bbl to \$60/bbl, the offshore industry is showing renewed signs of life around the world. More than 100 offshore projects are expected to come online in 2019—more than double the number of new projects from 2016. An additional



Richard Clark

\$127 billion in new offshore projects globally could also be sanctioned in 2019.

However, many of these projects will be located in regions outside the U.S. GoM. Countries like Mexico, Brazil and Guyana, hungry for economic growth and new energy production, have adopted competitive royalty policies to attract investment dollars, and billions are flowing to their offshore projects.

The days of the U.S. being the premier offshore player at the table are over, even in the GoM, and the U.S. must find new ways to remain the top destination for offshore energy investment and development.

Could deepwater royalty reform kick start further recovery in the U.S. market and for offshore energy companies?

In July 2017, intending to attract investors to a mature segment of U.S. GoM production, the Department of the Interior (DOI) lowered the shallow-water royalty rate from 18.75% to 12.5%, bringing it on par with onshore royalty rates. Results have been encouraging, with the number of bids for shallow-water blocks increasing in subsequent lease sales.

DOI has not acted on recommendations from its Royalty Policy Committee to bring deepwater royalty rates in line with royalty rates for shallow-water and onshore projects.

However, the Bureau of Ocean Energy Management (BOEM) has begun releasing an update to the 2011

Comparative Assessment of the Federal Oil and Gas Fiscal System, which examines the global competitiveness of U.S. royalty rates. Since 2011, significant events have shifted the competitiveness of global offshore energy markets, including Mexico's constitutional amendment allowing foreign companies to develop its oil and gas resources, massive oil and natural gas finds offshore Guyana and Brazil, and changes to the U.S. corporate tax rate.

BOEM recently released the first part of the updated study, which examines both shallow-water and deepwater royalty rates in the U.S. GoM. The study shows that deepwater plays in the GoM offer lower rates of return compared to other producing margins throughout the world. It appears that high deepwater royalty rates are causing producers to turn away from the capital-intensive high-pressure and high-temperature plays in the deepwater U.S. GoM and invest instead in areas offshore Guyana, Brazil, Angola, the U.K. and Mexico. The second part of BOEM's royalty report, expected to be released later this year, examines royalty rates for offshore frontier areas and onshore leases. The final full report should underscore the need for royalty reform and give the DOI the impetus to adopt smarter royalty rates.

New deepwater technologies and new efficient practices combined with onshore shale production expected to plateau by the mid-2020s are bringing investment dollars back to the U.S. GoM. The pendulum is swinging back toward offshore, and the U.S. must seize this opportunity by further incentivizing investments in new offshore oil and gas projects. ■

*Richard Clark is president of the Gulf of Mexico Business Unit for Kosmos Energy and Chairman of the National Ocean Industries Association (NOIA).*



## 2019 OTC Booth 8215 Hall D

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# Protecting Pipelines from Corrosion One Layer at a Time

■ Multilayered coatings address prevention, protection and preservation.

BY DR. JEFFREY DAVID ROGOZINSKI, SHERWIN-WILLIAMS PROTECTIVE & MARINE COATINGS

To protect pipelines from corrosion in today's challenging oil and gas extraction environments, pipeline operators are best served by following a multilayered approach to coating pipes that focuses on prevention, protection and preservation.

The first coating layer prevents the steel pipes from corroding. The second layer protects the anti-corrosion coating from damage. Finally, the topcoat preserves the two lower layers against ultraviolet (UV) degradation.

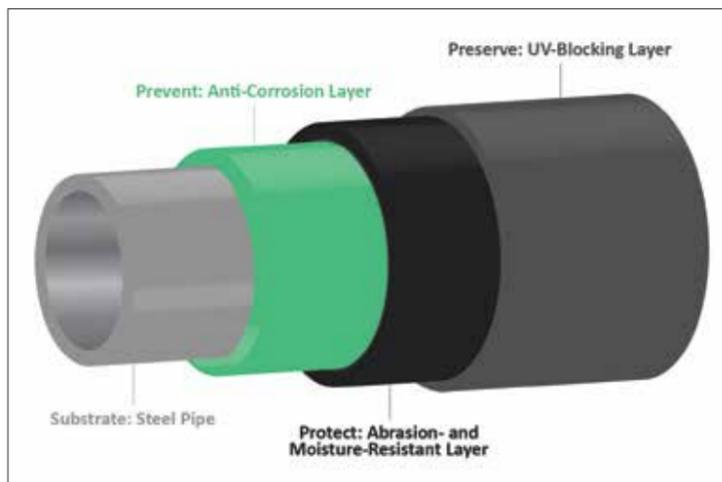
The first two layers are commonly fusion-bonded epoxy (FBE) coating technologies, which are plant-applied powder coatings that protect pipes against corrosion and wear related to underground soil stresses, bacteria and fungus attacks, soil acids, and alkalis. They deliver long-term performance against the corrosive elements associated with underwater and underground use.

The third layer could be a fusion-bonded polyester (plant-applied) or water-based acrylic coating (field-applied) that blocks UV-light waves from reaching the FBE layers below.

By building pipeline coating performance one layer at a time to address prevention, protection and preservation, pipeline operators can realize safe, efficient and cost-effective operations.

## Prevent

The base coating layer is an anti-corrosion FBE coating designed to prevent corrosive elements from reaching the steel pipe substrate. With excellent porosity resistance achieved during application, FBE coatings can effectively resist chemicals, salt water, solvents, corrosive gases and more to deliver long-term corrosion protection. Anti-corrosion FBEs should deliver excellent adhesion to steel, as well as excellent resistance to cathodic disbondment in a wide range of environments, to ensure



Long-term performance of pipe coatings requires a multilayered approach. (Source: Sherwin-Williams)

long-term protection. They should also offer outstanding resistance to cracking, cold flow and softening over a wide temperature range.

## Protect

The protective layer is an abrasion-resistant FBE coating that resists the scratches and scrapes a pipe may encounter from transportation to installation. For example, the coatings resist gouging as pipes are slid into place during horizontal directional drilling (HDD). Without this protective layer, the anti-corrosion layer could be damaged, exposing the bare steel below and increasing corrosion potential. Protective layers can also deliver a moisture barrier to mitigate the potential of water penetrating through to the anti-corrosion coating.

## Preserve

The preservation coating layer is optional, but it's often a beneficial insurance policy against project

delays since FBEs don't age well under UV light. Imagine thousands of feet of coated pipe staged on site waiting to be installed. If the project becomes severely delayed, both the protective and corrosion prevention FBE coating layers could deteriorate, possibly reducing performance and installation properties. Adding an outer protective coating layer of a fusion-bonded polyester or water-based acrylic coating prevents UV light from reaching the FBEs, prolonging their lives to enable later pipe installations.

## Long-term protection

To deliver long-term pipeline protection in today's hotter and harsher drilling environments, coatings formulators have responded with an evolving mix of desired

performance properties that include improved

- Flexibility and durability to handle the stresses of storage, installation and operation;
- Porosity resistance during application to enable better corrosion protection;
- Thermal properties to accommodate deeper well drilling at higher temperatures; and
- Cathodic disbondment resistance to keep FBE adhesion strong when used in conjunction with a cathodic protection system.

Coatings technology advancements like these will enable pipeline operators to continue protecting their assets over the long-term for a lower cost of ownership—especially when they build coating performance one layer at a time to prevent corrosion, protect against wear and preserve the integrity of their assets.

For more information, visit Sherwin-Williams at booth 5071. ■

# Decommissioning in the Gulf of Mexico

■ An all-new set of obstacles must be overcome en route to successful project decommissioning.

BY BLAKE WRIGHT

The boon of development activity in the U.S. Gulf of Mexico (GoM) over the past half-century has made it both the country's epicenter for oil and gas production and its greatest concentrations of life-of-field liabilities. With more than 7,000 offshore platforms installed of various shapes and sizes, and in varying water depths, the region's aging infrastructure has long been a source of debate when it comes to the timing, responsibility and logistics of decommissioning hardware that has reached the end of its intended purpose. The challenge in the GoM goes deeper—quite literally. The area's deepwater boom of the 1980s and those earliest developments are beginning to age out, leaving an all-new set of obstacles to overcome en route to successful decommissioning of projects.

Larger platforms will require bigger vessels with greater weight and steel-handling capabilities. While earlier jobs required the removal and disposal of 600-ton structures in water depths of up to 100 m, the upcoming portfolio of work includes 10,000-ton-plus structures in depths exceeding 100 m. In 2014, the first decommissioning job in the GoM involving a floating platform was undertaken as Anadarko Petroleum bid farewell to its Red Hawk natural gas development. The unique cell spar design was disassembled in over 5,400 ft of water—the platform's unique hull was converted to an artificial reef

and sunk in Eugene Island Block 384 offshore Louisiana. The facility's topsides were salvaged, brought to shore and are currently for sale.

Global energy consultancy Wood Mackenzie estimates \$32 billion will be spent on decommissioning worldwide from last year through 2022. Mature areas like the U.S. GoM have seen an average of about 100 platforms pulled per year since the mid-1980s. Globally, Wood Mac believes another 700 fields could cease production during the next five years depending on oil prices. One challenge remains that while fields are indeed drying up, there is still a raft of exploration and development activity ongoing in places like the U.S. GoM. Operators liable for decommissioning costs historically have rather spent their money on projects that offered a financial return, unless their hand is forced.

Liability policies vary from region to region. At a recent decommissioning conference held in Houston in March, it was suggested that international regulators could work together to formulate similar regulators policies. Eric Turner, chief, Risk Management Policy Group, for the U.S. Bureau of Energy Management (BOEM) said the different levels of concerns based upon geographical anomalies alone, such as hurricanes in the GoM and sea states in the North Sea, as well as differing national policy concerns, would make any form of standardization of decommissioning rules a daunting task at best.

BOEM is currently working on an updated financial assurance rule relating to the performance of decommissioning obligations on the OCS, initially part of a 2016 Notice to Lessees (NLT) related to offshore oil and gas activity. According to the White House's Office of Management and Budget Unified Agenda released last fall, the oft-delayed BOEM proposed rule will "protect taxpayers from unnecessary liabilities while minimizing unnecessary regulatory burdens on industry." The NTL prescribed new procedures for determining a lessee's ability to carry out its lease obligations—primarily plugging, abandonment and decommissioning of facilities—and whether lessees should be required to furnish additional security—additional insurance, bonds, etc.—to guarantee performance. Implementation of the NTL stalled almost immediately and its future under the current administration remains unclear. When queried, BOEM spokesman John Filostrat said the bureau was "still working on it, and can't give a specific timeline" for completion.

The GoM is not the only U.S. waters to deal with the burden of decommissioning. Both Alaska and California have aging structures that are approaching end-of-life. The state of California is in the throes of winding down Platform Holly off the Santa Barbara coast—a project that began in 2017. Plug and abandonment work is expected to continue into 2021. The fate of the structure itself remains undecided. ■

# Focusing on the Future of Subsea Projects

■ A new approach aims to connect the entire subsea development process and reduce life-of-field development costs.

CONTRIBUTED BY BAKER HUGHES, A GE COMPANY

Through Subsea Connect, Baker Hughes, a GE company (BHGE), has the ability to connect the entire subsea development process from the concept phase and support customers in optimizing not just the initial capex spend but the entire life of field. This approach means BHGE can influence 80% of project development costs and value drivers for the better. As a result, economic development costs can be reduced by 30%, unlocking more reserves and marginal assets.

BHGE has already leveraged Subsea Connect to secure a number of important contracts. Together with McDermott, BHGE will provide subsea umbilicals, risers and flowlines, and subsea production system equipment for the Greater Tortue Ahmeyim natural gas project. The award followed 12 months of close collaboration and co-location among the teams to define the right approach, technology and equipment for the project. The companies are working together to drive efficiencies and reduce lead times.

With Siccar Point Energy Ltd., BHGE is in a long-term partnership for the development of the Cambo Field in the U.K. North Sea, working on the drilling of the wells, the well operations, providing the production system and the installation.

BHGE also has a deal with Nexen for the second phase of the Buzzard project in the U.K. North Sea.

## Four-pillared approach

Subsea Connect is an outcome-based approach consisting of four pillars:

### 1. Independent Assessment and Project Delivery Process (Project Connect):

BHGE's proprietary workflow begins with targeted project outcomes, offering customers independent, flexible project assessment and management. This independent planning and risk management, which integrates subsurface, seabed, surface and EPCI capabilities, will radically optimize project execution, pushing the technical limits on process, project schedules and delivery certainty.

### 2. Reservoir to Topsides Technology Solutions:

BHGE's suite of value-engineered, standardized, configurable components and well designs will enable customers to meet the needs of any given project. Subsea Connect includes the Aptara family of modular products, including the new Aptara Lightweight Compact Tree and the new Aptara Compact Block Manifold.

### 3. Dynamic Partnerships and Commercial Models

BHGE's partnership model leverages relationships with the most efficient, established partners, such as iO, Gaffney Cline & Associates, and McDermott to name a few, to meet customers' needs and improve project economics. From assessment and project design to SPS-SURF, these partnerships offer a comprehensive solution designed to reduce complexity and accelerate speed-to-market across the subsurface, wells and subsea.

### 4. Digital Enablement:

BHGE is layering critical technologies with next-generation digital solutions to drive greater uptime and enhance productivity.



The Aptara family of modular products is up to 50% lighter with a dramatically smaller footprint, reducing manufacturing and logistics costs and improving installation flexibility. (Source: Baker Hughes, a GE company)

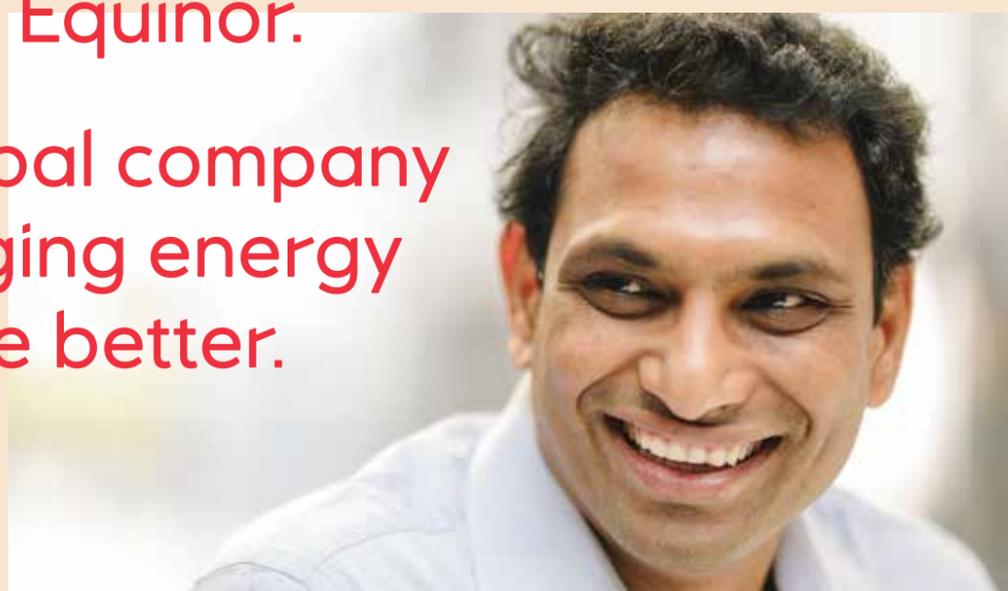
BHGE's engageSubsea asset life-cycle management solution is one example. It optimizes the planning, execution and connectivity of subsea projects with live "on the job" offshore activity planning, inventory optimization with remote visibility of equipment and tools, digital access to documentation for enhanced execution, and remote management of asset maintenance. engageSubsea will drive up to 20% reduction in maintenance costs through detailed forecasting and maintenance schedules, and up to 5% reduction in downtime through predictive analytics.

The challenges for the industry remain, but with them comes opportunity, which can be answered with technology and innovation. Visit BHGE at booth 2827. ■



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Equinor is an international energy company with a proud history. Formerly Statoil, we are 20,000 committed colleagues developing oil, gas, wind and solar energy in more than 30 countries worldwide. We're the largest operator in Norway, among the world's largest offshore operators, and a growing force in renewables.

Driven by our Nordic urge to explore beyond the horizon, and our dedication to safety, equality and sustainability, we're building a global business on our values and the energy needs of the future.

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# Revolutionizing Resolution

■ New service addresses the current and future formation evaluation landscape market.

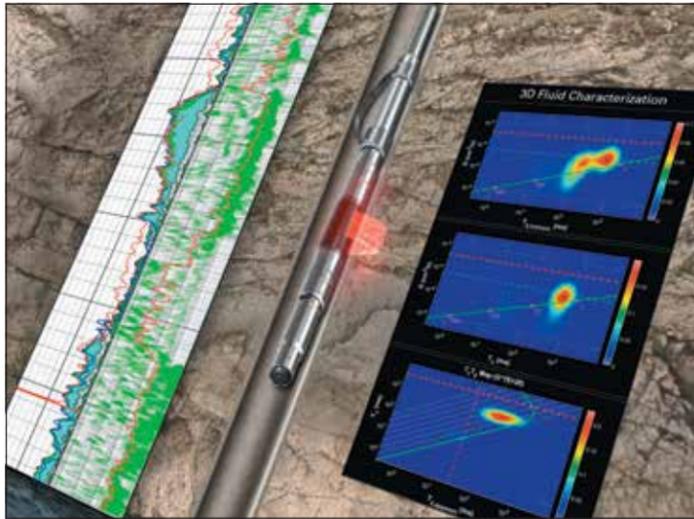
CONTRIBUTED BY HALLIBURTON

Rated to 35,000 psi, the Halliburton Xaminer Magnetic Resonance (XMR) service has been successfully run in several deepwater HP/HT Gulf of Mexico wells.

The tool provides full magnetic resonance (MR) solutions for basic-to-advanced formation evaluation requirements. This sensor delivers sharp formation bed resolution and evaluates a reservoir's full range of pore sizes, from micro to macro. It provides exceptional vertical resolution in thin beds, carbonates and organic shales using a short-antenna aperture, achieving a great improvement over existing MR sensors. This advantage translates into more robust data and lower risks in the field. Industry-leading pore-size characterization for micropores is achieved through a very fast inter-echo spacing. MR answers are derived from 2-D and 3-D fluid characterizations for reservoir evaluation of gas, condensate, heavy-to-light oils and water with Diffusion, T1 and T2. The XMR service can be run with the Halliburton's LOGIQ openhole logging suite of sensors to reduce rig time for openhole wireline logging and maximize drilling rig efficiency.

## Case study

Operators evaluating mature carbonate assets for ROZ (remaining oil zones) understand that commercial quantities of remaining (moveable) oil remain in the reservoirs after years of production. Locating the best zones with remaining moveable oil and distinguishing from residual nonmoveable oil is a primary objective for operators working with ROZ fields. Halliburton was asked to provide a formation evaluation suite of wireline sensors, including XMR service, to evaluate a carbonate reservoir column to provide insight toward the reservoir intervals containing the best remaining oil potential and the presence of any residual nonmoveable oil.



The Halliburton Xaminer Magnetic Resonance service provides full magnetic resonance solutions for basic-to-advanced formation evaluation requirements. (Source: Halliburton)

## The challenge

Faults and inefficient water sweeps can isolate or trap remaining oil, and formation evaluation techniques can be applied in the pilot holes to assess the best reservoir layers in which to land lateral well extensions. An assessment is required to target the reservoir intervals for lateral well placement where remaining oil is present and avoid reservoir intervals containing only residual nonmoveable oil.

## The solution

The Halliburton formation evaluation strategy centered around evaluating the fluids present without a focus on resistivity-based evaluation. While conventional porosity would be used, the fluid characterization would be driven by magnetic resonance fluid characterization and dielectric measurements. Dielec-

tric measurements would allow for an assessment of the water-filled porosity, and the magnetic resonance measurements would use the new Halliburton XMR service with a single combined log pass using 3-D fluid characterization (3DFC).

## The result

The integration of the XMR reservoir fluid analysis and dielectric results revealed good ROZ zones in the upper part of the carbonate reservoir. The middle and lower sections of the reservoir were seen to have the presence of considerable residual oil, which was identified from the XMR service's 3-D map evaluation.

The lateral well landing zone was then safely placed in the upper section of the reservoir and allowed the operator to drill into the ROZ zones where mobile oil was present. The reservoir evaluation with MR and dielectric was also used to better interpret and understand the resistivity response in reservoir intervals with high (50 ohm-m) resistivity where prior well tests had concluded only water production.

The XMR service was successfully used to uncover the answer why different reservoir intervals with similar resistivity response produced only water, while some were productive ROZ intervals. The evaluation reduced the uncertainty associated with ROZ reservoir interpretation and allowed the operator to focus on the productive oil zones within the carbonate reservoir.

This case study is representative of a scenario for which the XMR service was developed and excels. From reassessing reservoirs for bypassed or remaining oil to validating high-resistivity measurements in reservoir zones that only produce saline formation water, the XMR services offer a revolution in resolution. ■

# Aramco Looks to Long-term Investment, Technology and Partnerships

■ Technology and collaboration are making energy innovation 'work on a grand scale.'

CONTRIBUTED BY SAUDI ARAMCO

Marking the 50<sup>th</sup> anniversary of OTC, Saudi Aramco returns to this year's conference underscoring its long-term investment in the sector. With its partnerships, the company is continuing in its role as a world-leading energy supplier.



Amin H. Nasser, Saudi Aramco president and CEO (second from right), tours National Oilwell Varco's first local reinforced thermoplastic pipe (RTP) facility in Dammam, Saudi Arabia, as part of official opening ceremony for the facility. At far left, facility production line inspector Mahdi Al Khudhayr measures pipe. The investment in the first RTP hub in the Kingdom accelerates Saudi Aramco's aim of becoming a global leader in nonmetallic applications. (Source: Saudi Aramco)

Field upgrades and expansions are allowing for growth in production capacity, and new joint ventures in Saudi Arabia are supporting a "mega-project" environment.

As part of its upstream long-term investment plan, over the past year the company has issued a series of tender documents related to long-term agreements (LTAs) with contractors for oilfield projects—such as Zuluf, Marjan, Safaniya and Berri—off the coast of Saudi Arabia.

Many of these offshore investments have far-reaching industry effects and impact Houston's economy.

Saudi Aramco says technology and collaboration are making energy innovation work on a grand scale.

- Recent highlights include
- A land lease with McDermott Arabia Company Ltd., a subsidiary of Houston-based oilfield service company McDermott International, allows McDermott to establish a fabrication facility within the King Salman International

Complex for Maritime Industries in Ras Al-Khair, on Saudi Arabia's east coast. The new facility will fabricate large-scale offshore platforms and onshore/offshore modules. McDermott will also expand its in-country engineering and procurement offices to enhance project execution capabilities and establish a new marine base in the Eastern Province. The base will support installation of offshore platforms, subsea pipelines and cables, skids, and associated structures and assemblies.

- A National Oilwell Varco facility was recently opened in Dammam, where spoolable and jointed pipe will be produced including high-pressure line pipe and downhole tubing and casing. The reinforced thermoplastic pipe (RTP) manufacturing complex supports Aramco's aim to become a global leader in nonmetallic applications.

Representatives from the company's Northern Area Oil Operations (NAOO), which is experiencing an increase in offshore field activity due to expansion initiatives, will participate in the technical program at OTC on Thursday morning, Room 606, Session: Erosion and Corrosion Prediction, Monitoring & Mitigation in the Oil & Gas Industry. The paper, "Effective Corrosion Mitigation Exploiting Glass Reinforced Epoxy Lined Tubulars in Offshore Producing and Injection Wells," examines an approach to extend well life and reduce workover operations stemming from corrosion-related problems. ■



THE RBIDZ SPECIAL ECONOMIC ZONE - KEY INVESTMENT DESTINATION IN KWAZULU-NATAL, SOUTH AFRICA - CALLS FOR BUSINESS ACTION

# LOOKING TO INVEST IN THE OIL & GAS SECTOR?

Look no further: opt for the RBIDZ Special Economic Zone as the destination of choice - the future of the oil and gas industry in South Africa is taking a big leap.



Image: shutterstock.com

## FAST FACTS FOR EASE OF DOING BUSINESS AND ABOUT RICHARDS BAY IDZ AS A DESTINATION FOR OIL AND GAS INVESTMENTS

- Close proximity to one of the deep sea water Port with the ability to handle large ships;
- This Port is South Africa's premier dry bulk and liquid bulk port as well as break bulk cargos;
- It has specialised cargo handling facilities, efficient ship turnaround and deep water infrastructure;
- Existence of multiple shipping berths, deep sea rescue crafts and Ship repair facilities;
- This Port handles over 91 million cargos annually, and is in operation 365 days of the year;
- Closest SA port to the majority of 'takers' as well as multi-national industries utilising maximum electricity within Richards Bay and seek alternative energy;
- Port has the Use of a direct pipe to carry fuel inland using existing servitudes or an even shorter pipe to link to the existing multi-product pipeline;
- Substantial rail capacity to rail refined products and/or gas inland and into countries such as Zambia, Zimbabwe and the Democratic Republic of Congo;
- Significant existing electrical infrastructure which can be used to evacuate power from a gas power plant into the grid; and
- Indigenous African companies in the continent also seek for alternative energy mix.

## SECTORAL INVESTMENT OPPORTUNITIES FOR PROSPERITY INCLUDE:

- Ship and rig construction and repair;
- Drill pipe manufacturers;
- Drill mud compilers;
- Aluminium fabricators for offshore applications;
- A gas to power plant for over 2000MW as announced in 2016;
- Oil refinery;
- Upstream, midstream, downstream and power segments;
- Offshore supply services; and
- Petroleum pipelines in the Gas Corridors SEA.

## ABOUT RBIDZ

The Richards Bay Industrial Development Zone - Special Economic Zone (RBIDZ - SEZ) is a purpose-built and secure industrial estate on the North-Eastern coast of KwaZulu-Natal, linked to the international deep-water port of Richards Bay.

It is tailored for manufacturing of goods and production of services to boost beneficiation, investment, economic growth and the development of skills and employment. The RBIDZ, is a Special Economic Zone (SEZ), that aims to encourage international competitiveness through world-class infrastructure as well as tax, VAT and duty free incentives to qualifying companies.

South Africa as a country is taking a turnaround on issues relating to energy and the diversification of its energy base and this stature is supported by its strong hold as the continent's leading power player, with more than 45,000 MW of installed capacity and several new projects under development. Remarkably, there are prospects in the projects in the upstream, midstream, downstream and power segments.

## RBIDZ BRIEF OVERVIEW

The RBIDZ focuses on the following sectors: **Metals Beneficiation** (Aluminium, Iron Ore & Titanium), **Marine Industry Development** (Ship Building & Repair, Oil Refinery, Oil & Gas), **Renewable Energy** (Solar, Fuel Cells Biomass), **ICT** (Techno-parks, Innovations Hub) and **Agro-processing**.

The RBIDZ Special Economic Zone has been identified and announced as the host of 2000MW Gas-to-Power plant to be developed in the country. In response to this development, the KwaZulu-Natal Province is in the process of exploring gas opportunities in the province, and the RBIDZ has taken lead in the process. The identified 65 Hectares of land has been set-aside for the Oil and Gas hub, and a further 600-1200 Hectares of land is proposed for the Oil Refinery in this SEZ.

## THE RICHARDS BAY INDUSTRIAL DEVELOPMENT ZONE HAS THE WORLD-CLASS INFRASTRUCTURE READY TO TAKE ON BUSINESS.

**BIG DECISIONS CALL FOR  
INFRASTRUCTURE DEVELOPMENT THAT  
COMPLEMENTS THE ACTION**

**INVEST IN RICHARDS BAY INDUSTRIAL  
DEVELOPMENT ZONE TODAY**



# OTC Recognizes Innovative Technology and Futuristic Solutions

■ The 2019 Spotlight on New Technology Awards recognize 18 companies for leading the offshore industry in technological innovation.

In its annual awards program, OTC has honored 18 companies that have launched groundbreaking offshore E&P technologies. The Spotlight on New Technology Awards—a program for OTC exhibitors—showcase the latest and most advanced hardware and software technologies.

OTC sets forth the following criteria for selecting the winning technologies:

- **New:** The technology must have been offered to the marketplace in a ready-for-commercialization state less than two years prior to the application date;
- **Innovative:** The technology must be original, groundbreaking and capable of having a major impact on the offshore E&P industry;
- **Proven:** The technology must be proven, either through full-scale application or successful prototype;
- **Broad interest:** The technology must interest and appeal to the industry; and
- **Significant impact:** The technology must provide significant benefits exceeding existing technologies.

For the fifth time, OTC also has recognized the innovative technologies being developed by small businesses with a Spotlight on Small Business Award. In addition to meeting the above criteria, a small business honoree must be independently owned and operated or a not-for-profit company with no more than 300 employees for the 12 months preceding the application deadline.

The awards will be presented at 4 p.m. on Monday, May 6, in the NRG Center Rotunda Lobby.

AFGlobal has received an award for its Active Control Device (ACD), which provides the prerequisite seal and diversion of annular wellbore returns using a novel, nonrotating device enabled by an actively pressurized, co-molded element. This purpose-built device eliminates the bearings and rotating components that are a regular source of maintenance and failure in conventional rotating control devices. For more information about the ACD, visit AFGlobal at booth 938.



The ACD transforms how deepwater MPD operations seal and divert annular flow. (Source: AFGlobal)



AFGlobal's DuraStim hydraulic fracturing pump is designed for multiwell completions and helps reduce frac spread complexity. (Source: AFGlobal)

AFGlobal also has been recognized for its DuraStim 6,000 HP hydraulic fracturing pump, which is the industry's first variable displacement frac pump. Built for the extreme demands of long duration, high-pressure fracturing, the DuraStim pump dramatically lowers the cost of ownership, improves operational performance and creates many new safety and environmental advantages. To learn more, visit booth 10715.

**Baker Hughes, a GE company (BHGE)**, has been awarded for the NovaLT16, which is a double-shaft gas turbine designed for mechanical drive and power generation applications in the small power (5-20 MW) range segment. Utilized in both onshore and offshore applications, the NovaLT16 sets a new standard in the industry for performance through maximized availability, high fuel efficiency, low maintenance and reduced emissions. For more information, visit BHGE at booth 2827.



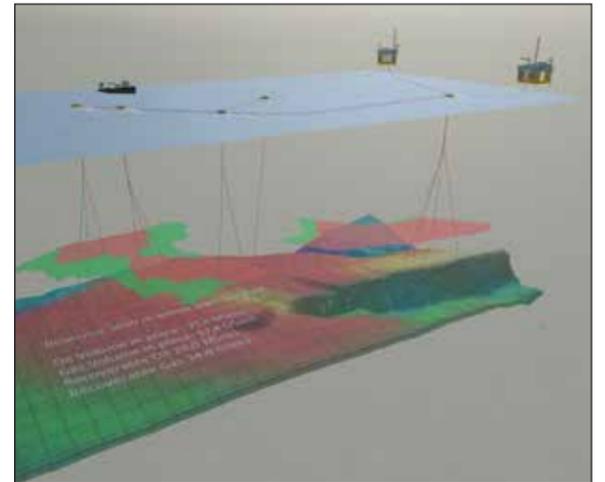
In addition to long intervals without maintenance, the NovaLT16 enables extremely short intervals for maintenance activities. (Source: BHGE)

**Dril-Quip Inc.** has received an award for the industry's first Double Expansion XPak Liner System that eliminates the need for fixed landing profiles and risk associated with sub-mudline hangers, increases operational flexibility and provides significant cost savings. The system deploys through wellhead restrictions to provide a metal-to-metal seal within seamed thin-wall casing and offers high hanging, lockdown and pressure capacities. To learn more, visit booth 4577.



The XPak system provides operators with an option to sub mudline profile hanger systems with the ability to traverse wellhead inside diameter (ID) restrictions and deploy into surface casing with large IDs. (Source: Dril-Quip Inc.)

**FutureOn** has been honored for its FieldAP, the Industry 4.0 cloud-based application enabling digital subsea field planning, subsea data and asset visualization, and installation planning for subsea projects. A FieldTwin platform application, FieldAP enhances collaboration among teams globally while reducing risk. Through digitalization, FieldAP is improving project margins and maximizing investment returns on existing talent. For more information about FieldAP, visit booth 4438.



FieldAP is the only digital offshore engineering software offering a 100% cloud-based approach to asset management. (Source: FutureOn)

**Hytorc** has been recognized as a Small Business Award winner for the Lithium Series II Electric Torque Tool, the next revolution in bolting technology redesigned from the ground up with improved durability, usability and functionality. This lightweight 36-volt battery-powered tool with capacity up to 5,000 ft-lb is the ultimate solution for strength and portability in industrial bolting jobs worldwide. For more information, visit booth 4015.



The metal frame cut from a solid piece of aluminum alloy protects the Lithium Series II Electric Torque Tool from damage on industrial jobs. (Source: Hytorc)

**National Oilwell Varco (NOV)** has received an award for its Subsea Automated Pig Launcher (SAPL), which allows pig launching from subsea to topside and promises a flexible and robust technology that enables a wide range of pigging operations. The system eliminates the need for a second flowline solely for pigging and wax handling. It also allows users to pig any time and on demand. To learn more visit booth 2839.



NOV's SAPL enables operational pigging without vessel or ROV support during pigging. (Source: NOV)

**Oceaneering** has been recognized for its unique Subsea Pumping Technology (SPT) that allows operators to reduce or eliminate their topside footprint by moving chemical storage and injection systems subsea, reducing the cost and complexity of conventional umbilicals. SPT offers value-added contributions to tieback architectures and applications where chemicals are required

See **TECHNOLOGY** continued on page 16

# Deepwater Completion System Helps Reduce Installation Time

■ RFID technology offers the potential for interventionless operations.

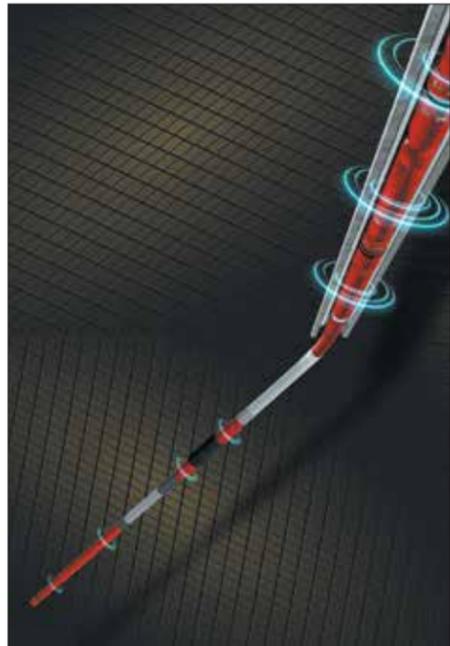
CONTRIBUTED BY WEATHERFORD

Weatherford International has brought to market the world's first remote-activated, single-trip deepwater completion system. By combining the upper and lower completions in one trip, the system has been shown to reduce installation time by up to 60% and to reduce rig time by four to six days.

Using radio-frequency identification (RFID) technology, the field-proven TRIP system delivers 100% interventionless operation in both producer and injector wells. As the only provider of RFID technology-enabled downhole tools, Weatherford coupled that capability with elements from its existing completions technologies.

In the first three wells of an ongoing deepwater field trial in West Africa, the TRIP elements helped save the operator 40% to 60% of rig time per well in comparison to a conventional two-trip completion process.

According to Mark Hopmann, president, completions, for Weatherford, the deployed system incorporates RFID technology, including an inflow control device (ICD), Optibarrier ball valve and OptiROSS remote operating sliding sleeve, all to mitigate deployment risks.



Weatherford's TRIP deepwater completion system is designed to reduce rig time and installation time. (Source: Weatherford)

The RFID inflow control device removed the need to run washpipe, maintained full wash-down capability and enabled testing liner integrity. RFID technology enabled the screens to be opened on command, independent of well pressure events, at the required time.

"The RFID Optibarrier provided a truly multicycle remote well barrier that enabled the team to test liner integrity, spot the breaker and isolate the toe and reservoir at operationally optimized points," Hopmann said.

The TRIP engineering team created specific single-trip operational logic for the RFID Optibarrier, RFID ICD and RFID OptiROSS components to remove the need for mechanical intervention. The TRIP team also developed a custom algorithm to open the RFID Optibarrier remotely and bring the well back online after suspension,

enabling the operator to use an ROV to open a deep-set barrier valve in the well.

"At the request of and in conjunction with the operator the TRIP team conducted system integration testing at the Weatherford Research and Development Center in Aberdeen, Scotland, to validate the tool logic," said Reggie Boggs, global director, sand control solutions for Weatherford. "Following a successful trial, the customer gave approval for field installation. The completions team used field-proven sand-control techniques to reach the designated depth with the completion string, all while meeting each customer objective, without safety incidents or adverse environmental impact."

"The ability to perform multiple operations in less time with less equipment and fewer personnel is a game-changing deepwater solution, and the answer to our customers challenge to significantly increase efficiencies when installing deepwater completion systems," Hopmann said. "TRIP gives you the ability to perform the operations demanded by your reservoir, rather than your budget."

TRIP has been named a Spotlight on New Technology award winner by the Offshore Technology Conference (OTC). These awards are presented for breakthrough innovation products impacting offshore exploration and production. ■



P Z 2 4 0 0

POWER THAT  
OUTPERFORMS THE  
COMPETITION

P Z  
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Visit booth 4947 for more information.

**TECHNOLOGY**

(continued from page 14)

for operational integrity management or flow assurance purposes. Visit Oceaneering at booth 2060 for more information.



SPT supports the move toward unmanned or subsea factories, along with all-electric technologies being implemented in subsea architecture. (Source: Oceaneering)

**Saipem** has been honored for its Offset Installation Equipment (OIE), which is a remotely operated subsea system. It is designed to allow the positioning of a capping stack onto an erupting subsea well laying in water depths from 75 m to 600 m (246 ft to 1,968 ft) at the safe step-out distance of 500 m (1,640 ft) from the support naval spread. Find out more at booth 4639.



The OIE is designed for use during a subsea well incident where direct vertical access to a wellhead is not viable. (Source: Saipem)

**Schlumberger** has received an award for the concert well testing live performance that brings digital automation and communication to well testing by giving everyone the same real-time information and interactive capabilities. This seamless access and sharing of data, diagnostics and analysis improves efficiency, data quality and safety to mitigate uncertainty and achieve actionable test results. For more information, visit booth 2415.



Concert well testing live performance increases operational control and communication by connecting everyone involved. (Source: Schlumberger)

**OneSubsea, a Schlumberger company**, has won an award for its Vx Omni subsea multiphase flowmeter—a compact, highly accurate and reliable flowmeter available in all applications, pressures and environments for

all fluid phases. It provides crucial data to understand how each individual production well is performing, enabling operators to enhance reservoir recovery and facilitate safer operation. For more information, visit Schlumberger at booth 2415.



The Vx Omni subsea multiphase flowmeter takes application of flowmeter technology to 20,000 psi while expanding on capital efficiency and expediting lead times. (Source: OneSubsea, a Schlumberger company)

**Siemens** has been recognized for the BlueVault, a lithium-ion battery-based energy storage solution that is suited for both all-electric and hybrid (diesel-electric) power applications. The solution is specifically designed to help ensure continuity of power and minimize emissions on vessels and offshore drilling rigs.

BlueVault energy storage solutions are designed to help ensure continuity of power and to minimize CO<sub>2</sub> emissions. (Source: Siemens)



Siemens also won an award for its Subsea Power Grid, which transforms field developments by extending tiebacks and allowing flexible subsea processing. It has subsea transformers, switchgear, variable speed drives, wet mate connectors and a remote control and monitoring system, enabling it to power large-scale subsea processing projects. For more information on either of these technologies, visit Siemens at booth 4422.



The Subsea Power Grid system is ideally suited to support enhanced recovery in subsea brownfield projects and tieback fields, benefitting from single- or multiphase boosting to increase oil recovery. (Source: Siemens)

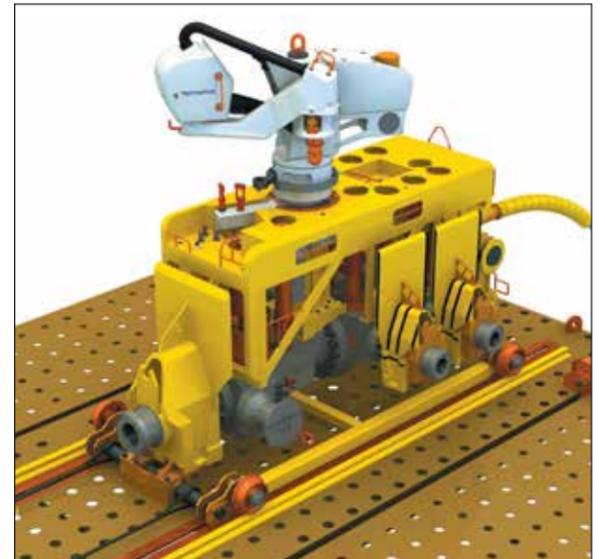
**Stress Engineering Services Inc. (SES)** has received an award for the Condition Based Maintenance (CBM) of drilling riser systems. SES's CBM technology provides innovative automation, digitalization and data analysis techniques, empowering drilling contractors to make real-time data-driven decisions concerning drilling riser asset integrity. These insights focus on

safety, identifying measurable risks and managing economics for the drilling contractor with actionable data providing a health assessment of the asset. To learn more visit SES at booth 431.



The CBM system determines the condition of drilling riser joints, predicts when vital components will require service and assesses remaining component life. (Source: Stress Engineering Services Inc.)

**TechnipFMC** has been recognized for its unique Subsea 2.0 In-line Compact Robotic Manifold. This technology has transformed the traditional manifold design to improve subsea field economics. The compact manifold design reduces size, weight and manufacturing costs. It incorporates a robotic arm for valve actuation, can be installed using the same vessel laying the flowline and increases the flexibility over the life of the field. For more information, visit booth 2038.



The Subsea 2.0 In-line Compact Robotic Manifold is designed to be half the size and weight of its conventional counterpart and reduces cost and delivery up to 30%. (Source: TechnipFMC)

**Van Beest B.V.** has been honored for its innovation of Green Pin Tycan, which is a high-performance fiber lifting chain that has the performance and flexibility of steel chain but is a fraction of the weight. It is extremely safe and easy to use, noncorrosive and completely waterproof. By using Green Pin Tycan, companies achieve greater efficiency and a safer working environment. Van Beest B.V. also has been recognized by OTC as a Small Business Award winner. To learn more, visit booth 1673.



Green Pin Tycan is up to eight times lighter than steel yet just as strong. (Source: Van Beest B.V.)

See **TECHNOLOGY** continued on page 18

# Composites Restore Offshore Asset Integrity

■ Safe installation methods reduce risk and deliver reliable repairs.

BY ANDREW PATRICK AND MATT GREEN,  
CLOCKSPRING|NRI

Advances in composite technology are introducing a growing range of viable options for repairing offshore structures. As materials and capabilities progress and more installations are successfully carried out, there is mounting trust in composite repairs.

One of the most compelling reasons for selecting a composite solution for an offshore asset is that production can continue while repairs are being made. Unlike other repair methods that require welding, most composite installations require no hot work, and because the components used for these repairs generally are not heavy, there is no need for heavy-lifting equipment. The combined appeal of minimal operational disruption and the reduction of risk is leading many asset owners to consider composites for offshore repairs.

Defects on an offshore structure can compromise asset safety, so decisions need to be made quickly about the type of mitigation measures that will be taken. Owners must determine if repair is feasible or if replacement is the only safe option.

When a test on a main firewater line failed, workers on an offshore platform discovered multiple through-wall defects at a bend in the line and realized it needed to be addressed immediately. The owner began looking for a way to restore the line and allow it to function safely until it could be replaced at the next planned shutdown.

The solution was Clock Spring Contour, an engineered wet-applied repair system that uses bi-axial or quad-axial stitched fiberglass cloth applied with two-part epoxy and a filler material.

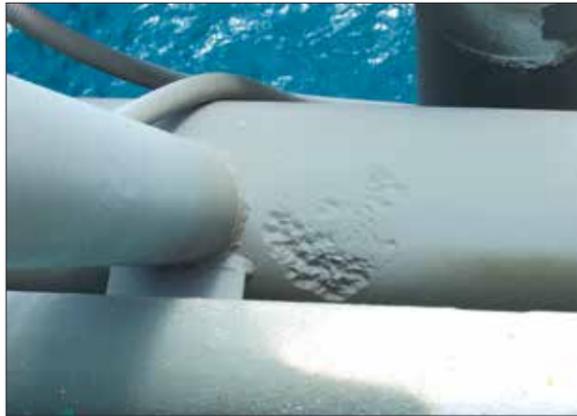
Trained and certified installers moved to the installation site to execute the repair, removing the coating on the damaged line using power tools and using a bristle blaster to produce the required surface profile, equivalent to SA2.5. With the line prepared, the installers applied a repair designed in accordance with ISO 24817, which outlines requirements and recommendations for qualifying, designing, installing, testing and inspecting the external application of composite repair systems to corroded or damaged pipework, pipelines, tanks and vessels used in the petroleum and natural gas industries.

Following established installation protocols, the team applied filler material to the holes, followed by epoxy and quad-axial stitched fiberglass cloth. Two installers completed the repair in two days, restoring the firewater line's integrity so it could function safely until the next planned shutdown.

Lines that have developed holes also can be repaired with composite materials, although application experience, a thorough understanding of composite material capabilities and proper design play a critical role in ensuring the repair system is appropriately designed and properly installed.

One such installation was carried out recently on several caissons on an offshore platform in the North Sea where multiple small holes had developed from below the splash zone to the floor of the platform.

Once the area was evaluated and engineers determined that a composite repair was feasible, the next step was to develop a repair appropriate for the pipe size, the type of damage and the operating environment. Trained installers prepared the



Composite solutions can deliver long-lasting repairs to damaged offshore assets. (Source: ClockSpring|NRI)

affected area, cleaning the surface of the caisson to ensure there would be adequate bond strength for the repair system to adhere to the host pipe, effectively containing the leak and keeping it sealed. With the surface properly prepared, the installers applied the composite wrap along the length of the damaged areas.

When the composite cured, it restored the integrity of the caissons, allowing safe operations to continue.

Successful, long-lasting composite repairs like these have been performed on active platforms around the world, leading more offshore asset owners to see the value in using composite solutions.

Regulatory acceptance is growing, and with continued successes over a broad range of applications, composites are gaining a reputation as a viable alternative to traditional offshore repair solutions. ■



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# Subsea Set to Outpace Other Oilfield Services Segments

■ The future of the subsea market looks bright, with steep growth in the years to come.

BY HENNING BJØRVIK, RYSTAD ENERGY

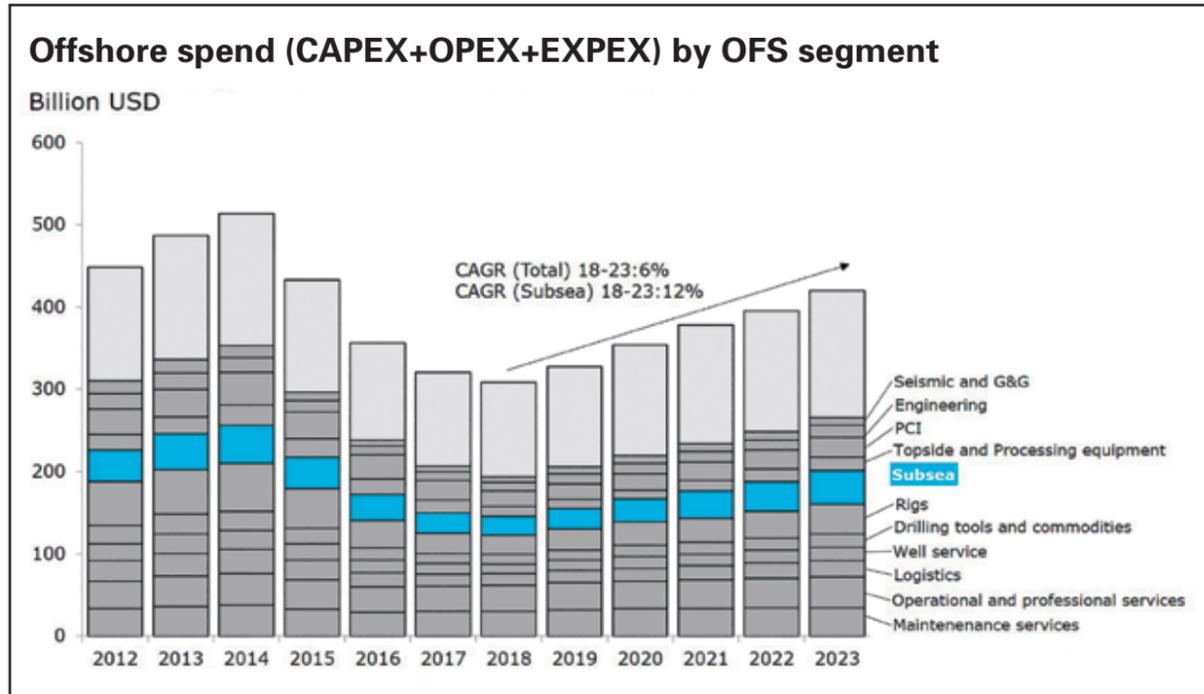
It has been a long road to the bottom for the offshore oilfield services market. Oil prices began to slip in 2014, and the offshore services market is expected to have hit bottom in 2018—two years after the onshore oilfield services market bottomed out. The subsea market took a huge hit during the downturn, falling from record high revenues of \$46 billion in 2014 to \$23 billion in 2018. With this 50% decrease, the subsea market was nearly the biggest loser within the oilfield services market; that dismal superlative goes to seismic, geology and geophysics, which fell as much as 53% from its peak.

However, it appears the clouds are clearing. Rystad Energy forecasts 6% annual growth for offshore oilfield services up to 2023. In fact, the subsea market as a whole is expected to outpace other oilfield services segments with 12% per annual growth going forward.

Despite the impressive pace, the road to recovery will be long for the subsea market. A 50% slash in revenues simply cannot be recovered overnight, and Rystad Energy expects the subsea market to have achieved about 80% recovery in four years' time, not achieving full recovery until 2026 at earliest.

That said, the future of the subsea market looks bright, with steep growth in the years to come. Rystad Energy forecasts that the main contributors to the growth will be the markets for subsea equipment as well as the subsea umbilicals, risers and flowlines (SURF) market. Rystad Energy expects both market segments to grow 13% per year up to 2023. The subsea services market is expected to move slower due to its brownfield exposure and longer frame agreement contracts. Nevertheless, subsea services was the first subsea segment to post growth after the downturn, hitting bottom between 2016 and 2017 before beginning its painful recovery.

Although Rystad Energy sees some evidence of inflation in the subsea market, increased final investment decision (FID) activity and increased demand for subsea equipment and SURF lines over the next years are key growth drivers. Already, the industry is witnessing a



(Source: Rystad Energy ServiceCube)

substantial increase in FIDs for subsea tieback projects. Close to 40 subsea tieback projects were committed to in 2018, a remarkable change since the 2016 low when there were fewer than 20 commitments for subsea tieback projects. In the coming three years, Rystad Energy also expects a significant increase in FIDs for floater projects, largely driven by upcoming FPSO projects in Brazil as well as the continued development of the Stabroek Block off the coast of Guyana.

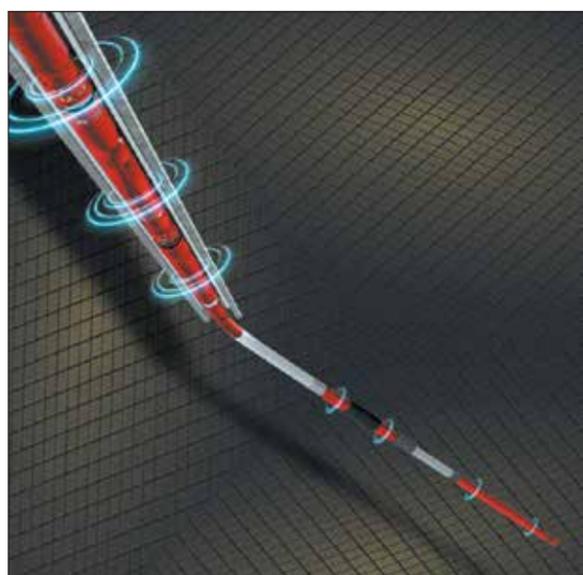
The number of installed subsea trees per year often is seen as a primary driver for the subsea market. There already has been a clear upward shift in the number of subsea tree installations globally in 2018, up from the bottom in 2017. Moving forward, Rystad Energy expects 6% annual growth in the number of installations. Growth is being driven by the wave of subsea tiebacks in Norway and the U.K. up to 2021, before relaxing to give way to an FPSO

boom in South America. When it comes to other subsea installations, such as SURF lines, manifolds and control modules, the same trends appear with subsea trees. For manifolds in particular, a largely greenfield-driven subsea unit, Rystad Energy expects the number of installations to double by 2021 compared to 2017.

With an understanding that the subsea market will increase over the next five-year period, the industry must ask what the untapped potential is for subsea developments in the future. Of course, huge potential could remain in projects yet to be discovered. However, there are already about 1,000 discoveries worldwide that are potential subsea developments—the majority of these being potential subsea tieback projects. Discoveries in Brazil, the U.S. GoM and Angola are dominating the deepwater space, while Norway and the U.K. discoveries make up the majority of projects below 300 m (984 ft). ■

## TECHNOLOGY

(continued from page 16)



With the TRIP system, operators can control multiple RFID tools in a single string and selectively target and actuate individual tools as needed. (Source: Weatherford)

Weatherford has received an award for its TRIP single-trip completion system that reduces deepwater completion installation time by up to 60%. By combining the upper and lower completions in one trip, the system reduces personnel risk and increases efficiency. Using

radio-frequency identification (RFID) technology, the field-proven TRIP system delivers 100% intervention-less operation in both producer and injector wells. For more information, visit booth 1839.

XSENS has been recognized for its XACT Ultrasonic clamp-on Flowmeter, which provides flow rate and fraction measurement at accuracies that were until now only obtainable by in-line technologies. Installation of an XACT clamp-on Flowmeter does not compromise pipeline integrity. XACT's size and weight are just a fraction of conventional flowmeter systems and is ideal for retrofit applications. In addition, XSENS has been recognized by OTC as a Small Business Award winner. For more information, visit booth 4438. ■



XACT's size and weight are just a fraction of conventional flowmeter systems. (Source: XSENS)

## NETL Presentations

Monday, May 6, 2019  
Booth 1325

### In-Situ Applied Coatings for Mitigating Gas Hydrate Deposition in Deepwater Operations

Presented by Carolyn Koh  
Colorado School of Mines  
11 a.m. – 12 p.m.

### Nanocomposite Surface Treatment for Oil and Gas Applications

Presented by Vinod Veedu  
Oceanit  
12 p.m. – 1 p.m.

### Partnering with NETL

Presented by Chuck Taylor  
National Energy Technology Laboratory (NETL)  
1 p.m. – 2 p.m.

# Six Trends Driving Digitalization in the Upstream Sector

■ These trends are transforming the industry and facilitating game-changing performances.

CONTRIBUTED BY  
EMERSON AUTOMATION SOLUTIONS

As the upstream space continues to gain momentum despite market instability, many producers are taking advantage of the fast-changing technological landscape to drive growth. To help navigate this move toward digitalization, Emerson has identified six trends that are driving digital transformation, along with solutions that can facilitate game-changing performance for upstream companies looking to gain a competitive edge.

## Automated production in unconventional plays

U.S. onshore production is expected to increase by more than 1 MMbbl/d this year, primarily from unconventional plays, according to the U.S. Energy Information Administration. To meet production goals, unconventional producers are employing new technologies that collect large quantities of oilfield data, accurately predict well performance and turn analyses into actionable intelligence.

New Industrial Internet of Things (IIoT) applications are capable of seamlessly connecting live data from sensors to integrated simulation and analytics tools. These platforms help improve decision-making about optimal completion design, artificial lift for maximum production, automatic subsurface calibration subsurface and optimal gas injection.

## Extending equipment availability to improve productivity

Unscheduled downtime causes more than \$20 billion in losses annually, according to ARC Advisory Group, and this has spurred producers to integrate remote sensors with embedded diagnostics into their asset management systems, providing real-time visibility into equipment health without placing personnel in hazardous areas.

Increasing uptime requires identifying, sourcing and integrating individual solutions that provide comprehensive analyses of equipment performance across the entire pad. Combining an automated production systems surveillance solution with asset management software allows operators to remotely access every critical component at the well pad and easily evaluate performance.

## Adopting digital technologies to drive operational excellence

Achieving operational excellence requires the rationalization of manual processes, integration of siloed decision support tools and updating of inefficient operational practices. Industry leaders see digital transformation and automation as the key to accomplishing this.

Many companies are changing the way their workforce interacts with IIoT technologies across the entire company. From innovative sensing technologies to data analytics and services, these solutions are designed to improve performance by securely linking operational technology data to existing IT infrastructure.

## Upskilling workers to keep up with technology

Training workers to match the digitalization of industrial operations requires a significant investment, but it is necessary for companies to stay competitive in the long term, and most producers are willing to take that step.

Many are finding it easier to work directly with a third party to provide or develop customized training programs online or on site. Interactive tools, like Emerson's new Performance Learning



Since the cost of manning offshore facilities can be three times what it is for onshore assets, many producers are leveraging solutions that make operational intelligence available 24/7 from anywhere with an internet connection. (Source: Emerson Automation Solutions)

Platform, provide a fully instrumented, hands-on training experience in a portable system.

## Smart commissioning of new onshore facilities

The need for expanded capital and schedule flexibility in the engineering and construction of new offshore platforms has led many companies to find ways to more consistently avoid budget overruns and expedite time to first oil.

Smart commissioning, which integrates device management tools and electronic marshalling technology to streamline the entire commissioning process, reduces trips to the field, eliminates tasks and accommodates late-stage project changes. Producers also can leverage digital twin solutions to test proposed design adjustments in real time without jeopardizing capital funds or resources.

## De-manning of offshore facilities

With the advent of new remote automation technologies, companies are finding cost flexibility by integrating new de-manning solutions that still allow effective asset monitoring while keeping only the most critical personnel offshore.

Producers now have access to an entire suite of solutions focused on centralizing expertise and connecting the right people to the right information remotely and safely. Wireless sensors and smart devices can be integrated with automation applications that record onsite data automatically and transmit it to the cloud through an IIoT-based platform, cutting costs and eliminating safety risk to offshore personnel.

For more information, visit Emerson's Digital Transformation Experience at booth 2261. ■

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# 'Drive to Zero' Process Safety: Mapping Performance Data to Cultural Factors

■ By adopting a culture analysis, leaders can prevent future losses and improve HSE performance.

BY LAURA O. JACKSON, ABS GROUP

As organizations struggle to achieve “drive to zero” safety objectives, a next-generation root cause analysis (RCA) and risk management tool can help them create lasting changes that promote sustainable, outstanding performance in safety leadership.

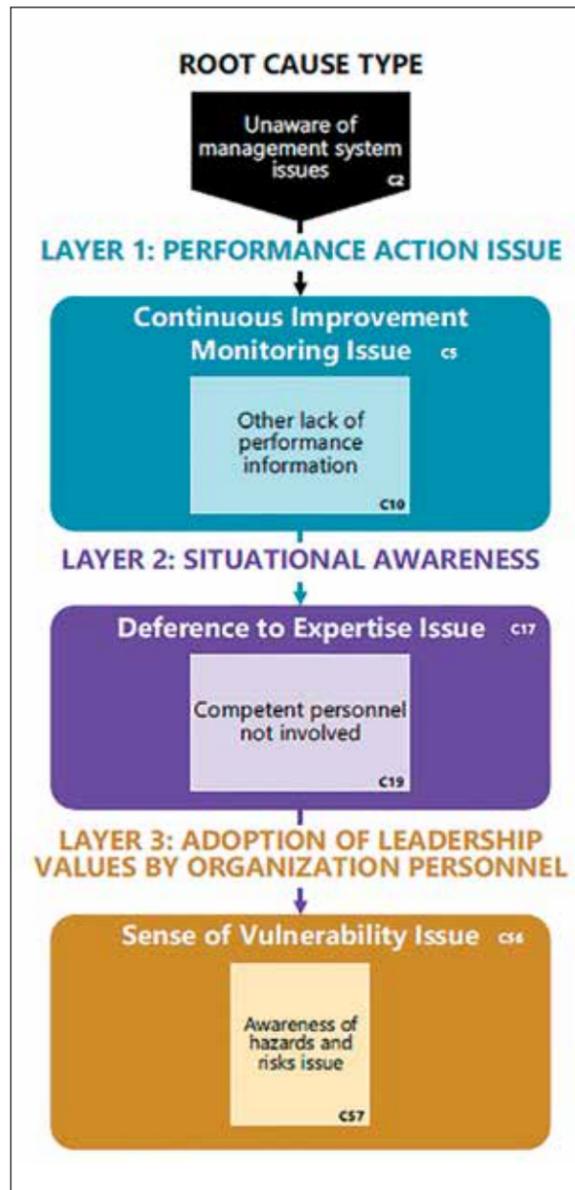
Cultural Cause Analysis (CCA) is a new methodology developed over 10 years through evaluating data insights that identify the leading cultural factors that contributed to major incidents. This breakthrough in analysis leverages more than 40 years of incident investigation and RCA expertise working closely with the industry and regulators to understand the cultural deficiencies that are causing chronic safety, quality and reliability issues within an organization's processes.

Organizations want to understand what happened after an accident has occurred because it is vital to ensure it will not recur. CCA can be used as part of a proactive safety culture evaluation or following an incident to understand how and why an organization has fallen behind HSE best practices. This approach builds on the foundation of RCA but moves the needle to address gaps in performance by systematically assessing, analyzing, trending and influencing the cultural causes that underlie performance issues. The goal is both reactive and proactive culture assessment to avoid repetition and empower personnel to become safety leaders committed to sustainable HSE performance.

## Evolution of RCA

In the 1960s, the introduction of the “5-Whys” method from the automotive industry spurred deeper thinking about safety incidents. In the 1970s, as government agencies sought higher reliability and better occupational safety standards in energy and space travel, they formalized the RCA method to understand management system weaknesses in standards, policies and administrative controls leading to incidents.

RCA now encompasses a cross-sector range of industrial safety, quality and reliability issues with analysis of the root cause of near misses, chronic issues and accidents. CCA is the next evolution in the RCA discipline. This approach dives deeper into understanding the organizational tendencies, behaviors, actions and



The Cultural Cause Analysis Map provides a method for systematically assessing, analyzing and trending the cultural causes that underlie key performance issues, such as gaps in communicating and adopting the leadership values that drive an organization. (Source: ABS Group)

individual cultural causes that create unsafe environments. This greater depth of understanding strengthens an organization's ability to influence the underlying cultural issues to avoid repeating actions that have a negative impact on performance.

## Industry need

The desire for CCA is driven by many factors, both positive and negative. The negative drivers of CCA are that accidents continue to occur and the recommendations from RCAs that focus on correcting company standards, policies and administrative controls do not create the desired long-term change. As a result, similar issues may occur again.

The positive drivers of CCA are the desire to create lasting changes following an accident, the demand from stakeholders for sustained outstanding HSE performance and a greater emphasis to leverage performance data in a more meaningful way that improves safety, quality and reliability.

A growing need exists across market sectors, including offshore, to understand cultural issues behind undesired behaviors. By doing so, the industry can develop corrective actions to influence the organizational culture in positive ways, correct management system weaknesses and reduce the potential for chronic performance gaps and associated incidents. CCA addresses this need.

## Safer, more sustainable performance

ABS Group's response teams have documented persistent questions about how to improve and mature a robust HSE culture from more than 40 years of conducting onsite investigations following major incidents, including explosions, oil spills and chemical releases. The common theme is that most leading organizations want to do the right thing in the right way at the right time, all the time—even when no one is looking. And yet, culture is hard to measure and even more difficult to change.

Corrective actions addressing cultural issues, if effective, will be valuable in positively impacting what may seem like unrelated areas of performance, including safety, quality and reliability. Leadership's ability to prevent future losses and improve HSE performance in critical energy operations is strengthened by adopting culture analysis. ■

## SHOWCASE

(continued from page 4)

### Wave prediction

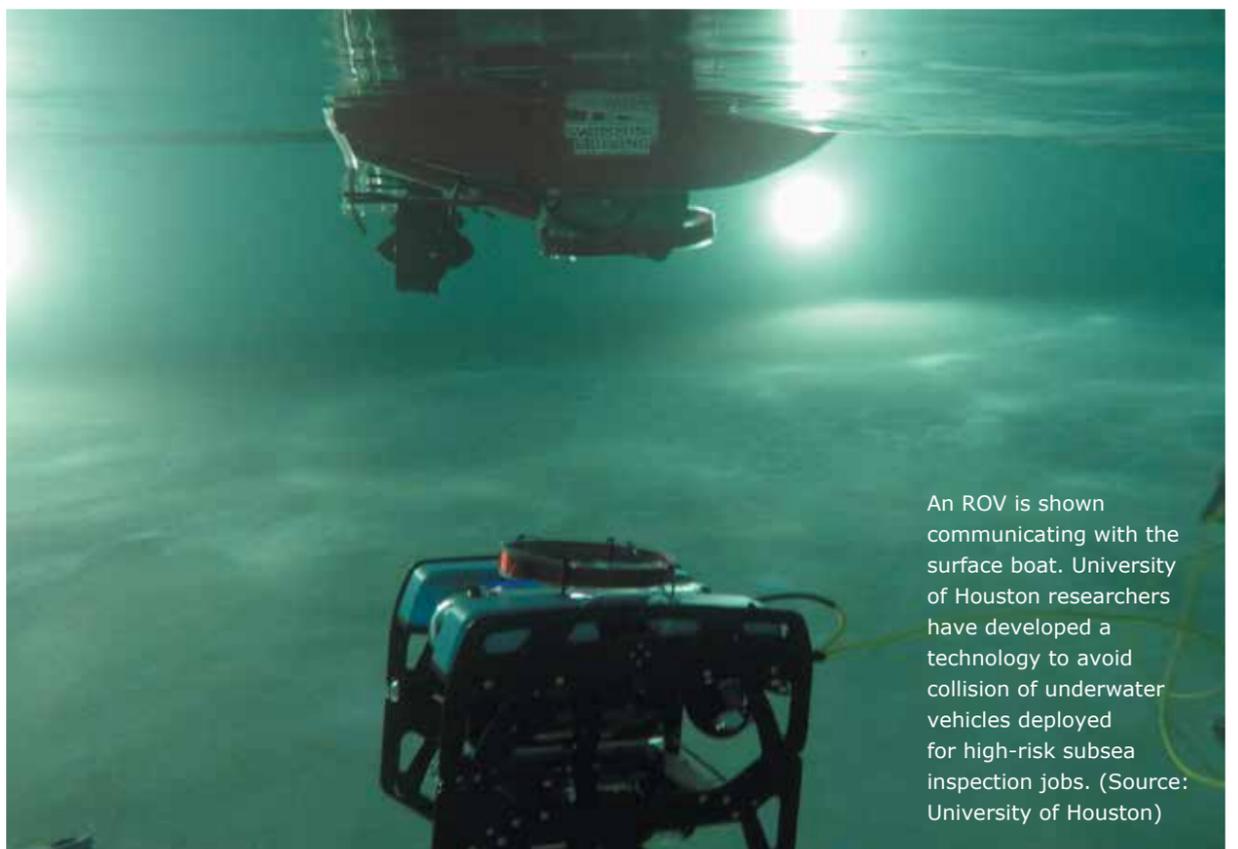
Although Japan does not have any oil and gas fields in proximity, many companies have competitive technologies for offshore development. The University of Tokyo has a laboratory, endowed by eight Japanese companies, that acts as a co-creation R&D platform between the university and energy industry.

The University of Tokyo will showcase its research project titled “Wave on Demand,” a wave prediction system utilizing wave measurement by drones.

“We have developed a new concept and algorithm where we can predict the sea-surface elevation of a vessel point 30 seconds in advance by combining sea-surface elevation data gathered from drones,” said Ken Takagi, professor and leader of the research laboratory. “We have also demonstrated autonomous navigation and wave measurements offshore with our drones, based on a robust control system.”

Other topics presented by the University of Tokyo include integrity management of subsea line structures, such as mooring lines and risers.

“For mooring lines, low-frequency motion and extreme load estimation is our area of interest,” said Takagi. ■



An ROV is shown communicating with the surface boat. University of Houston researchers have developed a technology to avoid collision of underwater vehicles deployed for high-risk subsea inspection jobs. (Source: University of Houston)

# MAO Tests Advanced Ship-to-Ship Motion Measurement System

■ Camera system measures the distance between the crane and any tagged object in real time.

CONTRIBUTED BY MCDERMOTT

Lifting from one ship to another ship is almost always a very delicate operation that is often restricted based on the existing sea conditions and the weather. The higher the waves, the more the ships move and the less capable the cranes are in those higher sea states.

McDermott is testing an advanced camera and PC system that measures ship-to-ship movement so that crane operators and offshore managers have more real-time information about the conditions and are enabled to make better decisions. Motion studies have shown that using measured data will often allow higher crane capacities, allowing a greater reach radius for the same capacity and, in some cases, will increase utilization.

After testing in a laboratory environment, the high-tech system has now entered a short-term operational test period aboard McDermott's lay vessel *North Ocean 105* on a project in the Gulf of Mexico. The project uses an optical measurement system that directly measures relative elevation and distance between the crane and any tagged object in real time.

Cyclops uses a high-definition pan, tilt and zoom camera system with a laser range finder mounted on the crane that allows it to track objects. The camera is aimed at a target called an April tag that looks like an oversized QR code, which is placed on the object to be lifted from the supply vessel.

Using the system, the crew will have all the information needed to guide the supply vessel into the ideal position for the lift. The computer provides a live readout of the target displacement and relative velocity on a chart.

David Guymon, McDermott's manager of mechanical engineering for marine equipment and machinery and the project lead, said when lifting an item off another ship, the motion of the ships and sea conditions at the time of the lift must be taken into account. Sea state is largely subjective, and motion response is highly dependent on waves. To account for those dynamics, derating charts were established and are used to assess the impact of the current sea state on the planned lift.

"The beauty of this system is that we know the exact conditions based on measurements and can improve our lift capacities, put a little more separation between ships, as well as operate in higher sea states as long as everyone is comfortable," Guymon said. "We can eliminate the conservative assumptions and directly measure relevant parameters."

Another advantage of the system is it is easier to know the safe working load of the crane before deploying it.

"Everything we do is about reducing costs through efficiency or increasing safety," Guymon said. "The benefit of this system is it allows us to perfectly time the lift at the optimal moment, and by using measured data, it ensures we get onto the right derating chart, which will save us time and money, and will improve our lifting safety."

Visit McDermott at booth 2463. ■



The precision gyro stabilized gimbal camera is mounted on lay vessel *North Ocean 105* for testing. (Source: McDermott)

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# Better Times Ahead for Offshore Sector

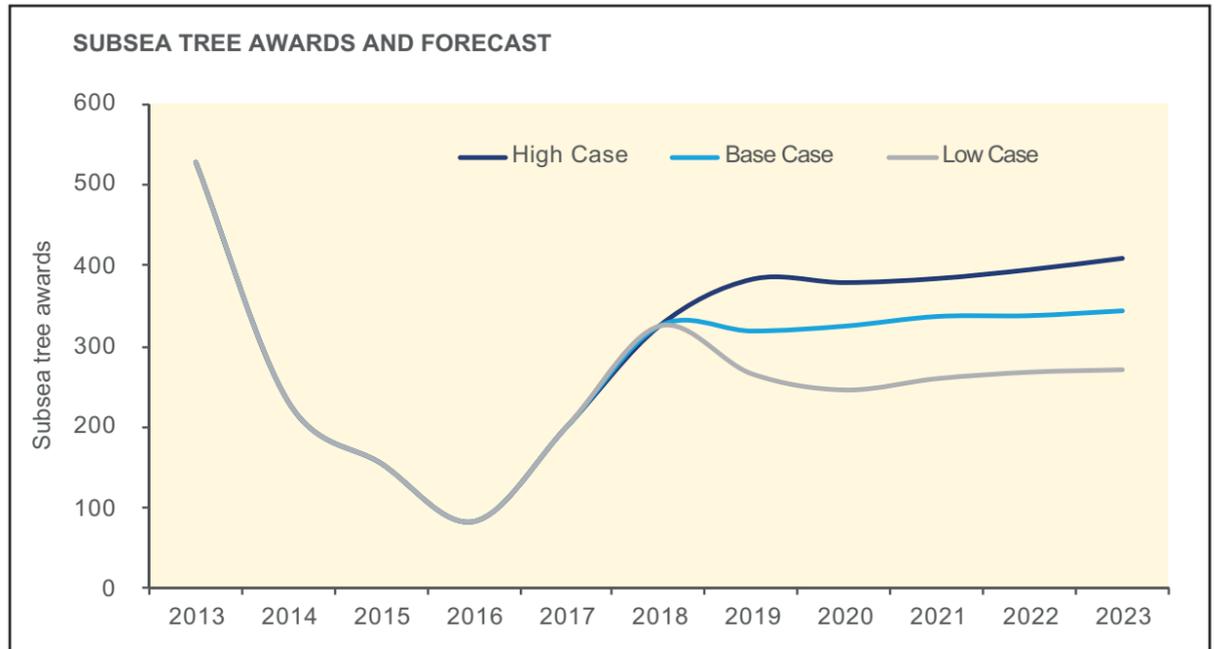
■ The three reasons the subsea market is back on its feet are the FID bonanza in 2018, brownfield beating greenfield, and the Golden Triangle making a comeback.

BY MHAIRIDH EVANS, WOOD MACKENZIE

The subsea market received a major shot in the arm in 2018. Operators placed orders for 325 trees—the highest count since 2013 and up by 60% on 2017's orders. This is significant for players in the subsea space and as a leading indicator that better times are ahead for the offshore sector as a whole.

The number of major project final investment decisions (FIDs) jumped to 49 in 2018, back to pre-2014 levels and a 40% increase on 2017. Not only was activity up, but the average project size almost doubled to 680 MMboe. With 33.5 Bboe of reserves and \$184 billion of investment sanctioned, confidence is back in the upstream sector. Wood Mackenzie expects 2019 to deliver more of the same—except this time, less onshore and more deep water. Companies remain disciplined and only the best projects continue to get over the line.

As operators seek to lower upfront capex and keep cycle times short, subsea tiebacks to existing infrastructure have won out against new greenfield projects. Projects like Troll, Zinia and Gorgon show that this doesn't just mean small projects. In 2018 there were six sizeable brownfield projects of eight wells or more. Wood Mackenzie thinks this trend is here to stay, and that is good news for the subsea sector. Expect to hear lots more "Phase 2" or "Phase 3" in 2019.



(Source: Wood Mackenzie Subsea Market Service)

Additionally, the Golden Triangle region of Brazil, West Africa and the Gulf of Mexico was particularly quiet during the downturn. Now projects in these regions are coming back into Wood Mackenzie's fore-

casts in a much more meaningful way. The picture is different though—no more megaprojects, as operators favor phased developments. Still, these regions offer a big prize for the subsea sector in the coming years. ■

# Digitizing the Oil Field

■ Building out cloud technologies, infrastructure and analytics capability is critical for organizations that want to embrace the digitization of the oil field.

CONTRIBUTED BY NATIONAL OILWELL VARCO

The digital oil field as we know it continues to expand as the volume of data within the industry grows exponentially. It is becoming easier to see how Big Data is starting to positively change the face of the industry as it begins to understand just how much

data one person or company is responsible for on any given day. The industry has seen firsthand how large-scale collection, aggregation and analytics of real-time equipment and performance data are resulting in significantly improved performance and reduced maintenance costs across a variety of products and systems. Building out cloud technologies, infrastruc-

ture and analytics capability, as well as getting a data pipeline in place, is critical for organizations that want to embrace digitization.

Within National Oilwell Varco (NOV), work is being done in the world of Big Data to enable a data ecosystem where the industry doesn't own the data, but rather be its steward while enabling secure access

to it. This allows companies to effectively maintain and service their equipment because they always know its condition.

NOV has built an industrial data platform, called MAX, which includes MAX Cloud, MAX Edge and Access NOV. These technologies connect the edge to the cloud, positioning NOV to drive meaningful change in the industry as an original equipment manufacturer drilling technology enabler. With the MAX platform, NOV is unifying the company's digital solutions, products and services to more effectively help the industry reduce costs while improving the performance and reliability of critical equipment.

Additionally, the continued development of the MAX Edge technology, which refers to the software stack running on the device at the edge of the network, connected to the actual equipment or sensor network, allows for the collection of equipment data, its storage and analysis in real time in the field and forwarding it to a cloud infrastructure. This solution includes native integrations with high-speed sensors designed specifically for condition monitoring. Purpose-built ground up with the latest technologies available, MAX Edge is more efficient and cost-effective than

See **DIGITIZING** continued on page 27

# High-performance Composite Materials for Offshore Oil and Gas

■ Specialty thermoplastic unidirectional tapes represent a solution to decrease the weight and cost of flexible pipes in ultradeep offshore fields.

CONTRIBUTED BY BARRFLEX TU

Arkema and Barrday have formed a new venture, BarrFlex TU, to supply the most advanced thermoplastic composite solutions to various players in the oil and gas market. The tapes will deliver substantial improvements in terms of weight reduction (replacement of metal) and corrosion resistance for the flexible pipes and parts used in deep offshore and onshore operations.

As oil exploration continues to evolve, oil wells are more often located in remote locations including deeper sea conditions with seabed depths of 2,000 m (6,562 ft) and beyond. New pipe structures have been studied with a movement toward improved performance due to the more difficult conditions encountered during installation and production. Traditional offshore flexible pipe systems can be improved by the use of composite tapes. The composite layers allow significant decrease of pipe weight to the point to eliminate the need of buoyancy systems (free hanging catenary), therefore enabling a quicker and cheaper installation in deep offshore fields. In addition, the composite tapes increase targeted performance characteristics such as aging, chemical permeation and pressure ratings.

Unidirectional thermoplastic composite tapes are being introduced to the industry to make pipelines lighter but with similar or better performance than traditional flexible pipes. Some offshore pipeline producers are exploring the use of these composite materials in flowlines and flexible risers up to 8 in. in diameter with the expectation to ultimately be able to produce the full spectrum of pipelines. These systems include the traditional polymer barrier layers but replace metallic components, such as the pressure armor and tensile armor layers, with composite constructions. Some or all of the metal components can be removed from the pipeline construction and replaced with thermoplastic composite tapes, forming either a hybrid unbonded (metal/composite/thermoplastic) or fully bonded (100% composite thermoplastic) flexible pipeline. The industry developed the DNVGL-ST-F1194 standard for thermoplastic composite pipes to help define this technology in the oil and gas application.

## Composite evaluation

For pipelines and other applications, the evaluation of the composite is a critical design point. Since the technical demands of these applications are high, the composites selected must be carefully evaluated. The composite is evaluated at both a tape level as well as in a consolidated laminate form. A single layer of tape, as manufactured, must be able to withstand the end-use application and the processing steps leading to the finished part. They also must be compatible with rapid, one-step processes, such as automated tape laying and automated fiber placement. These technologies rely on high-quality tapes that are fully wet-out and contain minimal void content.

One may think there are many different polymers that can be used in the composite tape. However, not all polymers may be appropriate in a given application. Arkema has been working on developing Kynar PVDF, Kepstan PEKK, Rilsan PA-11 and Rilsamid PA-12 resins for these applications, while Barrday has developed high-quality tape production for such products. These tapes can be made by various processing means that combine fiber technology, in most cases carbon fiber, and polymer. The polymer matrix will give the tape construction the temperature and chemical resistance needed

for the application, while the carbon fiber will give the mechanical strength required in the system. Multiple plies of unidirectional carbon fiber-based thermoplastic tape can be simultaneously wrapped at the appropriate steep angle or layered for consolidation into a part.

Although thermoplastic composite parts are still in the beginning of their history in the oil and gas market, there are very good opportunities for their use. The correct combination of polymer, fiber and composite manufacturing is needed to produce a safe and reliable product. ■



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DISCOVERY THROUGH IMMERSION

# Making Smarter Offshore Decisions with Digital Platforms

■ Create a digital strategy to lower risk, better weather cyclical market uncertainty and ensure long-term project success.

BY OLAV SYLTHE, FUTUREON

Offshore investment is increasing. Sanctioned projects are expected to jump to \$182 billion this year from \$30 billion in 2018 and continue for the next four years, according to a recent article in Forbes. GlobalData predicts total newbuild capex of \$846 billion globally on planned and announced upstream projects from 2019 to 2025.

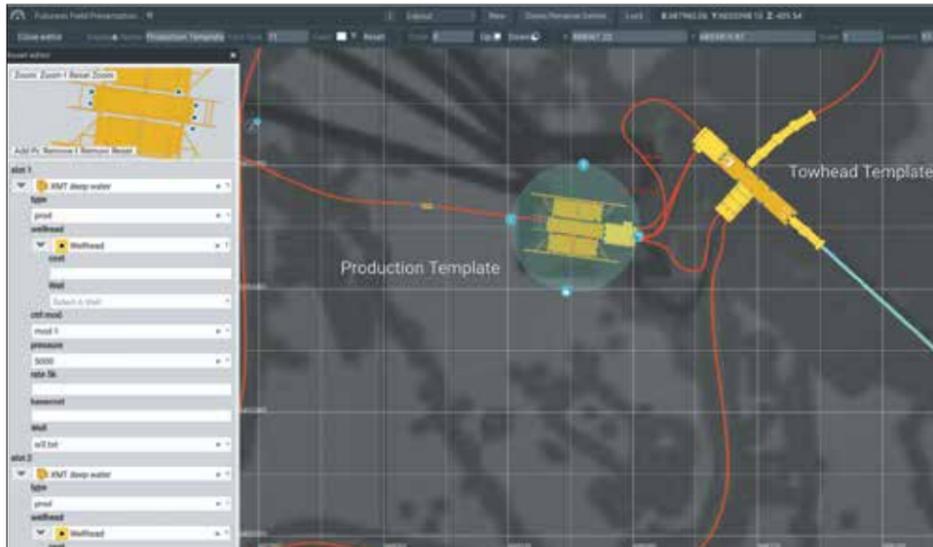
The demand hike drives the need for digital technologies to leverage massive field data to build the most accurate offshore field picture by volume, variety and velocity. The vast system of interconnected industrial assets generates hundreds of millions of bytes of data every day.

Given the uptick in new projects, this is an excellent time for companies to implement digital field twins from day one on new offshore projects to make better business decisions.

## Greater collaboration

With digital platforms, operators now collaborate cross-departmentally within the enterprise as well as with contractors working from the same real-time data source. The new collaborative work environment is a move away from the industry's traditionally siloed work environment with a variety of owned tools, applications and data.

For instance, FutureOn's FieldAP—a FieldTwin platform application enabling the digital twin in the offshore environment—uses open web standards to visualize a data-driven digital representation of the entire field from anywhere across the globe. FutureOn was awarded a 2019 Spotlight on New Technology award for FieldAP, which integrates with expert engineering systems to empower engineers to run complex simulations within the application. Flow assurance simulations, for example, can be calculated by merely clicking on a digital pipeline asset within FieldAP then opening the simulation tab. The engineers then click run simulation to seamlessly



FutureOn's FieldAP and FieldTwin create new fields digitally in the cloud. (Source: FutureOn)

connect to the simulation engine through the application API to visualize flow projections.

FieldAP's collaboration enhancements lead to vastly accelerated decision-making and reduced risk while also reducing staffing requirements. Operators, for instance, can leverage the FieldTwin platform for cloud-based centralized digital rig book creation from the start of the project life cycle. This approach will replace hard copy books and eliminate risks and errors caused by static, outdated information susceptible to destruction or misplacement.

## Generate more for less

Operators and service companies use FutureOn's digital solutions to generate more pre-FEED field concepts in less time, quickly identifying and eliminating unviable concept options without the need for significant upfront expenses.

FieldAP's 2-D/3-D visualization of subsea fields, integrated with popular engineering tools, facilitates more informed technical and operational discussions across multiple disciplines, reducing risk and improving delivery specificity.

McDermott, an early adopter of transformative digital technology, uses FieldAP to transform workflows, increase project teams' agility and respond rapidly and efficiently to bid opportunities by developing multiple concept proposals up to five times more quickly than in the past or the competition. McDermott understands that FEED and final investment decisions occur significantly earlier, benefiting service providers and the industry as a whole. By accelerating project time lines, McDermott has been able to maximize its capabilities, cut costs and improve efficiency, resulting in more offshore project awards.

## Cost-effective option

Companies can budget cost-effective digital platforms such as FieldTwin as an operational expense rather than a capex cost with immediate returns (i.e., \$45,000 in cost savings associated with outsourced drafters).

Of the \$1.3 trillion spent on digitalization transformation last year, an estimated \$900 billion went to waste, according to a recent article in the Harvard Business Review. Despite the current emphasis on workflows and digitalization, energy companies continue to approach digitalization from a hardware perspective. Traditional digitalization approaches can involve significant upfront capex through SMART equipment, sensors and upgrading systems. These expenses often unduly burden companies' balance sheets and increase insecurity during cyclical market dips or serious downturns. Internet of Things devices, SMART sensors and robotic tools require costly new equipment investments, employee training and retrofitting of existing systems. The return on investment is difficult to assess in the short term.

Instead, create a digital strategy focused on software solutions first to lower risk, better weather cyclical market uncertainty and ensure long-term project success. Companies see the competitive advantages digitization can bring to their unique position in the market and act proactively to change the game. ■



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Visit United Against Human Trafficking's booth in Lobby D of NRG Center during OTC to learn more about their mission and initiatives.

# Well Surveillance Can Use AI to Predict Failures

■ The application of AI-assisted monitoring represents a clear departure from how ESPs are currently monitored across the oil and gas industry.

BY DR. CHRISTOPH KANDZIORA, SIEMENS

Most oil and gas wells will require artificial lift at some point in their life cycle. Electric submersible pumps (ESPs) are widely considered to be one of the most efficient techniques and are used in a significant portion of oil fields, both onshore and offshore.

Due to the nature of ESPs (i.e., being buried at the bottom of the borehole), monitoring their performance is a significant challenge. Manual inspection is not possible due to the high costs of such an operation. Therefore, the only possibility for monitoring these devices is to make use of data generated from installed sensors.

Existing monitoring and control technologies on the market today look retrospectively at sensor data and are primarily used for troubleshooting and forensic analysis. While many systems can raise alarms if the threshold value for a given sensor signal is exceeded, this typically only happens after an event occurs—when the production interruption is already underway. Additionally, most traditional control systems can only make use of current sensor values and do not take into account historical data, which is critical to developing performance trends for predictive maintenance.

Siemens has developed AI4ESP, an autonomous well surveillance solution for remotely monitoring ESP performance that uses artificial intelligence (AI) to predict failures days before they occur.

## Smart pumps

AI4ESP creates smart pumps at the heart of the digital oil field, enabling operators to transform production operations by significantly reducing downtime and saving millions of dollars annually. Its self-learning model aggregates and analyzes operating data (real-time and historical) from a variety of sensors. The more data it ingests, the more intelligent it becomes. The application labels ESP behavior profiles based on their applications and environments. In addition to being able to detect performance anomalies in a single ESP, behavior profiles can be used to alert operators of ESP issues in similar applications and environments, delivering advanced notice of an event before it affects production.

Other key capabilities of AI4ESP include rest-of-life estimation, which gives operators the opportunity to appropriately prepare for irregular maintenance intervals. AI4ESP also aids in prolonging the lifetime of the pump by

1. Reducing the load to the pump (i.e., in the event that a specific failure mode is detected, AI4ESP provides recommendations to shift the event farther into the future); and
2. Providing actionable recommendations to counter or mitigate life-shortening events (e.g., increased transit of paraffins).

In recent years, many digital monitoring and control solutions that leverage data generated by ESPs have been developed. However, the overwhelming majority utilize conventional statistical based models that alert operators to performance issues and events that are already underway. Very few technologies are available that use AI to not only self-learn but also to look prospectively and predict failures before they occur. AI4ESP is one of the only solutions that has been validated in real-world field applications.

AI4ESP is widely adaptable to onshore, offshore and unconventional production applications. The solution is vendor-agnostic, standards-based and can be deployed in other types of artificial lift operations, such as sucker rod pumping and progressing cavity pumping.

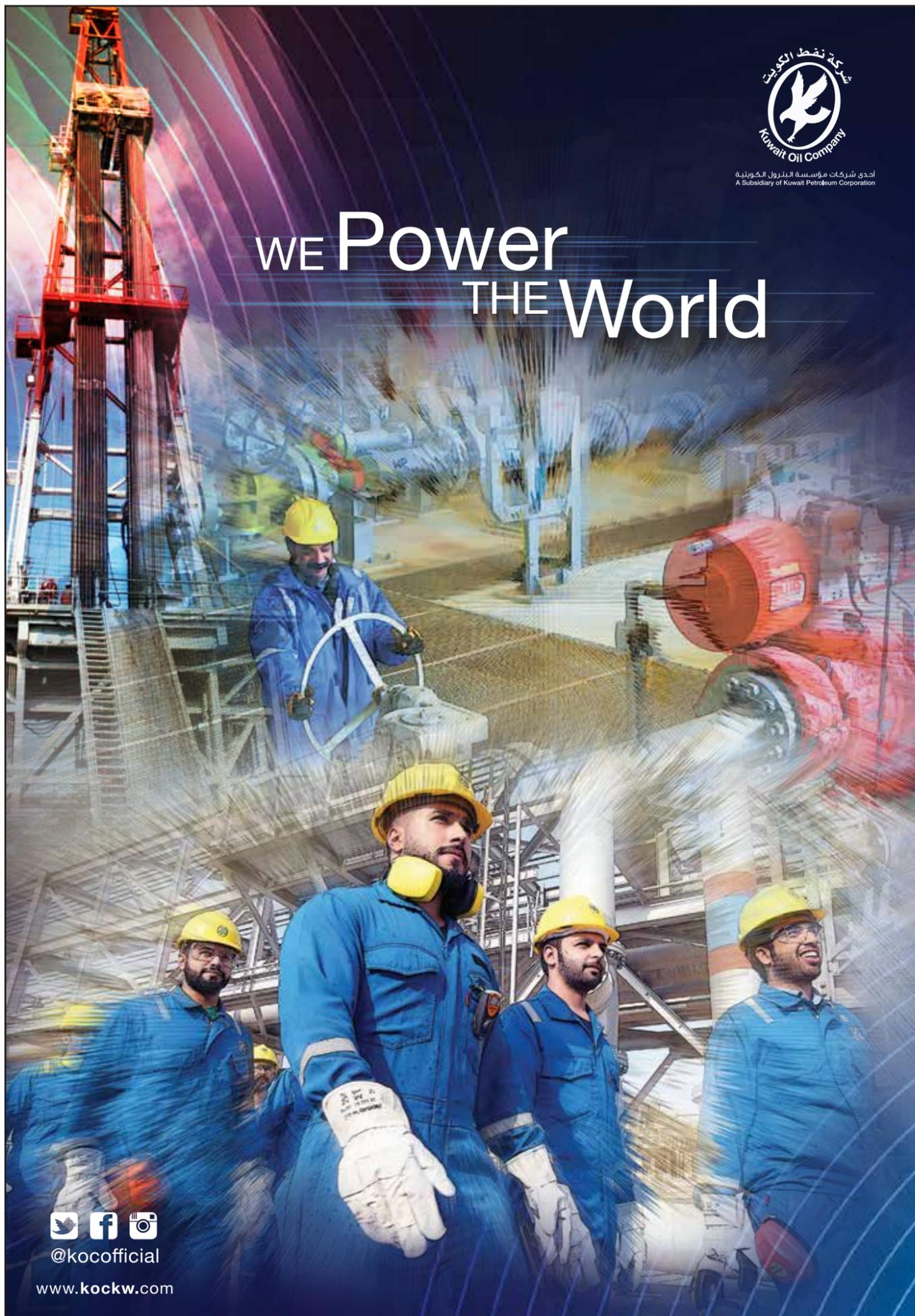
## Real-world applications underway

Siemens successfully deployed AI4ESP for an onshore E&P customer in Germany. The solution is live and has been up and running in the field for 10 months. Similar field applications are underway, including one with a major offshore E&P company. In field applications, AI4ESP has performed as expected, enabling operators to predict ESP failures up to 12 days in advance and reducing production downtime by roughly a third. ■

## Can I take photographs or video of OTC?

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Members of the press are required to report to the OTC Press Room to obtain permission for photography and videography.



## OFFSHORE

(continued from page 1)

“There is a need for it, but at the same time, we need to find what I would say is low-cost oil.”

Keeping up with the demands of a growing global population helps ensure the need for offshore oil and gas production. “The International Energy Agency sees the demand for energy will continue to grow,” Beydoun said. “If we do nothing, our reservoirs will deplete at about 5% to 7% every year. This will create a gap of about 35 million barrels per day by 2025. So exploration and production have a big role in filling this gap.”

Marine renewables also will have a part in meeting that demand, a role highlighted in this week’s technical program. “The core business is oil and gas, but with advances in technology combined with increased societal and environmental awareness, we felt it was important to include tangible renewables as part of the program,” he said. “We have 14 sessions dedicated to offshore renewables at this OTC, as this is a topic the board felt needed the space so that people could come and discuss this growing area of opportunity.”

In addition to renewables, attendees also will have an opportunity to travel the world without leaving Houston to learn more about offshore licensing opportunities, technology advancements and more as part of a new series of presentations.

“For as long as I can remember, OTC has had sessions dedicated to specific countries. This year, we will feature nine countries as part of what we’re calling our ‘Around the World’ series,” he said. “The format is quite flexible and provides [an opportunity for] representatives from each country to highlight and show how they have made an impact in the offshore industry.”

The lineup includes Australia, Canada, France, Ghana, Guyana, Israel, Mexico, Norway and the U.K.

“It is new for this year, but hopefully we will keep it around so that other countries will have an opportunity to share how they resonate with offshore opportunities,” Beydoun said.

This year will be Beydoun’s last in his role as chairman of the OTC board, capping off nine years of service that have provided many great memories and more. “It enhanced my professional network and my overall

understanding of the offshore ecosystem. Because we have many different societies represented on the board, with each representing a different aspect of the offshore, my awareness, understanding and appreciation for these other technologies increased,” he said. “It has been a wonderful nine years.” ■

## RENEWABLES

(continued from page 1)

Burris said OTC in previous years would typically feature a session on wind energy and occasionally wave energy, but this year chose to emphasize how those technologies are being adapted by the offshore industry.

“And not only adapting to those technologies but applying those lessons learned from the oil and gas patch so as to not repeat those same technology mistakes moving forward,” he said.

This year’s OTC technical program will feature at least eight sessions on renewable energy, among which will be a Tuesday session at 9:30 a.m., “Technical Advances for Cost Reduction of Offshore Wind Energy.”

Similarly themed sessions will take place Tuesday at 2 p.m. with “Offshore Wind Energy in the U.S.: Dawn of an Industry,” and Thursday at 9:30 a.m. with “Offshore Renewables: Site Investigation Challenges for Environmental and Engineering Assessment.”

“Another strong theme this year is digitalization and Big Data,” Burris said. “It’s been a buzz in the industry for a number of years, and we’re finally starting to see projects where that data is starting to be put into place by companies who make changes in their strategy and how they are managing their assets.”

Burris said that rather than focusing on discussions as to how digitalization can improve the industry, the technical program committee wanted to move the discussion toward actual application and results.

“We’ve been lacking the practical application of where digitalization can really make a difference,” he said. “So the approach this year was to make sure we recruited papers and also featured papers that were actually being written now that we’ve collected this data.”

The result will be sessions such as “Big Data Successful Application of Digital Transformation and Future Advances,” scheduled for Thursday at 9:30 a.m. Companies featured during that session include Equinor, ABS, National Oilwell Varco and KBR.

Other sessions focusing on digitalization in the offshore industry include “Digitalization Deployed: Case Studies,” on Tuesday at 9:30 a.m., and a ticketed breakfast presentation by the Center for Offshore Safety addressing senior leadership perspectives on digitalization and new technology.

Burris said the program committee looked to follow up on interest in HP/HT issues the industry is facing as developments continue to move and evolve into new fields. A two-part session focusing on HP/HT challenges, “HP/HT Solutions: Technology Verification, Validation and Deployments,” is set for 9:30 a.m. and 2 p.m. Wednesday.

“That’s been a hot topic for a number of years now as we push into deeper fields and deeper waters and older reservoirs where we have seen pressures and temperatures go up,” he said. “So, how do you safely extend our current technologies to those water depths and those operating parameters? That’s really the key to unlocking not only developments that are being sanctioned now, but hopefully five, 10 years down the road when we’ll rely on the technology being developed and presented this year.” ■

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# More Data Gathered Per Well Intervention

■ Data logging and delivery capabilities have improved with high-speed digital telemetry technology.

CONTRIBUTED BY PROBE

Probe offers resources to increase data logging capabilities through its high-speed digital (HD) telemetry platform. Known as the HD Platform, an increasingly wider range of high-speed, highly configurable digital sensors play critical and unique roles in helping operators log data much more efficiently. In addition to its range of standard and array production logging tools, Probe has been focusing on cased-hole formation evaluation solutions.

The company's new MAC 24 multi-arm caliper tool makes it possible to identify integrity problems, such as mineral deposition, corrosion, wear or mechanical deformation, inside a completion. The RADii segmented bond tool measures and maps the quality of cement behind casing in oil and gas wells. The RAS reservoir analysis sonde is a three-detector pulsed-neutron logging tool for measuring reservoir saturation using sigma and carbon-oxygen techniques. In addition, the spectral gamma ray tool is an evaluation tool that offers insight into the radioactivity and mineral composition of cased-hole formations.

The new HD Platform consists of two parts: an inter-tool communications bus and mono-conductor telemetry, which is managed by the telemetry control unit (TCU). The inter-tool communications bus is a single wire bi-directional system that operates at 500 kpbs, which is ample speed to accommodate many different combinations of logging tools. The controlling telemetry, or alternative memory



The new MAC 24 multi-arm caliper tool features HD technology. The HD cards can be easily switched out in the event of a failure, without rewiring or soldering. (Source: Probe)

tool, samples sensors at a rate of 50 times per second, allowing high data rate tools and, for example, multi-arm calipers to provide high vertical resolution. Commands and instructions also are sent to the sensors on the same single wire bus.

The TCU handles all communications to surface. This device controls the data collected by the tools below, and packages it for transmission to the surface system. It receives commands from the surface system via the fast downlink and responds back to the surface, as necessary.

The TCU can be replaced by the memory logging tool allowing all HD sensors to be deployed on slickline and coiled tubing, among others.

The HD Platform is a modular design offering simple mechanical maintenance and supported by plug-in electronic boards. It is well suited to both conventional and remote environment operations.

Probe plans to integrate HD telemetry technology into all current and future cased-hole logging tools. ■

## DIGITIZING

(continued from page 22)

traditional solutions. MAX Edge includes secure remote management capabilities enabling remote updates that are completed within minutes on thousands of devices.

Data plays a critical role in the industry and the industry has been fortunate to see just how much of a positive impact it can make for customers when they utilize NOV's suite of technologies. For instance, an operator recently wanted to find a way to avoid stuck pipe incidents that typically increase a normal \$250,000 drillout operation up to \$1.7 million (SPE 187337-MS). To do this, an operator worked with NOV to directly receive real-time data from coiled tubing units through the MAX platform. The operator was then able to build analytics to detect and quickly respond to any signs of stuck pipe events prior to them happening. The result was the elimination of incredibly costly stuck pipe events, drastically lowering the average cost of drillout operations.

As the industry continues to digitize the oilfield, it is increasingly important that suitable technology is developed and deployed. Digitizing the oil field means deploying thousands, even tens of thousands, of devices and being able to manage them efficiently. The MAX platform provides unification by aligning data so that customers can do more with their data and NOV can continue to build better products based on that data. ■

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- 10:30 am Leveraging Subsea Connect for a Radically New Approach to Planning Your Next Subsea Project
- 11:00 am Explore Advanced Developments in Autonomous Subsea Pipeline Pre-commissioning
- 11:30 am Discover BHGE's Innovative Commercial Models for Project Success
- 1:00 pm Learn How io oil & gas consulting Partners with McDermott and BHGE on Integrated Project Management for Improved Economics
- 1:30 pm Spotlight on New Technology Award Winner NovaLT16: Maximizing Production and Minimizing Offshore and Onshore Risk
- 2:00 pm Reduce Non-productive Time with the Intelligent Subsea Stethoscope
- 2:30 pm Drilling Through Narrow Hydraulic Windows Without Risking Losses or Restricting Performance
- 3:00 pm Improving Reliability Using AI to Predict System-level Failures
- 3:30 pm Improving Mature-well Recovery Rates with Fast, Effective Chemical Treatments
- 4:00 pm Using Data-driven Decision-making & TOTEX Savings for Subsea Blowout Preventers
- 4:30 pm Learn How BHGE is Enhancing Offshore Power Generation Solutions