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World Expro

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Carl Friedmann, editor

Game raiser

For the second quarter of 2018, Baker Hughes announced orders of \$6 billion, and revenue was also up to \$5.5 billion. This is an increase of 2% year over year on a combined business basis, according to the company. And while this impressive growth comes from many different sources, a substantial portion comes from technology – physical and digital.

“In our Oilfield Equipment (OFE) segment, we had our largest orders quarter since 2015,” commented Lorenzo Simonelli, BHGE chairman and CEO in a July 2018 press release. “In our Digital Solutions (DS) segment, strong execution led to solid revenue growth. We are seeing increased interest in our sensor, inspection and software offerings, and we are gaining traction with our Predictive Corrosion Management (PCM) software to support the growing corrosion market.” PCM is especially vital in order to scale monitoring and predict corrosion issues with the benefit of advanced sensors and real-time data. Damage by third party is the most common cause of pipeline incidents, but as we learn from Stuart Clouston, the group’s in-line inspection product management leader on page 32, deterioration starts at fruition and solid integrity management, as much as the pipeline itself, is key.

New laws and regulation put in place in recent years, as well as evolving technological advancements, have enabled better pipeline integrity, like smart tools to detect cracks –

stress corrosion to fatigue and hydrogen-induced fissures – and communication channels through the rise of social media are also better than ever before, so operators can be updated on pipeline failures almost instantly.

Baker Hughes’ technologies can now better locate and accurately highlight potentially dangerous breaches, and identify stress corrosion and cracks of unknown gestation. It also has engineering techniques to better predict rupture pressure, when adjacent cracks interact.

Dr Phil Hopkins, one of the world’s foremost pipeline experts, and a visiting professor at Newcastle University, discusses with Clouston in our feature on pipeline technology another of the upstream segment’s biggest headaches around pipeline integrity: the increasing rates of third-party damage.

In terms of the digital oilfield, which has been de rigeur in the industry for decades, the rapid acceleration of innovation in the face of unprecedented challenges has forced companies to find creative ways to do more with less. On page 52, Halliburton’s digital technology leader César Bravo discusses what we can expect from today’s digital oilfield, and what it means for the future. The company also posted impressive Q2 2018 numbers, with a revenue of \$6.1 billion. So, with companies like these leading the technological charge, there is a lot to be optimistic about.



Also in this issue

Page 17: Get clued in on this year’s OSEA event, taking place 27–29 November in Singapore.

Page 32: Stuart Clouston of Baker Hughes discusses the prioritisation of pipeline integrity and maintenance.

Page 46: Sandy MacMullin explains how Nova Scotia has become a hotspot for energy majors.

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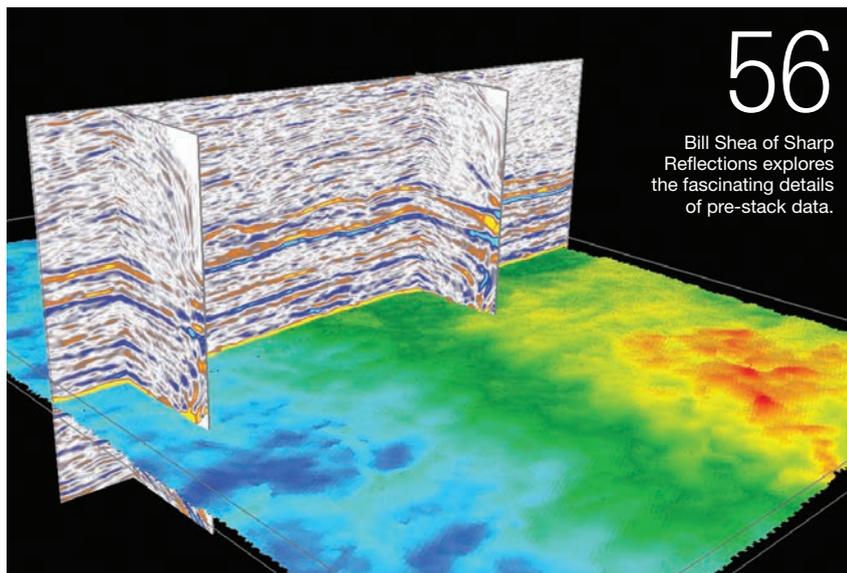
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Consult the specialists

In this issue...



56

Bill Shea of Sharp Reflections explores the fascinating details of pre-stack data.



12

Greg Julian of BSEE discusses increasing production and safety in offshore.

The intelligence

7 Vital statistics

Facts, figures and talking points from the global oil industry.

8 On the road to recovery

Enhanced oil recovery helps extend the life of an oil field. *World Expro* takes a look at the process and sustainability, with figures from GlobalData.

Safety & security

12 Burden of proof

The US Bureau of Safety and Environmental Enforcement is proposing changes to offshore safety rules due to President Trump's order to reduce the 'unnecessary burden' on industry. Julian Turner asks Greg Julian of the BSEE if it is possible to increase production and safety.

14 Fully qualified to qualify

SQA

Events

17 A fresh outlook

This year, OSEA, Asia's largest oil and gas event – taking place

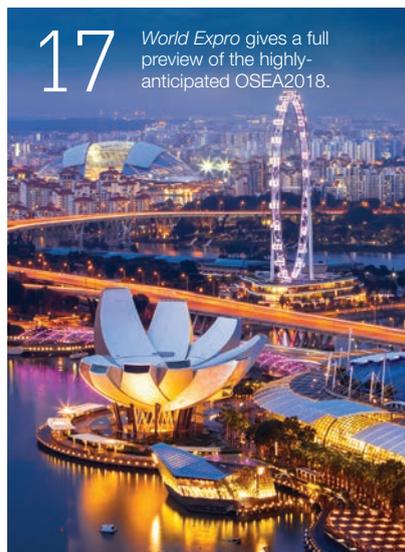
27–29 November in Singapore – expands its focus on gas amid the region's growing liquefied natural gas demand. *World Expro* gives a comprehensive preview of the occasion and the newly heightened focus on gas ahead of proceedings.

19 Blowing competition out of the water

PAMAS

21 Accelerating transformation

With creative partnership opportunities proving what



17

World Expro gives a full preview of the highly-anticipated OSEA2018.

is vital for the future growth of the industry, ADIPEC is realising its full potential with this year's event in Abu Dhabi. *World Expro* hears more about those succeeding in the industry and what's in store this year.

29 Venture below the surface

Eddyfi

31 Making the instant grade

Olympus

Pipeline technology

32 Paper over the cracks

Stuart Clouston, in-line inspection product management leader of process and pipeline services at Baker Hughes, a GE Company, and Newcastle University's Dr Phil Hopkins, the current state of pipeline priority with Ross Davies.

37 The sensible approach

Neptune Oceanographic

Innovators

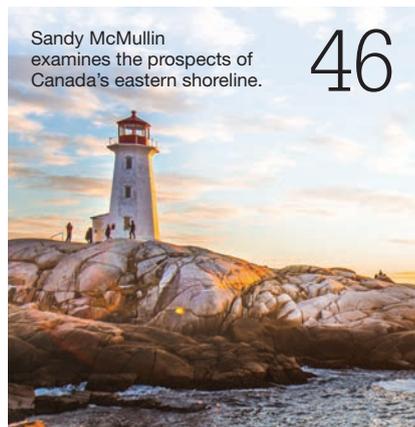
38 Reinvent the wheel

Bronswerk Heat Transfer



39

A look at the safety and cost-efficiency of robotics technologies.



Sandy McMullin examines the prospects of Canada's eastern shoreline.

46



49

The challenges of pushing into deeper water for new reserves.



52

César Bravo of Haliburton tackles the modern digital oilfield.

39 Enter the robots: a new approach

The UK Oil & Gas Technology Centre has invested in three robotic technologies to help transform pressure vessel inspection on offshore rigs. Ross Davies looks at how these new projects will help with cost-efficiency, as well as increase safety within the oil and gas industry.

43 Interactions in oils

BEA Technologies

45 The heat of the moment

Heatec

46 A new lease of life in Nova Scotia

Offshore exploration and production is a major topic. As the industry seeks cost-efficient reserves, the economic benefits are pushing many regions to attract the gaze of energy majors. Jim Banks speaks to Sandy MacMullin of the Nova

Scotia Department of Energy and Mines about the prospects on Nova Scotia, and the wider area of Canada's eastern shoreline.

Exploration & production

49 Brazil's rise to the challenge

Solange da Silva Guedes, head of exploration and production at Petrobras, studies how the logistical and technical challenge of pushing further offshore into deeper water to locate new reserves, and how it is being met in Brazil's Campos and Santos Basins.

Digital oilfield

52 Let's push things forward

There is a history of digital technology being deployed in oilfields, and the evolution of technology has required the industry to keep pace with the potential efficiencies it brings.

As companies move towards a more efficient and more autonomous future, Halliburton's digital technology leader, César Bravo, discusses what the digital oilfield means today and for the future of the wider industry.

56 Stack it and see

As oil companies continue to move into ever more challenging reservoirs, they need to maintain an understanding of what's happening subsurface. Big data solutions are emerging as a means to make accurate interpretations and discover data quality problems ahead of time. Bill Shea, CEO of Sharp Reflections, speaks to Abi Millar about why pre-stack data is the future of seismic interpretation.

Directory

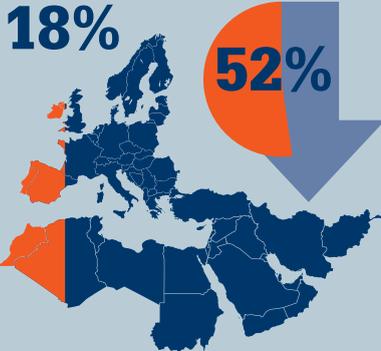
60 Product showcase

62 Index

Vital statistics

M&As in July 2018 – EMEA and Asia-Pacific

EMEA accounted for **18%** of global deals, with 11, representing a significant decrease of **52%** from the previous month's 23 deals.



In total, EMEA recorded a deal value of **\$1.7 billion in July 2018**, representing a sharp increase from the **\$645.3 million in June**. Of the total, nine, with a combined value of \$1.7 billion, were announced, and two, with a combined value of **\$6.3 million**, were completed.



Cross-border EMEA values increased enormously from **12 deals**, with a combined value of **\$78.8 million** in June 2018, to two deals, with a combined value of **\$1.1 billion** the following month.



9 domestic EMEA deals, with a combined value of **\$590.3m**



were registered in July 2018, compared

11 with deals, with a combined value of **\$566.5m**

in June 2018.



There were **five** deals worth more than

\$10 million

representing a marginal increase when compared with the previous month's **four** deals.



Deals worth more than \$10 million accounted for **99%** of the total deal value in June 2018 and July 2018.

The majority of M&A activity was centered on UK assets.



This segment of the market delivered the greatest share of deal volume, with **four** deals of a combined value of

\$1 billion.

Petrofac agreed to sell a **49% stake of Petrofac Netherlands Holding**, a company that holds the Santuario production sharing contract, for approximately



\$274 million.

The purchase consideration consists of an initial

\$200 million.

The Asia-Pacific region accounted for **10%** of global deals.



With **six**, representing a substantial increase when compared with **two** deals the previous month.



In terms of M&A volume, Asia-Pacific cross-border deal values decreased, with a combined value of **\$0.8 million**

in June 2018, to one deal, with an undisclosed value, in July 2018.

Five domestic deals, with a combined value of **\$355 million**

were recorded in July 2018, with no deals in June 2018.



Source: GlobalData

On the road to recovery

Enhanced oil recovery helps exponentially extend the life of an oil field, which is why an increasing amount of companies are employing the process to better the production and stamina of oil fields globally. *World Expro* takes a look at the process, implementation and sustainability, with figures provided by **GlobalData**.

The enhanced oil Recovery (EOR) process is currently witnessing rapid developments in the oil and gas industry. More than 70% of the oilfields around the world have reached or are nearing maturity. Oil and gas production from several of these mature fields is declining each year, while demand for energy is growing with each measurable increase in global population. This is prompting oilfield operators to employ secondary or tertiary recovery techniques to extend the life of these mature fields. Oil and gas companies in the some of the leading oil producing regions like the Middle East and Russia are adopting EOR to ensure optimum oil supply to their customers. Tertiary recovery methods are also being used in the US to obtain the maximum potential out of some of their oldest oilfields in the Gulf of Mexico. A few other leading producers of oil and gas, such as Norway, the UK, and Malaysia have also used EOR process in their continental shelves.

Oil production declines once it reaches its peak. When the use of pump jacks and secondary recovery methods such as water flooding do not yield the desired results, tertiary recovery methods, such as EOR, have to be employed to stimulate the oil displacement. According to the US Department of Energy, primary and secondary recovery procedures can recover up to 25% of the oil from the well. An increase in recovery rate by one percentage point can potentially add up to two years of hydrocarbon supply for the oil company. Hence, improvements in oil recovery rate can give a significant boost to the oil company's revenues and profitability. It can also reduce the concerns regarding global energy supply as recent discoveries of oil and gas reserves have not been substantial.

EOR techniques have the potential to considerably improve the oil recovery factor and increase the economic value of the wells. However, it considerably

increases the cost of production of oil due to the capital expenditure required to design and construct the additional infrastructure and to source the gas or chemical to be injected. In the case of CO₂ injection EOR technique, the cost of procuring CO₂ itself can add \$20 per barrel of oil to the overall production cost. Moreover, the results of EOR processes are not immediate and time can also play an influential role in adding to the costs.

All must be factored in before initiating an EOR project. The prevailing oil price, then becomes an important determinant and the uncertainties associated with the price movement are major risks for most EOR projects.

When oil prices stabilised over \$100 per barrel, it led to significant advancements in the EOR techniques, especially in the US and Europe. New polymers and surfactants were introduced for the chemical EOR industry with the potential to increase

the recovery rate by a significant margin of the estimated recoverable oil in the wells. Oil and gas companies also invested in the research and development of nanoparticles to improve the foam generation capability and stability of surfactants against permeable rocks. Polymer flooding and surfactant flooding are emerging as alternatives to CO₂ injection in improving the oil recovery rate of the fields. Microbial and miscible gas injection EOR techniques also saw considerable developments during the high-price environment.

Even after the prolonged oil price crash that occurred during 2014–16, and the subsequent price recovery in the past year, EOR is still playing an important role in global oil production. Recent developments in drilling technologies and improvements in efficiency have enabled oil and gas companies to bring down their production costs across several oil fields. These companies are also continuing the use of EOR processes to ensure optimum production from their matured wells. Some of the leading oil companies, such as Shell and BP, have started incorporating EOR in the initial field development planning itself. This approach can enable oil and gas companies to plan for a much longer production time-frame than usual and maximise the potential for oil extraction from the discovered fields.

Playing the field

Most oil fields only produce a fraction of the oil contained in the reservoir. EOR helps to maximise the oil reserves recovered, extend the life of fields, and increase the recovery factor through external input of chemicals or energy. EOR is an important tool for companies helping to maintain production and increasing the returns on older investments. Although, benefitting from the presence of existing infrastructure EOR technology is often costly and uneconomic. The high cost of EOR efforts has been deterrent to its wider use but, when economical, it can provide equivalent or lower-cost barrels when compared with new greenfield developments. As fewer large

Table 1. Oil and gas sector trends	
Trend	What's happening?
Incorporating EOR in techniques in field development planning	Traditionally, EOR was considered as a tertiary recovery option for oil production due to the additional costs and resources required to execute the EOR processes. In the case of mature wells having legacy infrastructure, it becomes very capital intensive to incorporate new infrastructure for EOR. Moreover, as new exploration activities haven't yielded significant oil discoveries, it has become vital to improve the output from operational and newly discovered wells. Hence, oil companies have started incorporating EOR in the field development planning itself to accurately assess the economic viability of the field and to ensure optimum oil production. Oil majors, such as Shell and BP, have already started considering EOR at initial stages of field development.
EOR for horizontal drilling	The adoption of horizontal drilling and hydraulic fracturing gave North American oil companies the access to a vast cache of oil and gas in shale formations, particularly in the Permian Basin. Even after further developments in this unconventional extraction technology, it is estimated that the recovery rate of shale oil is only 7%, as observed by the Energy and Environmental Research Center (EERC). So in order to further increase the production of shale oil, operators are considering adopting EOR techniques for long-term sustainability. One company is EOG Resources, which has already started employing CO ₂ EOR technique at its wells in the Eagle Ford. The company has completed an EOR pilot study on 32 wells and is in the process of implementing the technique across 100 wells to improve the recovery rate.
Increasing EOR usage driving natural gas demand in the Middle East	A number of oil fields in the Middle East have reached their maturity, and require secondary and tertiary recovery methods to stimulate the production. Gas and steam injection are commonly used to enhance the oil recovery from the fields in this region. As a result, the demand for natural gas for reinjection is growing rapidly, especially in the UAE. ADNOC, the integrated oil and gas company from Abu Dhabi, is deploying gas injection and CO ₂ injection EOR techniques to increase the productivity of its oil fields by 400,000bpd.
Source: GlobalData	

discoveries are made, EOR will be an option to maintain or increase production for mature fields. EOR will continue to be an important technology to increase the value of the late life assets and as new techniques evolve, EOR will play a greater role in the global supply of oil.

EOR can be defined as thermal or compositional transformation of either the hydrocarbons or reservoir rock to aid in the recovery of additional volumes. This tertiary method of increasing oil recovery is invoked after the primary and secondary recovery methods have run their course. New technologies and materials are greatly improving the yield of these techniques and will continue to provide additional production at mature fields. In addition, EOR is now being considered during the development to further enhance the performance of new fields. The macroeconomic effects of

increasing EOR programmes will increase production and recoverable reserves of oil though most will solely be viable in a higher-price environment.

EOR technology is broken into three main types: gas injection, chemical and thermal. Chemical EOR usually involves the injection of chemicals into the reservoir to alter the properties of the oil to improve migration. Miscible flooding or gas injection is used to reduce the surface tension between oil and water to increase the flow the oil using carbon dioxide, nitrogen or natural gas and liquefied petroleum gasses. Physical EOR involves a change to the reservoir via thermal efforts commonly in-situ combustion, hot water injection, and steam flooding, all of which reduces the resistance to flow of oil aiding recovery. Steam-assisted gravity drainage is most effective in heavy oil fields that

have only single-digit recovery factors. In these cases, often the recovery can be increased by 50% or more. Each field presents its own challenges and a combination of EOR studies are needed to determine the best course of action on a case-by-case basis. Many companies are preparing for eventual use of EOR by collecting more detailed information via seismic studies and pilot testing as the successful deployment of EOR technology is highly dependent on the reservoir's geologic and fluid properties.

The key players in the EOR theme are upstream companies that have the capital to contract or even research and develop techniques and technologies. The upstream category will also be supported by multiple companies across the industry as EOR becomes more widespread. Some of the top upstream oil and gas companies by production with EOR programmes currently under way are China National Petroleum, Rosneft Oil, Abu Dhabi National Oil and Petroleos Mexicanos, for instance.

EOR outlook in the Americas

The US has been the leading adopter of EOR technologies in the Americas for nearly four decades. Being the largest consumer of energy, the US extensively used EOR across its oil fields while also depending on oil imports from the OPEC countries. According to the US Department of Energy (DOE), there were approximately 200 EOR projects in the US before the shale boom. The oil produced using EOR accounted for nearly 14% of the total US oil production in 2012. CO₂ injection is predominantly used in the US oil fields, although other techniques such as chemical and steam injection were also used in some of the fields. This high adoption of CO₂ in EOR has encouraged the US to consider CCS to reduce the greenhouse gas emissions from power generation and industrial operations.

The advancements in horizontal drilling and hydraulic fracturing technologies in the past decade have enabled the US to produce large quantities of oil and natural gas from shale formations. This has not only enabled the US to meet its domestic energy requirements but has also allowed

Table 2. Technology trends	
Trend	What's happening?
Advancements in chemical technology	Before the collapse of oil prices crash in late 2014, oil and gas companies were able to dedicate a sufficient share of their revenues to EOR research. This led to advancements in a variety of EOR-related areas, including the development in chemical technology for use in chemical EOR processes. The application of superior grade polymers, co-solvents, gels and surfactants can increase the oil recovery by around 20% of the initial crude oil estimates, which can give a significant financial boost for the stakeholders.
Nanoparticles for surfactant flooding	In the EOR process, addition of surfactants to the injected aqueous fluids decreases the interfacial tension of oil in the reservoir, enabling higher oil recovery from the field. However, these chemicals get easily absorbed by the rocks, thereby limiting their potential in oil recovery. New studies on surfactant flooring are adopting nanotechnology to improved stability of surfactants in porous media. These combine the surfactants with synthesised nanoparticles, primarily of silica gel, to create more stable foams for improving sweep efficiency and increase the overall oil recovery.
Use of fibre optics to monitor the efficiency of CO ₂ injection in EOR	Fibre optics technology is commonly used as a distributed temperature-sensing (DTS) system for well monitoring in the oil and gas industry. Recent technological advancements enable fiber optics to be deployed for monitoring performance and efficiency during CO ₂ injection in EOR and CCS processes. The CO ₂ movement in geologic formations and subsurface reservoirs is tracked using seismic imaging, in which geophones capture the seismic data. When fibre optics are deployed for vertical seismic profiling in a monitoring well, they can deliver better results to geophones in subsurface imaging. Moreover, fibre optics can also monitor temperature variations during CO ₂ injection, which can prove an added input parameter for efficiency evaluation. Battelle, an oilfield services company, is further studying the effectiveness of fibre optics for CO ₂ injection, in collaboration with Core Energy.
Adoption of big data	Big data solutions can be applied on to a wide array of data sets simultaneously to monitor changes in the reservoir at various stages of field development, drilling, well construction and production. The data sets obtained during phases, such as seismic, drilling and production, can be analysed to assist in supporting decisions related to the application of primary, secondary or tertiary recovery techniques. Even during EOR, the fluid injection process can be monitored for its efficiency and ensure optimum recovery of oil from the field.

Source: GlobalData

the country to start exporting oil and gas to international markets. The shale boom has unlocked a cache of crude oil and natural gas reserves for the US. However, at present, the oil recovery rate from shale formations is only 7%. The shale oil producers have started testing EOR techniques to improve the recovery rate. EOG Resources, an independent oil and gas company, has tested CO₂ technique in its shale plays in Eagle Ford and is planning to implement the technique on 100 wells to improve the recovery rate.

EOR techniques are being used in other oil-producing countries in the Americas, including Canada, Brazil, Venezuela and Mexico. Gas injection, especially CO₂ injection, is the most

commonly adopted technique for EOR in these countries.

Adoption of EOR in EMEA

The EMEA region, including Russia, has actively adopted EOR techniques for the past four decades. In fact, during this period, the oil and gas industry in Europe has been at the forefront in the development and adoption of EOR techniques. Several oil and gas fields in the North Sea continental shelf are reaching their maturity and EOR is expected to play an integral role in furthering the life of these fields. The UK and Norway are the most prominent oil producers in the North continental shelf.

The UK is evaluating different ways to reduce its greenhouse gas emissions by 80% of levels observed in 1990 by 2050. One of the approaches under consideration is carbon capture and storage from various emissions sources, including power generation, and CCS's application in improving oil recovery. The process of CCS and its use in CO₂ injection not only has the potential to increase oil output from matured wells but also in achieving net carbon reduction, thus meeting climate change goals.

Norway traditionally has been among the leading oil producers in the world. The vast stretches of continental shelf in the North Sea, Norwegian Sea and the Barents Sea surrounding Norway have been a rich source of hydrocarbons. However, the crude oil production in Norway reached its peak in 2000, producing 181m³. Since then, it has dropped to nearly 50% of its peak in the last 17 years. Oil and gas is an important contributor to the national GDP and is also a leading generator of employment for the country. In an attempt to halt this declining production levels, Norway's petroleum regulator is pushing for the use of EOR techniques across its fields. The regulator has also asked the operators at its newly discovered offshore field, Johan Sverdrup, to undertake pilot studies on polymer EOR injection to stimulate oil recovery when the field starts production in 2019.

The oil-rich Middle Eastern countries have employed EOR techniques in their mature fields to increase the oil recovery amid growing energy demand from domestic and international markets. The demand for gas in the UAE is growing rapidly due to the utilisation of gas injection technique at its oil fields. In 2017, Kuwait became the first country in the Middle East to initiate testing of chemical injection EOR in its northern region. Saudi Aramco, the national oil company from Saudi Arabia, in its 2016 Annual Review announced its plans to adopt surfactant injection at the Ghawar field.

Oman has widely contributed to the advancement of EOR technologies for accelerating oil recovery. The adoption of

Table 3. Macroeconomic trends: highlighting the key macroeconomic trends impacting EOR processes

Trend	What's happening?
Government encouragement to adopt EOR in Malaysian continental shelf	The Malaysian oil and gas industry has traditionally contributed to between 20 to 30% of the GDP. The country's oil production has remained steady over the years but the gas output has declined, prompting the government to encourage companies to use EOR. Malaysia intends to retain and even increase its LNG market share amid growing LNG demand from China, India and other Asian countries. In order to ensure sufficient supply of gas to its LNG terminals, Malaysia has started encouraging oil and gas companies to invest in EOR techniques to boost the production of natural gas.
Norwegian regulator pushing for EOR adoption	Crude oil production in Norway has fallen to nearly 50% of its peak output of 181 million cubic meters produced in 2000. The country's petroleum regulator is aiming to halt this downward trend as the oil and gas industry is a major employment and revenue generator accounting for around 12% of the national GDP. The Norwegian regulator is pushing for the use of EOR techniques in mature as well as new fields to increase the production of oil and gas.

Source: GlobalData

EOR in Oman has halted the decline in oil production considerably. The production in Oman fell by 27% during 2001–07, but in the next five years, oil production increased by 28%, driven by EOR projects. As most of these EOR projects were based on gas injection, the demand for gas is growing significantly. To reduce the dependency on gas for EOR, in 2011, Oman started constructing the world's first thermal EOR technique that used solar power for steam generation. This project is estimated to reduce Oman's gas use in oil production by 20%, allowing gas to be diverted for other applications like power generation and desalination.

EOR outlook in the Asia-Pacific region

Asia-Pacific (APAC) has traditionally been among the leading importers of crude oil and natural gas as the domestic production has been considerably lower than the energy demand of this region. There are, however, some key exporters of oil and gas in this region, such as Australia, Malaysia and Indonesia. The production of hydrocarbons in other parts of APAC is insufficient to meet the domestic demand. Despite this fact, EOR is being adopted in these countries in order to improve the oil recovery from the domestic fields, thereby reducing the need for imports. This is especially evident in China and

India where the demand for energy is growing rapidly, resulting in growing dependency on imports, which has the potential to impact the trade finances of these countries.

Oil producers in Australia, Malaysia, and Indonesia have employed EOR techniques to increase the oil production and extend the life of mature fields. The proximity of these countries to leading oil and gas importers – namely China, India and Japan – is a major factor for employing EOR. In Australia, production of hydrocarbons from its mature fields is declining and there is a rise in use of EOR techniques to ensure sufficient oil supply for domestic as well as international markets. Australian energy companies are also conducting studies to evaluate the possibility of CCS and its use in EOR. In Malaysia as well, a similar scenario of declining gas production is being observed. The Malaysian Government is encouraging oil and gas companies to adopt EOR to halt this decline, as it intends to retain its market share for exports of LNG. The oil and gas industry in Indonesia has used EOR techniques for over three decades. Steam flooding has been the most commonly employed technique in Indonesian oil fields, while other techniques have also been tried out with varying results. The application of steam flooding at Duri Field in Indonesia, is considered among the world's largest project, in terms of output, that is making use of this technique. ■

Burden of proof

The US Bureau of Safety and Environmental Enforcement is proposing changes to offshore safety rules due to President Trump's order to reduce the 'unnecessary burden' on industry, Julian Turner asks **Greg Julian** of the BSEE if it's possible to increase production and safety.



In December 2017, in response to a presidential order to reduce undue burden on industry, the US Bureau of Safety and Environmental Enforcement (BSEE) completed a review of Production Safety Systems Rule governing oil and gas production on the US Outer Continental Shelf (OCS).

Under new rules, operators will use industry-set 'recommended practices' to ensure that safety equipment works – as was done prior to the Deepwater Horizon disaster – and are not required by law to follow guidelines laid out by industry groups, such as the American Petroleum Institute (API).

"The documents are filled with 'should' instead of 'must'," Nancy Leveson, a professor at the Massachusetts Institute

of Technology (MIT) who served as a senior adviser to a presidential commission set-up after the Deepwater Horizon disaster in 2010, told the *Washington Post*.

BSEE director Scott Angelle disagrees. Announcing the proposed rule changes, he claimed it was possible to increase US domestic energy production, and safety and environmental protection. Is this really feasible and is it unrealistic to expect oil and gas companies to regulate themselves?

"Contrary to recent misleading reports, the Department of the Interior is not weakening offshore safety or environmental rules," says BSEE press secretary Greg Julian. "The BSEE is working hard to fulfill executive orders, which require an extensive review of our regulations.

“Our common sense approach is to propose revisions that could potentially reduce unnecessary burdens on operators without impacting safety and protections of the environment. Our changes will never reduce safety, and will in some cases improve safety.”

Production decline on the OCS

The OCS is a critical ingredient of the US energy mix. One out of every six barrels of oil produced in the US originates there; annual production exceeds 550 million barrels of oil and 1.3 trillion cubic feet of natural gas. However, in the past three years, production on the OCS has markedly declined.

“Let us be clear that the decline in offshore drilling is not merely ‘perceived’ – it is a fact,” says Julian. “In January 2015, there were 79 drilling rigs active on the OCS of the Gulf of Mexico. In January 2018, there were only 41 – representing a 48% decrease over that three-year period.”

The offshore industry lays the blame squarely at the feet of the Obama administration, which it says overstretched on safety regulations enacted in the wake of Deepwater Horizon.

“In January 2015, there were 79 drilling rigs active on the OCS of the Gulf of Mexico – in January 2018, there were only 41.”

However, Julian concedes that other factors, among them the US onshore shale boom, historically low global oil prices and resource scarcity, may have contributed, at least in part, to this decline.

“We have no meter that suggests how much of the offshore drilling decline in the US has been due to regulations or to onshore growth, but certainly those factors can affect drilling decisions,” he says.

“Those who make the capital deployment decisions have said, consistently and publicly, that over-regulation of the US Outer Continental Shelf has led them to consider it less desirable relative to other options.”

Analysis carried out by the BSEE estimates that the proposed

amendments to the Production Safety Systems Rule would reduce industry compliance burdens by at least \$228 million over ten years.

The Production Safety Systems Rule

The Production Safety Systems Rule addresses safety and pollution prevention equipment, subsea safety devices and safety device testing for the production of oil and gas resources on the OCS.

Potential technical changes to another piece of safety legislation, the Well Control Rule, which aims to prevent blowouts similar to the one that claimed the lives of 11 workers on Deepwater Horizon, have been put forward by seven industry groups and are still under review.

Neither proposal seeks to radically overhaul the existing rules. Instead, the proposals will, if enacted, minimise some oil and gas industry obligations and change several compliance terms to language favoured by drillers.

The revised Production Safety Systems Rule, for example, eliminates the requirement that safety and pollution prevention equipment be

inspected by independent auditors certified by the BSEE.

“Enacted in late 2016, the Production Safety Systems Rule covering production operations is not related to the 2010 Deepwater Horizon incident, which was an exploration operation covered under separate regulations,” explains Julian.

“The changes we propose are common sense – reducing unnecessary notifications and clarifying when operators must provide documentation.

“We also affirm that safety and pollution prevention equipment that meets required industry standards set by the API and American National Standards Institute has achieved third-party verification and ensures that each device will function in the conditions for which it was designed.

“We also propose to codify 17 updated standards in the regulation so they bear the force of law as another sign of our commitment to safety. We are examining other rules, but have not reached the public-comment phase.”

Beyond the horizon

Among the more vocal critics of the proposed rule changes is Michael Bromwich, who served as the first director of the BSEE. He claims the argument that the regulatory burden needs to be lifted as put forward by the oil and gas industry is not credible since neither rule came into force until 2016.

Bromwich also noted the incumbent government’s emphasis on promoting offshore energy when proposing regulations, in marked contrast to the policies advocated by the Obama administration.

“The rhetoric seems to be moving away from being a tough-minded but fair regulator and instead being a cheerleader for industry,” he told the *Washington Post*.

Julian insists that the BSEE is committed to maintaining safety levels on the OCS, not systematically rolling back laws put in place in the wake of Deepwater Horizon.

“We have no plans to alter two significant rules enacted following Deepwater Horizon. These are the Drilling Safety Rule and the Safety and Environmental Management Systems Rule,” he says. “The SEMS approach rightly moves operators towards a performance-based safety approach, allowing the government, industry and independent third parties to focus on improving safety outcomes.

“We are also strengthening our inspection programme by implementing a risk-based process that focuses our efforts on potential safety problems. I am confident that the BSEE will be able to achieve the goal of integrating a risk-based inspection protocol in 2018.

“Through these efforts, and many others, we are moving forward towards meeting the administration’s goal of achieving energy dominance without sacrificing safety.” ■

Fully qualified to qualify

SQA has been active in the international marketplace for more than 20 years, providing educational services in numerous countries while serving a wide range of clients including governments, national oil companies, international oil companies and academic institutions.

Throughout its existence, SQA has consistently delivered programmes aimed at supporting workforce nationalisation and supply chain development.

This means providing organisations operating in oil and gas markets with comprehensive, cross-functional qualifications and consultancy services for local workforces.

With over 100 years' experience and expertise in Scottish technical vocational education, SQA has also consulted and advised governments and global private sector stakeholders on how to develop new or existing frameworks, as well as building capacity and creating reform for the education and training infrastructure for workforces now and in the future.

This time it's personnel

The company's approach offers workforce development across business functions and those areas involved in the technical, support and delivery of onshore and offshore production as well as the serving of the industry itself. The products and services on offer exist to address needs, such as upskilling, reskilling, compliance and efficiency. This creates meaningful solutions to the vocational education and training issues being faced by the sector.

“ SQA's solutions offer industry-recognised standards for the competency development and progression of workforces worldwide. ”

SQA's solutions offer industry-recognised standards for the competency development and progression of workforces worldwide. This enables global oil and gas personnel to work towards and achieve industry-recognised technical qualifications. Additionally, this supports oil and gas-focused service functions, such as supply chain logistics, administration, management, technology, human resources and finance to help employees better understand the work they do. Naturally, employees increase their individual problem-solving skills and make more informed decisions on the job.

By the industry, for the industry

SQA has developed standards and qualification frameworks that help employers develop skills and competence in their technical operations and associated business functions. Building a competent workforce through frameworks will help to meet compliance requirements, support workforce

nationalisation and achieve operational excellence. Managing, monitoring and ensuring compliance with the increasingly complex labour regulations that exist worldwide is essential for oil and gas companies. SQA can provide a fully integrated skills-based solution that can integrate with existing learning and human resource requirements, helping to respond to new and changing regulations.

Adapt, design and teach

Developed by the industry for the industry, the support is continuously updated to reflect the most current industry requirements and standards. SQA understands the challenges in the industry at governmental and corporate level. From qualifications in processing operations and downstream field operations, to those in process engineering maintenance, it covers the length and breadth of the industry, to ensure that everyone is fully competent and can prove it through accreditation systems.

Each service enables anyone at any level, from trainee to experienced professional, to get ahead in the industry. SQA qualifications can be delivered by approved colleges, training providers and employers. Interested parties could even become an approved SQA centre in its own right, whether a private company or larger government body. SQA is constantly developing new awards as the industry diversifies into new areas, designing qualifications to match the applicant's need, which can be rated against international frameworks.

A world of difference

Internationally, SQA is working with governments, NGOs and oil companies across the world to develop and implement national and international competency frameworks that will allow citizens to access job opportunities in the oil and gas sectors within their country, as well as further afield.

The company also identifies the need for workforce development to meet industry demand and design programmes to support the ongoing development of the oil and gas industry through framework development, capacity building and Technical Vocational Education and Training (TVET).

All the work is tailored to support the specific needs of customers based on international best practice. SQA has proudly worked with governments and agencies in Central and Eastern Europe, the US and South America. ■

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A fresh outlook

OSEA, Asia's largest oil and gas event – taking place 27–29 November in Singapore – this year expands its focus on gas amid the region's growing liquefied natural gas demand. *World Expro* gains an insight on the occasion and the procedure behind the escalated focus.

Following a challenging period for oil and gas, Asia's biennial flagship industry event, OSEA, emerges this year with a fresh new look, as well as an expanded focus on the burgeoning gas value chain in Asia. Staging its 22nd edition, OSEA2018 will be held on 27–29 November in Singapore, at the Marina Bay Sands resort.

With more than 1,000 exhibitors from 48 countries and regions,

16 international group pavilions and 18,000 attendees expected to take part this year, OSEA will see the launch of a specialised segment at the exhibition – Gas Technology Asia – as well as new conference sessions covering the commercial aspects of increased demand and trade of liquefied natural gas (LNG) in Asia.

“What we have seen over the past few years of depressed oil

prices and tough business climate is a growing shift in Asia towards a focus on supplying for the LNG value chain. Aligned with the upturn in the demand for LNG, Gas Technology Asia will include suppliers for functions such as the transport, bunkering, treatment, and liquefaction and distribution of natural gas,” says Carol New, head of sales for maritime and offshore, UBM. >>

Brand-new sessions

According to GlobalData, 130 new crude and natural gas projects will start operations in Asia over the next eight years. By 2025, the projects will contribute around 518,000 barrels per day to global oil production and close to 11.5 billion cubic feet per day to global gas production overall.

As the event positions itself to support businesses in preparation for the oil industry upturn and bright gas market outlook, the OSEA2018 International Conference – aptly themed ‘From Survival to Growth in the New Era’ – has curated a programme that provides key strategies and business models to respond to market volatility, changing energy demands and industry disruption.

The keynote presented by Thom Payne, director of Westwood Global Energy Group, titled ‘The Future of Global Oil and Gas Supply and Demand Dynamics’, will delve into geopolitics and crude price movement, future exploration and production spending trends, strategic moves to survive market volatility, as well as the future energy landscape.

New sessions focusing on LNG include ‘Thought Leaders’ Panel: LNG Market in Perspective – An Asia Outlook’; ‘How US Global LNG Exports Will Impact the Asian Market: New Structural and Financial Considerations’; ‘LNG Shipping Options’; ‘FSRU & FLNG Latest Development in the Region’; and ‘Small Scale LNG and Bunkering in Asia: Opportunities, Challenges and Prospects’.

By the numbers

- The event boasts a packed conference and exhibition schedule over three days.
- Over 120 conference speakers and delegates will be on hand to lecture and mingle.
- More than 1,000 companies will be exhibiting from 48 countries or regions.
- 16 international groups and pavilions will be in attendance to debut products and services.
- The event will provide ample opportunity to network with trade attendees from over 60 countries and regions.
- Over 30 complimentary OSEA Tech Garage seminars will be available to attend.

As the oil and gas industry evolves through digital transformation, the conference will also feature sessions addressing issues surrounding the digitalisation of the supply chain. These include ‘From Electrification to Digitalisation’ and ‘Are We Doing Enough in Cyber Safety in O&G?’.

On the show floor

At the exhibition, the showcase will consist of the very latest solutions and services that support Asia’s oil and gas value chain. The third edition of OGmTech 2018 will also be held alongside OSEA. This serves as a strategic platform for international manufacturing technology and solution providers to connect with leading oil and gas equipment manufacturers and operators from Asia, as well as those from further afield.

First-time exhibitor at OSEA2018 Uniclimb Services, a Singapore-based

company that specialises in rope access work for rig building, non-destructive testing (NDT) inspection, servicing and maintenance for the marine offshore, oil and gas and structural maintenance industries, will showcase the RIEZLER robotic camera crawler system, which is designed for application in pipe and tunnel inspections. “Market sentiments have improved, and we feel it is a good time to increase our market presence in the region,” says Adrian Yeong, managing director of Uniclimb Services. “We are looking forward to OSEA2018 to help connect us with major drilling contractors.”

Also looking to capitalise on the upturn, long-time exhibitor and gasket, sealing and valve specialist Khong Lieng is returning with a much heightened presence. “The focus seems to be on onshore now. In fact, we’ve just secured a three-year contract with one of only two oil refineries in Vietnam, despite fierce competition from major contenders. As a licensed manufacturer of several major brands, we are able to combine their best qualities for the products under our own house brand,” says Edward Quek, group chief operating officer of Khong Lieng.

“We decided to get a bigger booth at OSEA2018 as we are contemporarily distributing more brands. These include large global brands, such as Klinger, Garlock, Valqua, Jeil E&S, JDV, Zuercher Technik, Greene Tweed and Seal Maker. We are excited to showcase our own new products as well, such as expansion joints and butterfly valves. OSEA is a great opportunity for us to build brand awareness, since we are well equipped as a gasket, sealing and valve specialist,” he concludes. ■



Blowing competition out of the water

PAMAS offers esteemed particle counters for injected water and hydraulic fluids. Set to showcase some of its products at OSEA in Singapore, on 27–29 November, *World Expro* gets an insight into what it has to offer.

PAMAS focuses on high-quality particle-measuring systems for particle counting and sizing. The company boasts a global reach, with worldwide activity and respect. Since 2001, PAMAS Regional Office – a subsidiary of Sintech Scientific – has promoted PAMAS products, and offered ancillary services. The support from Sintech Scientific has allowed PAMAS to provide technical support, such as installation, commissioning, user operating training, calibration and repair, and so much more to its clients.

PAMAS offers applications as far-ranging from oil and fluid contamination control, water analysis, online monitoring or lube oil and hydraulic fluids, water glycol and water in Christmas trees. Such applications are compatible with MacDermid Oceanic HW540, 443 443r and Castrol Transaqua among other industry standard control fluids.

PAMAS will be bringing a range of products to showcase at OSEA this year, such as the PAMAS FastPatch 2 GO, an automated filter membrane particle counting and sizing system that comes with a certification of ISO 4407 standard.

Additionally, the company will exhibit its portable particle counting system for water-based hydraulic liquids. This product is specifically geared towards the oil and gas industry, with two models – the PAMAS S4031 WG and S4031 GO WG – catering to particular needs. The final innovation is the PAMAS SBSS WG, a lab-bench particle counting system for water-based hydraulic fluids. ■

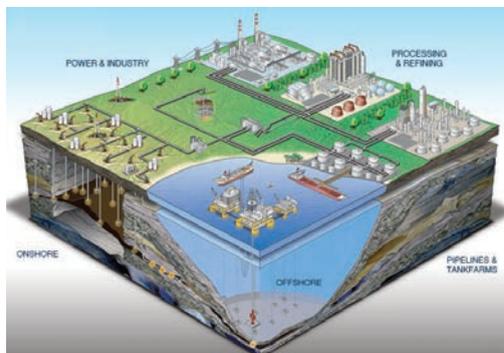
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Accelerating transformation

With creative partnership opportunities proving inimitably vital for future growth, **ADIPEC** is realising its full potential at this year's event, to be held on 12–15 November 2018. *World Expro* hears more about those succeeding in the industry and whats in store.

The decision by Abu Dhabi's Supreme Petroleum Council to offer six offshore and onshore oil and gas blocks for competitive bidding has proved to be enlightening. This represents a major advance in how Abu Dhabi unlocks new opportunities and maximises value from its hydrocarbon resources. With the first bid round planned to conclude in the months ahead, successful bidders will enter into agreements in 2019, granting exploration rights and, provided defined

targets are achieved in the exploration phase, have the opportunity to develop and produce any discoveries, alongside ADNOC.

The launch of these large licensing blocks is an important step for Abu Dhabi and ADNOC, as the Abu Dhabi International Petroleum Exhibition and Conference (ADIPEC) realises the full potential of its resources, maximises value for its stakeholders and accelerates the exploration and development of new commercial

opportunities. And, as the company expands its downstream portfolio, the new licensing blocks will reinforce long-term production growth ambitions and build on the successful legacy the company maintains as a leading upstream player.

The downstream growth strategy and licence blocks represent rare and exciting opportunities for investors to collaborate, as it further redefines and transformsthe ADNOC Group. >>

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Against the global landscape of accelerating change throughout the oil and gas industry, ADIPEC is the meeting point where thought leaders embrace change and capture new opportunities to deliver profitable market growth and value creation across the oil and gas supply chain.

On trend

Fundamental to this new thinking is the type of agile, creative partnership and investment models being implemented by ADNOC.

These new collaborative eco-systems enable sharing, innovation and growth, as the partners navigate the emerging trends that are shaping the industry.

DMG events and ADNOC – serving as the former’s host – extend a warm welcome to all of its exhibitors, visitors and delegates to the ADIPEC, which takes place at the Abu Dhabi National Exhibition Centre on 12–15 November 2018. Held under

the patronage of H.H. Sheikh Khalifa Bin Zayed Al Nahyan, president of the UAE, ADIPEC is one of the world’s largest, most important and influential oil and gas events that brings together industry stakeholders and experts to share knowledge and exchange ideas on a brighter future for the energy sector.

Building on the strength of the past 34 years, ADIPEC 2018 is shaping up to be another record-breaking year, bringing new features and enhancements.

On the exhibition side of the event, the 2018 edition will see the event grow to cover 155,000m² of space across 15 dedicated exhibition halls, hosting over 2,200 companies, including 38 NOCs and IOCs, and over 28 international country pavillions.

ADIPEC 2018 will see the launch of three new dedicated exhibition zones, covering Digitalisation, Heavy Machinery, and a dedicated Dive Zone in the Offshore & Marine Hall, with the

Digitalisation sector weaved into the strategic and technical conference programmes, thereby highlighting the event’s versatility and forward-looking nature. Key features of ADIPEC 2018 will include the Middle East Petroleum Club, while the Offshore & Marine subsector will host a new Middle East Maritime Club, which is an extension of the existing club, aimed at providing a dedicated and secure business and networking area for offshore and marine’s CEOs and business leaders.

Meanwhile, conference discussions will take place across several streams including global ministerial panels, global business leaders panels, C-Suite dialogues, plus strategic roundtables at the Middle East Petroleum Club.

The international conference programmes will welcome CEOs from all over the globe, span 200 sessions, 980 expert speakers and is expected to attract over 10,400 delegates. >>

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Revolve to evolve

The oil and gas market continues to evolve rapidly, presenting the industry with challenges and, at the same time, exciting new opportunities. ADNOC is embracing these opportunities, by transforming and strengthening the company, to make for a more resilient, efficient and performance-driven environment. In tandem, the company is investing in growth across its upstream and downstream value chains, with a 3.5 million barrel per day upstream production capacity target, that it will achieve by the end of this year, and an ambitious downstream strategy that will triple its petrochemical production capacity by 2025.

This growth will deliver multiple openings for new partnerships and attractive investments for those who appreciate the scale of the opportunity, who share the same values and who are willing to accompany the company on its journey. To maximise value from these opportunities, ADNOC is accelerating transformation, creating a new business model for national oil companies, while shaping and setting commercial terms that benefit ADNOC partners and customers.

ADNOC has driven down production costs, increased operational margins, and enhanced financial structure to ensure a smarter use of capital and assets. This has been matched by a rationalisation and culture change, aimed at raising operational efficiency, optimising unit costs per barrel, enhancing profitability and strengthening overall performance.

In parallel, the company has launched a new and expanded strategic partnership and investment model, and is proactively managing its portfolio of assets and capital, to unlock value and drive new growth.

Global industry growth

Since the last ADIPEC, two major opportunities have been announced for existing and potential new partners to participate in the next stage of developing the UAE and Abu Dhabi's hydrocarbon resources. In May, at Downstream Investment Forum, ADNOC unveiled plans to invest AED165 billion (\$45 billion) with partners, over the next five years, to become a leading global downstream player. The construction of an aromatics plant, a mixed feed cracker and a new refinery, along with upgrades to existing assets, will underpin the downstream strategy that will significantly expand its refining and petrochemical operations, and undertake highly targeted overseas investments to secure greater market access.

Building on the strengths and competitive advantages of the Ruwais Industrial Complex, ADNOC will create the world's largest and most advanced integrated refining and petrochemicals complex. The company will increase the range and volume of high-value downstream products, secure better access to growth markets and create a local manufacturing ecosystem that will significantly stimulate in-country value creation, private sector growth and employment. The strategy is expected to add more than 15,000 skilled jobs by 2025 and contribute an additional 1% to GDP per year. ■

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EGS has established an integrated management system which integrates several components: quality, environmental protection, occupational health and safety and radiological security in accordance with ISO 9001:2008, ISO 14001:2005 and OHSAS 18001:2008.

With 4,300 square meter of assembly floor split into two workshops, 4 x 50 tones, 2 x 12.5 tones and 6 x 10 tones cranes, 3 paint booths, 1 shot blast booth and top-class packaging equipment (laser alignment tools, Windrock analyzer, etc.) EGS has the capability of serving its customers for almost any kind of compressor package related project regardless the size or number of units required, focused on meeting the promised delivery date.

Over 100 compressor packages delivered worldwide on time in the last 7 years, EGS is continuing the growth phase aiming reach new markets together with increasing the production capability by expanding the assembly floor to 7,000 sqms by the end of 2018.

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Evolving ACFM

Over its 30-year history, ACFM technology has developed a solid reputation for accurately detecting and sizing surface-breaking cracks through paint and coatings. Since 2000, the AMIGO analog ACFM instrument has become a staple in a wide range of topside ferrous and non-ferrous NDT applications. A lot has changed in 18 years.

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Venture below the surface

Testing and inspection are the keys to preventative maintenance, which saves time and money in an industry that thrives on efficiency. **Eddyfi**, which specialises in non-destructive testing equipment, is helping to ensure the oil and gas sector avoids equipment failure without costly shutdowns.

Historical data shows around 60% of pipe leaks are caused by corrosion, which is just one of the causes of potential failure in critical equipment. Knowledge of corrosion and vulnerabilities in pipes and tanks can help to ensure that any threat to smooth operations – and to the safety of workers – is solved before it happens, and that is what Eddyfi helps operators to achieve.

The company specialises in non-destructive testing (NDT) equipment, specifically high-performance eddy current and electromagnetic solutions for the inspection of critical components and assets. Established in 2009 in Quebec, Canada, the company is developing eddy current array (ECA) technology for a range of markets, including oil and gas, transport and nuclear power, and for the past 30 years, one of its key subsidiaries, TSC, has been developing revolutionary alternating current field measurement (ACFM) systems.

“The original founders of Eddyfi have backgrounds in the inspection industry, particularly in electromagnetic inspection, and they saw a gap in the market for advanced electromagnetics.”

“The original founders of Eddyfi have backgrounds in the inspection industry, particularly in electromagnetic inspection, and they saw a gap in the market for advanced electromagnetics. They focused on one aspect of magnetic inspection, which is eddy current arrays, and basically developed that to its full potential,” says Dr Mike Smith, Eddyfi’s director of technology and innovation.

Eddyfi now has four subsidiaries, including Swansea-based Silverwing, which focuses on the inspection of storage tanks and vessels using magnetic flux leakage (MFL) techniques. In 2017, Eddyfi bought TSC, based in Milton Keynes, UK, to bring into its portfolio a technology that has been in development since the 1990s, in order to replace difficult-to-use methods of finding and characterising surface cracks in subsea environments.

Deep dive NDT

ACFM senses disturbance in the electromagnetic field created by cracks. The return signal is converted into alerts, immediately warning operators of any defects. Independent testing has shown ACFM misses fewer defects than

magnetic particle inspection (MPI), as well as the more conventional eddy current testing (ECT).

“These electromagnetic technologies are particularly good at the surface inspection of metals, looking for cracking – particularly stress corrosion cracking – and other damage mechanisms, but with some conventional techniques, you need to remove the paint or coating from a structure. So, if you are inspecting a well you may need to strip it right back to bare metal. Our technology enables you to do this inspection without removing the coating. So, there’s a huge potential for cost and time saving, and you are not interrupting the reason the coating is on there in the first place, which is usually as a barrier against environmental weathering,” remarks Smith.

Distinguish and extinguish

ACFM can support in-land-based safety and testing applications, but its key advantages come in when displayed within deepwater environments.

“We can distinguish between the wide variety of defects failure mechanisms. The advantage of this is not only that we can avoid unplanned, shutdowns and outages, but also that only tubes that are actually damaged are replaced. These technologies are typically able to characterise defects more thoroughly, so you have information about the depth of defects, beyond what you may see on the surface. And it’s typically the depth of a defect that is key when determining its severity and the remaining life of the structure, which informs the type of repair that is going to be done,” says Smith.

Improve, cut and save

“The two main technologies are ACFM, which is excellent at detecting surface breaking cracks through the subsea paints and coatings, and the pulsed eddy current (PEC) system, which can detect corrosion under insulation and thermal jackets subsea. And TCS has developed a range of tooling for ROVs that has been used on a lot of different sorts of different geometries subsea. The advantage here is primarily in safety,” he adds.

In the harsh subsea environment, improving safety, cutting costs and saving time are high priorities. The esteemed output of Eddyfi belies use of the technology to achieve all three of these goals. ■

Further information

Eddyfi
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- Harsh conditions



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Making the instant grade

In the oil and gas, chemical and power generation industries, preventing leaks and spillages caused by component failure is of vital importance. A reliable and comprehensive positive material identification (PMI) programme is essential to ensuring safe plant operation. **Olympus** details its Vanta XRF technology that renders PMI programmes smoother and quicker than ever.

The key to running a successful PMI programme is adjusting for the specific challenges of the industry. In the oil and gas industry, harsh conditions and the resulting risks of damage are big challenges for inspection equipment. Furthermore, due to the scale of a typical plant, traceability and short measurement times – without compromising on reliability – are also critical for success.

Instant grade and composition identification

In the oil and gas industry, pipes, solder, welds, connectors and screws all have to be made of the correct alloy for their application. Due to high temperatures, high pressures, mechanical stresses and corrosive substances, use of the wrong type of alloy in one component can jeopardise the safety of an entire pipeline or vessel. In a comprehensive PMI programme, all these components are tested before operation and as part of in-service inspections or when needed – for example, in the case of a missing certificate.

With the use of XRF technology, this type of alloy identification can be carried out in seconds. XRF spectra reveals the relative abundances of metals, which are then automatically checked against a preloaded library of alloys and grades. This approach enables fast decision making and saves time on PMI inspections.

The sensitivity of XRF analysers also makes them well suited for detecting trace elements. This feature enables XRF analysers to be used in other applications, such as corrosion inspection. For example, the presence of trace elements such as chromium, nickel and copper in carbon steel can indicate corrosion in hydrofluoric alkylation units, or carbon steel with low content can exhibit accelerated and non-uniform corrosion due to the known sulfidation corrosion process.

Traceability and reliable report generation

A key challenge in the inspection of large plants and structures – such as long pipelines – is the traceability of measurements. Even when measurement results are generated quickly, collating the data into detailed reports can make PMI inspections laborious and time-consuming. The number of measurements involved also increases the risk of human errors in report generation.

Advanced XRF analysers are equipped with GPS, wireless connectivity, Bluetooth and cloud storage to simplify the creation of inspection reports and improve measurement traceability. The combination of GPS and timestamping of all measurements saves time on reporting



XRF analysers boast GPS, Bluetooth and cloud storage to ease the inspection process and improve traceability.

and reduces the risk of errors, and easy internet access enables automated data sharing and archiving.

Dealing with the elements

The working conditions on industrial plants are often tough for inspection equipment. Damage due to water, dust, drops or shocks is highly likely when unsuitable equipment is used. Also, due to the layout of a plant, it is often necessary to inspect in hard-to-access locations.

Designed for portability and damage resistance, XRF analysers are well equipped to handle the harsh conditions of oil and gas plants. The devices are lightweight and can be carried in one hand, or stored in a holster and worn on a belt. Additional features such as IP ratings, a design made to pass a drop test, detector shutter protection and cooling fans make XRF analysers highly suitable for in-service testing.

Designed for industry

Olympus's Vanta XRF analysers fulfill the requirements for a reliable, efficient PMI programme in oil and gas plants. The analyser's drop-tested, rugged design and IP64/65 rating improve the return on investment by reducing the risk of damage. These features, combined with fast results that are both accurate and repeatable, underline its suitability for a PMI programme that helps to avoid part failures and ensure plant safety and profitability. ■

Further information

Olympus
www.olympus.co.uk



Paper over the cracks

Even the tiniest of cracks in a pipeline can carry catastrophic consequences for operators. Pipeline integrity should be top of the priority list, as **Stuart Clouston**, in-line inspection product management leader, process and pipeline services, at Baker Hughes, a GE Company, and Newcastle University's **Dr Phil Hopkins**, discuss with Ross Davies.

From the very moment a pipeline is commissioned, it starts to deteriorate. Even with the best protection, systems and coatings, corrosion sets in. Over time, this will eventually compromise the pipe wall's integrity. However, despite this slightly gloomy statement, today's operators have new technologies available to them that allow them to not only detect defects but also bring them to heel.

In this respect, the oil and gas industry actually has much to cheer about. The latest figures suggest that pipeline failures are decreasing, suggesting a pervasive safety culture. However, the operators cannot afford to rest on their laurels. Even a minuscule crack on a pipeline – it may be almost invisible to the eye – can, if not treated, be catastrophic.

Traditionally, the leading cause of pipeline failure is damage resulting

from outside force, which accounted for 35–50% of incidents in Europe and the US between 1970 and 2001. It still remains a serious challenge, as third-party damage – whether it be accidental or intentional – tends to still go unreported at the time of incident, allowing defects to fester over time.

According to the Pipeline & Hazardous Materials Safety Administration (PHMSA) – which comes under the US Department of Transportation and publishes statistics on the causes of pipeline incidents and failures – between 2004–18 the main causes of pipeline incidents were excavation damage (33%), incorrect operation (11.9%), other outside force damage (6.8%), manufacturing and equipment failure (6.9%), corrosion (5.6%) and natural force damage (4.6%).

The damage done

Damage by third party is the most common cause of pipeline incidents. What much of this boils down to is solid integrity management, as much as the pipeline itself. Pipeline failures aren't necessarily related to age; a newly commissioned project carries just as much risk as a pipeline that has been in operation for decades.

Better pipeline integrity has also been facilitated in recent years by the introduction of new laws and regulations. As aforesaid, this has been twinned with new technologies coming to the market, such as smart tools for the detection of cracks. With the rise of the internet and social media, communication channels are also better than ever before, operators can be updated on a pipeline failure almost instantly. Staff have reams of technical information at their fingertips.

As the world's first and only full-stream group, Baker Hughes, a GE Company, uses advanced technology to deliver pipeline safety and integrity. The company has built a reputation as a provider of reliable inspection data, with its solutions dating back to the development of magnetic flux leakage tools in the 1960s to manage corrosion and metal loss.

“Historically, theft has been endemic in countries such as Nigeria and Mexico, but it is now becoming a worldwide problem. It is an increasing worry in Europe.”

– Dr Phil Hopkins

The group's technologies allow the accurate location and highlighting of potentially dangerous cracks, and the identification of stress corrosion and cracks of unknown gestation. It also employs engineering techniques to predict rupture pressure, which occurs when adjacent cracks interact.

Stuart Clouston, in-line inspection product management leader, process and pipeline services at Baker Hughes is joined by Dr Phil Hopkins, one of the world's foremost pipeline experts, and a



New technology arriving into the market is set to reduce and repair instances of pipeline failure. With the internet having proved to be a vital tool in communicating any damage.

visiting professor at Newcastle University, to discuss another of the upstream segment's biggest headaches around pipeline integrity increasing rates of third-party damage. Oil theft reputedly cost the Chinese oil industry more than \$124.6 million in one year alone, while between 2002–09 one unnamed company encountered 19,804 cases of oil stealing, involving drilling into oil pipelines, as well as 12,167 cases of direct theft from production wells.

Companies that fail to tackle these are at risk of losing out on billions of dollars.

Baker Hughes has developed a technology, ThreatScan, which is able to assess construction and third-party damage and product theft. In the event of any impact on the pipe wall, acoustic waves are created, of which ThreatScan measures the timing and magnitude to determine the location and severity. Data is then transmitted to a central system for detection analysis and alarm confirmation. This all takes places

within a few minutes. Another hot topic is line piggability. Pipeline inspection gauges (commonly abbreviated to PIGs) are devices mostly used to clean or clear the line of debris, which in turn allows a better flow of the product through the line while reducing the likelihood of contamination.

Smart PIGs are coming under increasing demand as operators look to detect the various elements of their pipeline. These devices are able to amass an array of information on everything from temperature and pressure to corrosion and metal loss, diameter, bend and curvature. This information is then processed to provide a clearer picture of a pipeline's integrity.

This little piggy

Aside from issues caused by third-party sources, issues regarding the breakage or splitting of pipes can cause serious setbacks – with labour and economics taken into equal consideration.

Clouston knows all too well that cracks can develop, and where is most likely to be affected. “The types of cracks most likely to develop in operating pipelines are stress corrosion cracks (SCCs), fatigue cracks, hydrogen-induced cracks and sulphide corrosion cracks. They can occur in the base material of the pipe, in welds and in the heat-affected zone adjacent to welds,”



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says Clouston. “Cracks can also appear in substandard axial and girth welds, and can occur in conjunction with other flaws such as dents, gouges and corrosion. Although a crack may be almost invisible to the eye, it can still weaken a pipeline enough to cause leaks or even failure.”

Hopkins agrees with Clouston, stating, “Today, the most common cracks leading to failures are cracks grown by fatigue, cracks caused by a combination of stress in the pipeline and corrosion. These are SCCs.” The threats posed by these cracks are managed by pipeline operators through a winning combination of good operating practices, high-technology inspections and repairs.

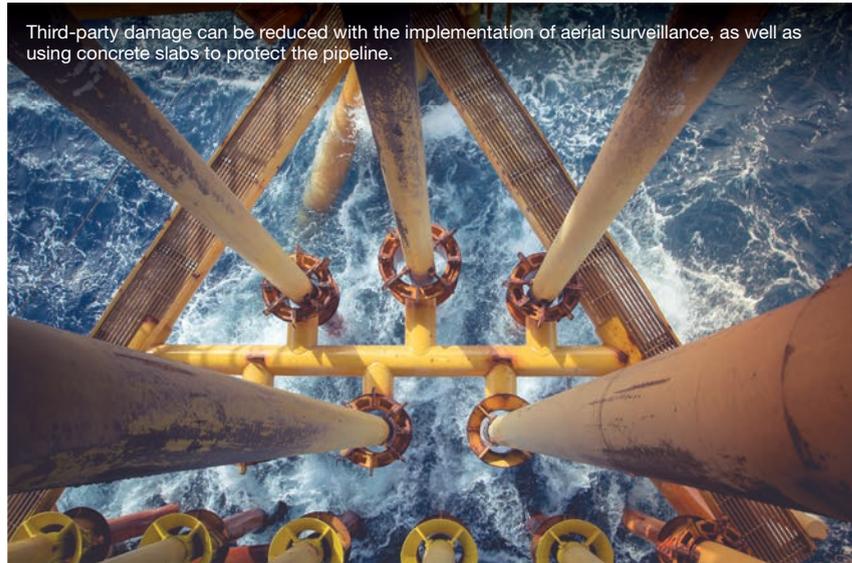
“With regard to the aforementioned unpiggable pipes, pipelines around the globe cannot be inspected with in-line inspection tools, this is due to tight bends, multidiameters and plug valves, among other challenging features. However, inspection technologies can be engineered to overcome some of the common unpiggable challenges but our CPIG inspection tool, with its dual diameter capabilities, short length and low drag operation is particularly suited for these lines previously considered decidedly unpiggable.”

“ Product theft can be dangerous, with several attempts at theft resulting in casualties among perpetrators and bystanders alike. ”

– Stuart Clouston

Clouston provides a solution, remarking that, “Baker Hughes offers a range of services to help operators meet these challenges, minimising disruption and replacement costs while meeting regulations. These include feasibility studies and customised cleaning programmes to determine the state of debris and build-up in a pipeline that could interfere with in-line inspection.”

In agreements, Hopkins ascertains that new pipelines are designed to be able to accommodate in-line inspection. These ‘smart pigs’ are facing an increasing demand, as older pipelines lack the



technology, due to subsized valves, among other issues. However, Hopkins is optimistic in the capacity to refurbish older tools: “These older lines can be modified and upgraded,” he concludes.

Crash the third party

Third-party damage continues to be a threat to many pipeline operators. However, adoption of recognised good practices and intelligent technology can minimise the threat. Technologies such as aerial surveillance or use of protective measures, such as placing concrete slabs over a pipeline, are efficient with third-party damage.

“A far bigger threat to mitigate is theft,” says Hopkins. “There has been a startling increase in theft of product from pipelines. Historically, theft has been endemic in countries such as Nigeria and Mexico, but it is now becoming a worldwide problem. It is an increasing worry in Europe and also a problem in countries where poverty is the driver, or where high fuel costs are a factor, or where organised gangs can steal on an industrial scale and create major outlets for the stolen product.”

“Accidental or intentional third-party damage is especially dangerous for

operators because it often goes unreported at the time of occurrence, allowing defects to deteriorate for months or even years,” Clouston agrees. “Product theft can be extremely dangerous with several attempts at theft resulting in casualties among perpetrators and innocent bystanders alike. Product theft also poses a threat to the future integrity of a line, and can impact pipeline operator’s revenue.”

To combat the prevalence of third-party intrusion, Baker Hughes’ ThreatScan technology is designed to detect impacts to the pipeline – these could be in the form of an attempted product theft or an anchor strike to a subsea pipeline.

An impact on a pipe wall will create acoustic waves. The ThreatScan technology measures the timing and relative magnitude of these waves to determine the impact location and severity. Data is immediately transmitted via any type of communication network to a ThreatScan supervision system for analysis and expert alarm confirmation.

The customer is notified within a few minutes to enable fast and effective reaction to the strike to protect the pipeline and to determine the cause of the strike. The sensor equipment attaches easily to above-ground pipeline features so no excavation is required and the system can be easily retrofitted to existing pipelines. ■

Oiler's core business is the inspection of drill collars, drill pipe, heavy-weight transition drill pipe, and other premium downhole tools. Our professional inspectors are DS-1 certified, and conduct inspections compliant with standards API RP7, TH Hill DS1 and NS-2 standards.



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The sensible approach

Marine science expert **Neptune Oceanographics** detects leaks in everything from subsea pipelines, risers and templates to control systems. If you have a leak in deep or shallow waters, in any sort of pipe, its state-of-the-art subsea leak detection systems will find it.

It is important to conduct leak inspections periodically, as maintaining pipeline integrity is vital to avoid serious failures that can result in suspended production, damage to the environment and costly repairs. Neptune Oceanographics offers an array of detection services capable of identifying even the tiniest leaks in equipment.

The company was founded in 1999 to provide specialised techniques and services that enable easy, efficient and reliable detection of leaks in submarine pipelines.

Neptune is continually expanding its research and development programme in order to devise new detection methods and technology that will benefit the oil, gas and subsea sectors.

Over the years, it has pioneered numerous approaches to leak detection. Its submersible fluorometric sensors have been fine-tuned to remove reliance on visual observation, eliminating most of the problems associated with black lights. This focus on innovation continues to this day.

All four senses

The four senses of pipeline leak detection are sight, sound, smell and touch. Any combination of the following techniques can pinpoint a problem:

- **Sight – fluorescent:** Neptune’s fluorescent detection techniques use tracer dyes, or the natural fluorescence of crude oil, to spot leaking fluids at low concentrations. Its submersible fluorometers are extremely sensitive and can register detection dyes at concentrations that are so low as to be invisible to the naked eye or underwater cameras.
- **Sound – ultrasonic:** ultrasonics ‘listen’ for the audible waves generated by leaking fluids, differentiating between background noise and the sound of fluid passing through a pressurised orifice.
- **Smell – methane:** methane leakage is not identifiable using fluorescence. Neptune’s SNIFFIT detection system, however, can ‘smell’ leaks and display the data in real time. SNIFFIT can also detect all gaseous hydrocarbons in water.
- **Touch – thermal:** flowline water is normally warmer than the seawater that surrounds it. This enables Neptune’s sensors to detect leaks by ‘feeling’ for temperature variances.

Hydrocarbon leakage requires different detection methods for oil, gas and multiphase. Neptune’s long-range UV fluorometer can detect crude oil pipeline leaks, lubricating oils, hydrocarbon-based control fluids and so on in a gas environment, while SNIFFIT is able to locate hydrocarbon leaks in water. The detection systems may be used together in multiphase applications.



Neptune Oceanographics deploys a range of vehicles and sensory equipment to locate underwater pipeline leaks.

Neptune can help

Neptune’s specialised subsea leak-detection service has won it a range of high-profile clients, including Total, BP, ExxonMobil, Shell, Statoil, nkt cables, Subsea7, IKM, Saipem, Halliburton, Oceaneering, PetroCanada, Husky Energy, Technip, Deepocean, Fugro, Bibby, Ocean Installer, Baker Hughes, C-Innovation, Canyon Offshore, Reliance and many others.

“Neptune is continually expanding its research and development programme in order to devise new detection methods and technology that will benefit the oil, gas and subsea sectors.”

“Neptune’s system was able to detect small leaks from our SCMs, and easily detected a step change when the selector valves within the SCM were operated,” commented Shell in a testimony. “It backed up suspicions and certainly proved a reliable method of leak detection. Considering the short time it had to mobilise, the ROV interface and familiarisation was faultless.”

Further information

Neptune Oceanographics
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info@neptuneoceanographics.co.uk



Reinvent the wheel

Using automotive and aeronautical technologies, **Bronswerk Heat Transfer** has developed the innovative Whizz-Wheel fan, and in its turn helping to lower energy consumption, increase output and lower noise in the air cooler system sector.

Any air cooler system needs to be as efficient as possible, with low energy consumption, high output and preferably low noise. That is exactly why Bronswerk Heat Transfer developed the innovative Whizz-Wheel solution. The company based the new fan on automotive and aeronautical technologies, and manufactures components with maximum quality and precision. As a result, the Whizz-Wheel fans emit 50% less vibrations when compared with conventional fans that have been balanced. This results in significantly lower maintenance costs and improved plant reliability.

The Whizz-Wheel offers maximum efficiency because of the ideal rotor design, its smaller hub and the aerodynamically shaped blades and twisted curves. The fan has no blade tips, no gap between the fan tip and the fan house, and additionally boasts a fan inlet of an optimised shape with increasing radius.

Customers can deploy Whizz-Wheel-based equipment in greenfield projects. For example, it can be used for improving plant performance; reducing noise emission, power consumption and vibrations; minimising maintenance costs and increasing plant availability. The technology can be used in brownfield projects for the same purposes.

“ The Whizz-Wheel offers maximum efficiency because of the ideal rotor design, its smaller hub and the aerodynamically shaped blades and twisted curves. ”

Dramatically increased performance

Air-cooled equipment is extremely sensitive to changes in airflow and ambient temperatures. Global warming, equipment ageing and more demanding processes have led to a need for increased performance. The Whizz-Wheel fan system can increase performance by up to 30%. Bronswerk Heat Transfer achieve this by using the high efficiency of its design and fully exploiting plenum recovery – 30–40% more air has a huge impact on thermal performance of existing coolers. For air-fin cooler sites, it is able to remove performance bottlenecks on summer days, allowing full production throughout the entire year. For air-cooled steam condensers, it yields year-round lower turbine pressure and more generator output.

The reduction of plot space

In offshore or brownfield applications, plot space is scarce. This is why the reduction of unit size is a major factor in



Bronswerk Heat Transfer's Whizz-Wheel boasts the maximum efficiency available in its field due to its aerodynamic blades.

reducing capital expenditure. The Whizz-Wheel fan system can save up to 30% on plot size, providing size and weight relief for all offshore or brownfield solutions. Less weight is particularly important in offshore applications. Every kilogram on the topsides requires 3–5kg in the substructure. The savings are enormous if taken on board in the early design of a vessel or platform.

The reduction of noise and power consumption

There is no longer the need to choose between less noise or reduced power consumption, as the Whizz-Wheel simultaneously delivers on all accounts. This aforementioned reduction is up to 50% lower power consumption and 20dB less noise respectively.

Customers are invited to speak to the Bronswerk Heat Transfer engineers to find out how the company can make the seemingly impossible happen. The Whizz-Wheel design is efficient, bringing down parasitic loads with no strings attached. The Whizz-Wheel is so silent that motor, transmission and even airflow noise become the dominant factor in noise calculation. This way the customer is guaranteed the lowest noise levels. ■

Further information

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sales@bronswerk.com



Enter the robots: a new approach



The Oil & Gas Technology Centre (OGTC) is looking into new methods of vessel inspection.

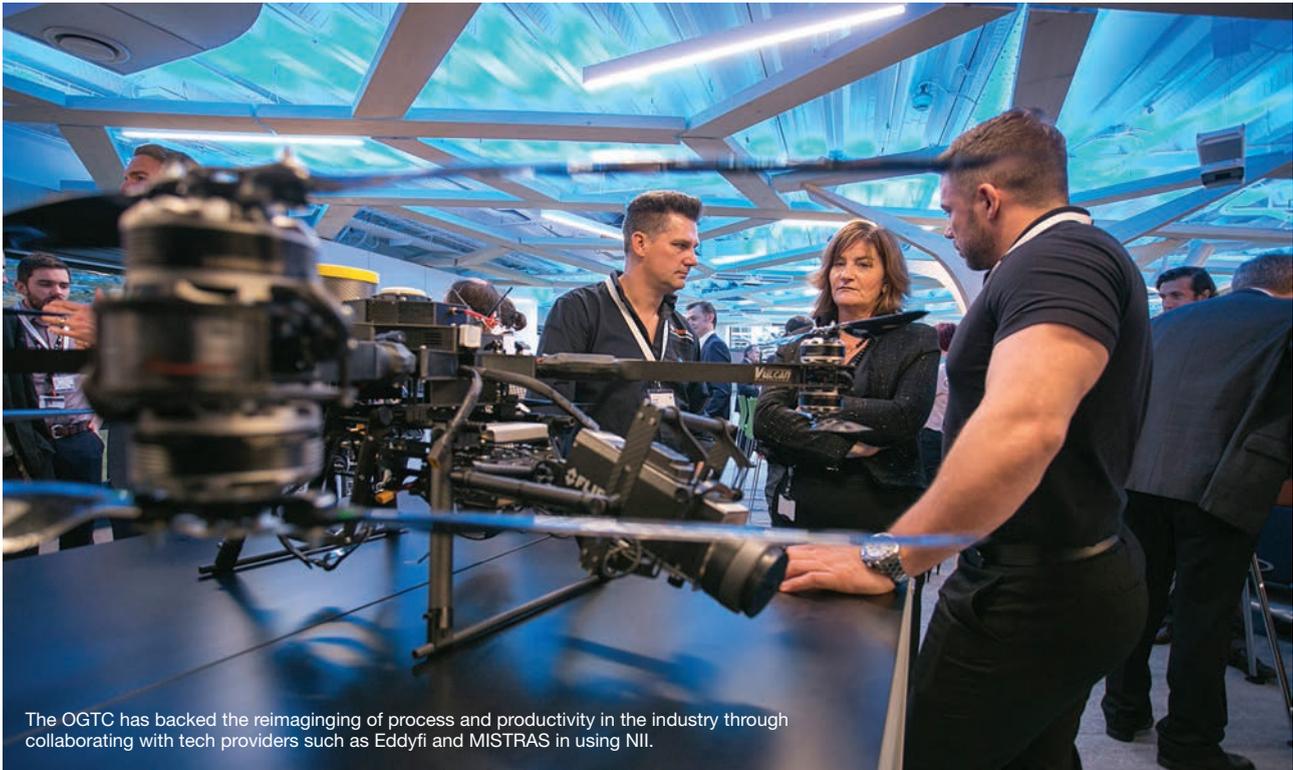
The UK Oil & Gas Technology Centre has invested in three robotic technologies to help transform pressure vessel inspection on offshore rigs. Ross Davies looks at how these new projects might help turn a traditionally burdensome undertaking into a more cost-efficient and safer task.

When it comes to assessing the condition of their process vessels and tanks, most North Sea operators traditionally use intrusive inspection techniques.

This commonly necessitates shutting down the platform and sending an engineer into the vessel to carry out a manual inspection. The method is far from ideal, and often results in loss of

production; platform shutdowns are costly – not to mention hazardous.

It is high time operators working on the UK Continental Shelf (UKCS) looked at newer, more innovative ways of vessel inspection, claims the Oil & Gas Technology Centre (OGTC). According to a recent survey by the Aberdeen-based group – alongside engineering group ABB – the adoption of non-intrusive inspection (NII) technology could deliver increased



The OGTC has backed the reimagining of process and productivity in the industry through collaborating with tech providers such as Eddyfi and MISTRAS in using NII.

production and lower maintenance costs worth up to £242 million per year to the UKCS.

Up to 80% of vessels currently operating in the North Sea could be examined using NII – without requiring a shutdown – claimed the study. Adoption of the available technology, however, remains low.

“The application of robotics in offshore oil and gas is almost limitless, but as an industry we’ve only scratched the surface of what’s possible.”

– Rebecca Allison, OGTC

New ideas and joining forces

The OGTC is looking to remedy the disappointing status quo concerning NII awareness. In April 2017, the group launched its first Asset Integrity ‘Call for Ideas’ initiative, which identified pressure vessel inspection as a “crucial challenge to maximising economic recovery from the UK continental shelf”.

In March, the centre announced it had invested in three robotics projects in collaboration with inspection specialists Sonomatic and the

University of Strathclyde, with an aim to completely transform the process.

The OGTC is currently working on two separate projects with the University of Strathclyde. The first is concerned with developing a new robot crawler, equipped with 3D laser scanning and non-destructive testing technology.

The solution will construct a virtual, dynamic 3D representation of the inspection site, allowing remote operation. The second project with the university is focused on the use of drone swarms, which are as commonly used by the military, as well as for logistics activities as a safer, more flexible and cost-effective alternative to the classical approach of human inspection.

The aim is to develop “the next generation of robotic NII technology, with improved agility and autonomy compared with existing systems”.

The benefits

“The application of robotics in offshore oil and gas is almost limitless, but as an industry we’ve only scratched the surface of what’s possible,” explains Rebecca Allison, asset integrity solution centre manager at the OGTC.

“Companies could reimagine their business processes and transform productivity. But this will only be possible if we understand the challenges and collaborate on the potential solutions.”

The OGTC and Sonomatic have worked together before. Last year, the latter was one of the technology providers – along with Eddyfi and MISTRAS – involved in three NII trials jointly organised by the centre and Total E&P.

The trials, which took place on two process pressure vessels on Total’s Elgin Franklin platform – while the vessels were online and operating – revealed NII delivered the same outcome as traditional intrusive methods (also tested as a benchmark), but without the costly shutdown and personnel entry into the vessels.

“NII allows vessels to be inspected in service,” says Mark Stone, Sonomatic’s integrity services manager.

“This means production is not disrupted. The cost of the inspection is also typically lower than cost of preparation and internal inspection. It also avoids man entry into vessels, meaning the major hazards of inspection are removed.”

So, what are the dangers facing engineers when it comes to traditional intrusive inspection techniques?

“The cost of the inspection is lower than the cost of preparation and internal inspection. It avoids man entry into vessels, meaning the major hazards of inspection are removed.”

– Mark Stone, Sonomatic

“There are significant risks associated with confined spaces and managing the hazardous substances encountered,” says Allison. “That’s exposure to everything from naturally-occurring radioactive materials, to mercury and pyrophoric scale.”

“Confined space entry is one of the biggest risks in operation of pressure equipment, so operators want to avoid this,” adds Stone.

Limitless potential

The potential of robotics cannot be underestimated, believes Allison. It is an area of technology that carries the potential to not only make a traditionally burdensome task infinitely easier, but to eventually better the general performance of an entire industry.

“Robotics have the potential to transform the offshore oil and gas industry,” she claims. “We have countless repetitive, dirty and potentially dangerous tasks carried out every day. Integrating robots for these tasks will help upskill our workforce and improve job quality.”

“Projects like this will help inspire and attract the next generation of oil and gas workforce. NII of process pressure vessels has a direct impact

on maximising economic recovery. Every vessel is intrusively inspected; it has to be shutdown, resulting in lost production. NII means the condition can be assessed while the vessel is online and operating.”

For Stone, the new project represents a vital opportunity for the offshore sector to capitalise on the significant advances in robotics technology.

“The aim is to develop a scanning system for NII that will provide improvements in inspection speed – reduced time of inspection – and reduce manpower requirements to complete NII,” he says.

“The system developed represents the next generation of inspection technology, taking advantage of recent developments in automation, robotics, navigation and inspection capabilities.”

This March also saw the launch of the OGTC’s second Asset Integrity ‘Call for Ideas’. The focus this time around is on corrosion under insulation (CUI), a problem that can be ascribed to over 20% of the major oil and gas incidents reported within the EU since 1984, says the OGTC. By the centre’s estimates, CUI costs the UK economy £28 billion every year. ■



The industry is finding innovative ways to capitalise on significant advances in robotics technology.



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Interactions in oils

BEA Technologies is a world-leading provider of automatic filtration systems and filters for downstream operations. The operators can rely on BEA's advanced solutions to meet refining challenges and realise sustainable productivity. Here, *World Expro* receives an explanation behind the formation of micelles and relative aggregates in heavy oils.

The high-boiling constituents of petroleum are influencing the physical properties of crude oil, especially in the case of filtration. In particular, asphaltenes and resins are characterised, as high-molecular-weight materials, with the tendency to form aggregates in the crude oil and intermediates.

The aggregates are produced by the presence of intermolecular hydrogen bonding between the asphaltenes and the resins. It appears that when resins and asphaltenes are present together, hydrogen bonding is one of the mechanisms by which resin-asphaltene aggregates are achieved and resin-asphaltene interactions are preferred over straight asphaltene-asphaltene interactions. As a result, asphaltenes and resins are forming a complex mixture of constituents of higher molecular weight.

Interactions of asphaltenes and resin products

The interactions between polar aromatics, resins and non-polar are leading to the formation of micelles. The micelle center is formed from polar molecules of asphaltene with pronounced aromatic nature, which are then progressively surrounded by other more soluble molecules – of a less aromatic nature – places between the center, and the periphery.

It has been observed that the resins play an important function in stabilising the asphaltenes in the crude oil. Since the asphaltenes are incompatible with the oil fractions, asphaltene dispersion is attributable mainly to the resins. Under unfavourable conditions the asphaltene species might aggregate into clusters that are unstable and can precipitate or maybe easily become stuck to any surface during filtration or other separation process.

The model requires that the asphaltene micelles are composed of an insoluble molecular core that associates with the resins is providing steric stabilisation against flocculation and precipitation. The elementary micelles units can further cluster into larger particles similar to flocs.

Influence of solvent and heat

An important corollary of petroleum composition is that the mole fraction of the resins is always larger than that of the asphaltenes and hence the micelles are expected to be richer in resins.

The addition of non-polar solvents to crude oil can procure the reduction of solubility parameters or polarity of hydrocarbon medium. The micellar solubilisation of the resins is leading to dissociation of the resin-asphaltene complexes, resulting in destabilisation of the asphaltenes, and relative precipitation and phase separation. The size of the asphaltene



Duomatic is an automatic feed filter designed for use in heavy oil treatment.

agglomerates can vary as a function of the temperature, the asphaltene concentration, as well as the presence of the resins. This establishes that the self-association of the asphaltenes is reversible and that the molecular size in the solution state results from a thermodynamic equilibrium between primary particles and reversible aggregates.

It has been recorded that the formation of micelles and aggregates is highly probable in the presence of asphaltenes and resins. The amount and size of the aggregates are influenced by the temperature and the total storage time in tanks. For temperature over 150°C the aggregates are reduced and generally dissolved, and for temperature below 80–125°C, the formation of aggregates might be consistent, depending on the origin of the oil, procuring a fast clogging of the filter media.

Specific filtration design

The temperature and process conditions are even influencing the average size of the aggregates. Generally, it has been registered that the specific filtration design adopted by BEA Technologies is less sensible to the clogging by retention of asphaltene and resin conglomerates due to the fact that when the pressure drop, through the filter media, increases the aggregates are partially disrupted and the asphaltenes are able to be extruded on the other side of the filter media – something that is not possible for hard solid particles and contaminants which are plugging catalysers.

The situation to be avoided is the formation of a compact layer of asphaltenes and resin aggregates on the surface of filter media, as this can lead to a fast clogging of the filter surface with a pressure drop increase and sudden decrease of the flow. The usual backwashing cannot clean out the compact layer formed and manual cleaning is required to soften and remove the compact layer. ■

Further information

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The heat of the moment

Heatec have been supplying the offshore oil sector with specialist fluid and convection heaters since 1977. *World Expro* talks to Adriano Santos, a sales manager at the company, about how its products stand up to the extreme conditions experienced on platforms.

Oil producers are picky for good reason, according to Adriano Santos. As a sales manager with Heatec, one of the world's leading suppliers of heaters for platforms and other offshore facilities, he knows full well that the extreme conditions experienced on board demand only equipment of the highest quality.

"Normally, it's required to be explosion-proof, or suitable for Class V areas," he says, referring to the designation of areas where combustible gases are present. "The threat of corrosion means that they require special painting, and all sorts of other redundancies and accessories to make the heater more reliable."

Production under extreme conditions

Heatec works hard to ensure its products can stand up to the dangerous conditions normally encountered on an offshore platform. A typical heating system – one or two heaters, a pump system and an expansion tank with an output of ten million BTU per hour – is built with PLC controls housed inside NEMA 4X stainless steel panelling with Z-type purging, a CO₂ fire suppression system, heat sensors and special paint that resists water corrosion. Heatec is one of the sectors largest suppliers of package heaters, which emerge out of the factory fully assembled and readily tested. "As you know, real estate on offshore platforms is valuable," adds Santos. "A packaged unit, for them, is ideal."

“Offshore oil producers need to rely on suppliers that not only have a sense of tradition, but also the financial strength to support them in the future when they need it.”

Heatec's products are designed to work in the most extreme climactic conditions. The company's heaters can be found as far afield as the baking heat of the Sahara to the frozen wastes of northern Alaska. In the case of the latter, Heatec prepares its products by using either special materials, like low-temperature steel, or insulation equipment. "We can offer instrumentation and components that are designed and rates to -50°C," says Santos. "Alternatively, you have the option of enclosing everything in a packaging we call the 'dog house', which is heated to an appropriate level."



Heatec's products are meticulously planned and produced to best brave the un hospitable conditions of an offshore platform.

Ready for battle

That guarantee against equipment failure in extreme conditions is bolstered by Heatec's army of engineers. "Most of the other heater companies that have been playing in our market are much smaller, and do not possess an engineering group of the same size," says Santos. "At Heatec, we have a relatively large team of 30 engineers, who stand ready to tackle any challenge."

It's all part and parcel of the service customers sign up for at Heatec. "Our customers don't pay anything for that service," explains Santos. "Additionally, we have a fully equipped training facility with two rooms housing extensive simulation and heater repair equipment. Each room can house up to 48 people, and we make those facilities available to our customers all year round."

In operation since 1977, Heatec's reputation among offshore oil producers as a reliable partner in high-profile projects – some costing billions of dollars – is unrivalled in the sector. These qualities are underwritten by the company's core values: devotion to meeting the needs of the customer; honesty and integrity; respect for all individuals; and a commitment to the preservation of the entrepreneurial spirit, as well as to safety, quality and productivity as a means to guarantee success.

"Offshore oil producers need to rely on suppliers that not only have a sense of tradition, but the financial strength to support them when they need it," explains Santos. "We have the tradition, we have the brand recognition and we have that strength," he concludes. ■

Further information

Heatec
www.heatec.com



A new lease on life in Nova Scotia

Offshore exploration and subsea production is a major topic, with operations getting under way in hot spots around the world. As the industry seeks new cost-efficient reserves, the economic benefits are pushing many regions to attract the gaze of energy majors. Jim Banks speaks to **Sandy MacMullin** of the Nova Scotia Department of Energy and Mines about the prospects on Canada's eastern shoreline.

Around the world, many contracts for offshore exploration and subsea production are currently being awarded, and there is intense competition among the different regions to attract energy majors with the promise of new production potential. Norway has awarded 78 contracts for exploration in the North Sea, Brazil is conducting a round of auctions for offshore discoveries, and Guyana's offshore assets are being split and sold. The area around eastern Canada – Nova Scotia and Newfoundland – has also attracted attention with the promise of plentiful deposits.

For Nova Scotia in particular, an analysis of seismic data and information generated

by previous exploration efforts off the coast suggests great potential, and there is keen interest in what happens with BP's current well. Earlier this year, BP received approval from the Canada-Nova Scotia Offshore Petroleum Board (CNSOPB) to drill a deepwater exploration well – Aspy D-11 – on its exploration license.

“For offshore Nova Scotia, there is eight billion barrels of oil potential and 120 trillion cubic feet of gas potential,” says Sandy MacMullin, executive director of the petroleum branch at the Nova Scotia Department of Energy and Mines.

“Upon completion of its current well, any successful announcement by BP would draw the eyes of the world to Nova Scotia.”



MacMullin leads the region's efforts to identify and market investment opportunities to oil and gas companies. His team coordinates the ongoing programme of geoscience research work to investigate areas of risk, as well as high-impact and quick turnaround items, and oversees the gathering of deep-sea core samples to analyse them for hydrocarbons. He also works on the development of policy and regulations.

"We have made use of the data and refined our work, though there are still some interpretive ambiguities," he explains. "We have had to extrapolate shallower water interpretations into most of our deepwater areas. With the recent Shell wide azimuth seismic data, and the Monterey Jack and Cheshire deepwater wells, we are able to analyse and update deepwater interpretations for oil and gas potential. This is a competitive market. A decade ago, we felt we were competing with Norway and the Gulf of Mexico. We now realise that every region has different fiscal, geological and political risk."

Last year, Shell announced that it would close operations at the Monterey Jack exploration well, and that deepwater wells did not discover commercial quantities of hydrocarbons. However, MacMullin's team is keen to build on the history of the region, which proved successful in the shallower waters around Sable Island.

“ For offshore Nova Scotia, we believe that there is eight billion barrels of oil potential and 120 trillion cubic feet of gas potential. ”

"There is nothing like the prospect of being hanged in the morning to focus your mind," says MacMullin. "A decade ago, we were losing interest in offshore exploration, while seeing huge revenues for the Sable Offshore Energy Project (SOEP), a project that we knew would not last forever. As offshore royalty dollars flooded Nova Scotia, we knew the renewal of development would prove successful. We decided to validate whether Nova Scotia is a significant place of interest to the industry. Big oil saw us as a high risk, but we were fiscally stable. "An expert assessed the existing data and



Piston coring equipment is raised from the ocean bottom to Canadian Coast Guard ship Hudson.

helped identify more geoscience. He told us we had a wealth of data that we could readily analyse to the standard Shell or BP upkeep internally," says Macmullin.

Decades in development

"Our first offshore activities were in 1959, but we actually did not drill until about 1967, when Mobil Oil drilled the first well on Sable Island," explains MacMullin. "The very first offshore discovery was made in 1969 by Shell Canada with the Onondaga offshore well. It was between 1992–99 that we had the first offshore project in Canada,

which proved that production was possible year-round in the harsh North Atlantic."

During the aforementioned decades, the six gas fields at SOEP were discovered. For a period in the 1980s, Mobil was pegged to develop the Venture gas field by itself. The project was deemed non-economic due to falling prices, but interest would rekindle throughout the decade. The SOEP would ultimately lead to the development of a domestic gas market for the first time in Nova Scotia. At the end of the 1990s, energy majors had made commitments to invest \$600 million to explore 19 offshore parcels. "A little over ten years ago, we looked

at falling natural gas prices, which were due to advances in fracturing technology, and we could not compete with the Marcellus shale gas for the New England market. We were faced with the prospect of Nova Scotia being gas prone and unable to compete.

"Between 2009–11, we spent \$15 million on the Play Fairway Analysis project with a look to evaluate oil potential, especially in deepwater areas. We released our analytical data to the public in early 2011." MacMullin explains. "Subsequently, Shell announced a \$970-million exploration commitment for four parcels. BP followed with a bid of more than \$1 billion for another four parcels. Now, BP is drilling its first well after extensive 3D seismic analysis.

"An important factor is that we have built a brand for geoscience work sourced out of Nova Scotia," he adds. "It is peer reviewed, and we always flag the soft spots in the data and interpretations. We've taken an all-encompassing approach, covering all aspects of the petroleum systems of offshore Nova Scotia. By releasing our analysis for free, the industry also gains an independent check on its work."

A friendly environment for E&P

As companies risk the harsh waters of the North Atlantic, MacMullin has been working to ensure that Nova Scotia is a hospitable environment for E&P activity. An important element of his work is to help guide regulation and

policy improvements, and remove regulatory uncertainty.

“We can have some control over regulatory risk and we need that process to be as efficient as possible, with no unnecessary delays in regulatory ruling,” he says. “In Nova Scotia, and in Canada as a whole, there are many groups that are concerned about spills and other issues concerning exploration and production, as well as First Nation consultation, so we need to take a look at those concerns, despite geological risk being our main focus.”

The Frontier and Offshore Regulatory Renewal Initiative (FORRI) is a federal-provincial partnership working to modernise the regulatory framework for oil and gas activities in Canada. It is currently focusing on the development of a modern suite of operational requirements, known as the Framework Regulations. FORRI is a partnership between Natural Resources Canada, Indigenous and Northern Affairs Canada, the Nova Scotia Department of Energy and the Newfoundland and Labrador Department of Natural Resources, with involvement from the Canada-Nova Scotia Offshore Petroleum Board, the Canada-Newfoundland and Labrador Offshore Petroleum Board, and the National Energy Board.

“ We always try to be diligent in our approach to geoscience, and an important part of that is testing new ideas with the private sector, so that we are grounded in our thinking. ”

“We need to remain vigilant on the regulatory side. Nova Scotia sets the regulations with the national government, so we work closely with Ottawa. FORRI is enabling the industry to take advantage of new technologies but we do still have some concerns about the environmental approval side. The government has moved to make that more efficient, but the new approach is yet to be tested. We have had a recent case in which a BP well went through three years of approval before receiving a regulatory ruling. We currently have a nine-year exploration licence,” says MacMullin. The new process is expected to reduce



Jamie Webb of Applied Petroleum Technology works with split piston core samples aboard the Canadian Coast Guard ship Hudson during a research cruise in offshore Nova Scotia.

unnecessary delays. An efficient regulatory environment is essential if a region with a small population and high levels of debt is to benefit from the royalties that will accrue from successful production activities.

“Nova Scotia’s debt is about \$16 billion – that is \$16,000 for every person in the region. One 2Tcf gas project generated \$2 billion in royalties alone, so three separate governments – Conservative, Liberal and one New Democratic Party – have all seen the value in offshore since 2008,” MacMullin remarks.

“Even in an era of climate change, oil and gas cannot go away overnight.

seismic data and advance cost-saving tie-back technology to extract more from existing sites.

For Nova Scotia, much depends on the success of BP’s latest well. Whatever happens, it will be a signpost for how MacMullin and his team will approach the next milestone in the development of the region’s offshore industry, on a journey that he has always tried to ensure is grounded in fact rather than aspiration.

“The well could be the biggest thing in 2018,” he stresses. “It could find nothing, it could be technically successful but not economic, or it could turn out to be economically viable. We can learn from any of those scenarios in terms of what to do with more geoscience research as we gather more data. If BP announces a successful well, then we can still look at how to further derisk source presence. We are constantly refining our knowledge.”

“We always try to be diligent in our approach to geoscience, and an important part of that is testing new ideas with the private sector, so that we are grounded in our thinking. All of our analytical data will eventually enter the public domain. Then it can be analysed in any way that potential investors choose, and help an energy major to attract partners for a project,” he adds. “We have seen it work, and will continue to perform high-valued, low-cost and efficient geoscience research for the foreseeable future.” ■

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Brazil's rise to the challenge

Pushing further offshore and into deeper water to find new reserves is a huge logistical and technical challenge. Jim Banks speaks to **Solange da Silva Guedes**, head of exploration and production at Petrobras, to find out how this challenge is being met in Brazil's Campos and Santos Basins.

Across the world, there are many new ventures being launched to uncover potentially huge reserves of oil and gas in deepwater regions. In Norway, many contracts have been awarded to enable oil companies to explore further into the North Sea. Offshore discoveries near Guyana are being sold to oil majors, and off the coast of Canada, the data suggests great potential for new oil and gas discoveries.

In Brazil, the summer saw the fourth auction of offshore drilling rights since September, 2017, with consortia including the likes of Chevron, Exxon Mobil and Norway's Equinor bidding for prize assets. The heavy interest

suggests the country's potential as a producer is huge, and the International Energy Agency is already predicting that, outside of OPEC, Brazil could soon be second only to the US in its contribution to the growth in oil supplies in the years ahead.

The Campos Basin is already a key site for deepwater production. The first deepwater discoveries made by Petrobras were in the 1970s, and the company has undergone a long technological journey to put itself in a strong strategic position to develop offshore reserves, and it firmly believes that the discoveries it made before reaching the pre-salt exploratory frontier will be surpassed in the future.

"The Campos Basin, despite being in operation for more than 40 years, still has great potential," says Solange da Silva Guedes, chief exploration and production office at Petrobras. "In this region, we are counting on reservoir management to increase the recovery factor of the fields. Technological partnerships, such as the one we have with Statoil in the field of Roncador, may be the key for the company to achieve this goal. This basin is linked to the growth of the company and continues to present so much great geological potential that we intend, by 2022, to invest \$19 billion in the region."

"The new exploration areas acquired in the Campos Basin in 2017 and 2018 open up several possibilities

for the company. The results of the bidding rounds indicate that there is still great unexplored potential in the ultra-deep waters of the Campos Basin, and Petrobras and its partners will use their geological knowledge and new technologies to discover this new giant, especially in the pre-salt," she adds.

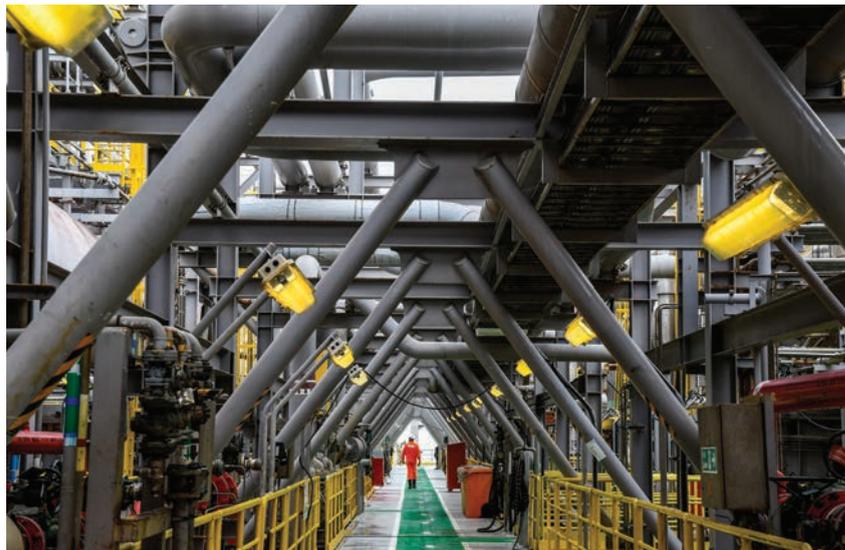
Pushing the potential of the pre-salt layer

Evidence for the continued strategic importance of the Campos Basin is plentiful. A quick look at the operational highlights Petrobras has recorded in the first half of 2018 speak for itself. For instance, there is the start-up of the first production system in the area of the Transfer of Rights agreement – the P-74 – in the Búzios field, a new floating production system in the Campos Basin, and the FPSO Cidade Campos dos Goytacazes, installed in the field of Tartaruga Verde. Another significant milestone was the arrival of the P-67 in Brazil, which will be the eighth platform to operate in the ultra-deep Lula field.

It is also worth considering that the Santos Basin has great potential. This year also saw the completion of a well in the Sururu field. It has a column of oil of around 1,740ft, which makes it the largest, so far, in the pre-salt layer of Santos Basin.

“ The new exploration areas acquired in the Campos Basin in 2017 and 2018 open up several possibilities for the company. ”

Beginning in 2017, Petrobras has steadily increased its exploratory area by 31% through acquisitions in the bidding rounds of the National Agency of Petroleum, Natural Gas and Biofuels (ANP). Its focus was on prioritising the highest potential areas in the Campos and Santos Basins through a strategy that sees it act selectively to rebuild its portfolio, and ensure future and sustainable production. In doing so, the company has had to meet the many challenges of the pre-salt layer head on, drawing on its vast experience, particularly from the past 12 years.



With a focus on inflating the potential of the Campos and Santos Basins, Petrobras has employed innovative and varied methods to ensure a sustainable future at the locations.

The pre-salt discoveries made in 2006 are still among the most important recent finds anywhere in the world. During the past decade, they have opened up a new horizon in the history of oil production. They are located in ultra-deep waters – around 22,965ft below sea level – and the pre-salt province has an extension of around 500 miles in length.

It is estimated that there are billions of barrels of high-quality light oil waiting to be discovered, the commercial value of which would likely be enormous.

When these discoveries were first made, they brought Petrobras face-to-face with conditions unlike anything the company had previously experienced. There was no choice but to embark on an intensive process to improve existing technologies and develop new technical solutions. This has been achieved largely through collaboration between the technical teams of operators and suppliers, as well as through the support of academics and researchers from universities and technology centres.

The success of these efforts is proven by the fact that, currently, more than

half of Petrobras's total production comes from the pre-salt layer. The company's success in pushing the potential of this exploratory frontier has delivered great dividends. Towards the end of April this year, the company's pre-salt production passed a benchmark of 1.5m barrels of oil per day. The highlight was the Lula field, located in the pre-salt of the Santos Basin, which is now the largest oil-producing field in Brazil, as well as the largest national producer of natural gas.

The kind of pioneering technology that the company developed to make the pre-salt layer profitable was recognised in 2015, when it received – for the third time – the OTC Distinguished Achievement Award for Companies, Organizations, and Institutions. This is the highest technological recognition that an oil company can receive as an offshore operator, but it has not allowed the company to rest on its laurels. Instead, Petrobras has taken its award-winning technologies as a starting point from which it can build on the successful partnerships that made it technologically and economically feasible to produce in the pre-salt layer.

A future rife with innovation

In order to maximise the potential of the Campos and Santos Basins, innovative technological solutions will be required. Already, work in the

Libra area of the pre-salt layer of Santos Basin is bringing good results.

Petrobras sees the Libra area as one of the largest and most promising oil and gas production projects ever developed in the offshore industry. The asset already has reservoirs that are among the most productive in the world, with columns of oil that reach approximately 1,312ft in size. The first discovery to be developed in the area of Libra was Mero field, which lies in ultra-deep water around 180km off the coast of Rio de Janeiro, and is estimated to hold around 3.3 billion barrels of oil. In the past year, the commerciality of this field was officially declared.

In November 2017, the long-term testing (LTT) of the Mero field began. Its goal was to evaluate the behaviour of the oil reservoir and to gain insight into its characteristics. The test is under way, using the platform vessel FPSO Pioneer of Libra, which has been installed in the north-western portion of the block, and which has the capacity to process around 50,000 barrels of oil and 141 million cubic feet of gas every day.

Successful production requires the development of new solutions that are specifically adapted to the unique conditions of the deposit, and it these solutions that have made LTT possible at the Mero field. Such new technological solutions have focused on high pressure, increased productivity and managing the depth of the oil reservoirs, and there have also been significant strides to manage the strong presence of gas associated with the oil, which is a key issue to overcome in order to boost the development of higher production across the region.

Among the technological advances that have been applied with Libra is the development of Hi-SEP. This focuses on CO₂ separation in dense phase and is a technology that enables the production of more oil for longer with the same processing plant. The first unit will be installed in Libra, though the unprecedented technology, patented by Petrobras, is still in the testing phase.

Hi-SEP will help the company to overcome the big challenge of the high gas-oil ratio (GOR), as well as

Since 2017, Petrobras has increased its area by 31% through acquisitions from the ANP.



addressing the high concentration of contaminants, especially CO₂. The subsea separation proposed by the Hi-SEP technology has the potential to benefit fields such as Libra and any others with high GOR and high concentrations of CO₂. Since January, Petrobras has been running a pilot plant in operation in Fortaleza, in the north-east of Brazil, to test the Hi-Sep solution.

The old and the new

Further deepwater exploration and subsea production will, no doubt, depend on the development of new technologies to uncover and exploit new reserves. There is, nevertheless, a pressing need to ensure that existing deepwater assets live up to their potential. For this reason, Petrobras has been focusing on its existing discoveries in the pre-salt layer of Campos Basin.

The Campos Basin is one of the largest maritime oil complexes in the world, and it has been producing oil and gas for more than 40 years. Petrobras already has new systems in the region that are slated to start production, and it has acquired ten exploration blocks in the past two rounds of ANP's auctions.

In addition, it is focusing on projects that will involve the revitalisation of mature fields and the increase of their recovery factor. In the Campos Basin, the company has many

discoveries in the pre-salt province, but in this region, the biggest potential gain could come from the fact that these discoveries occur in fields that have been producing for many years in the post-salt layer, and that already have infrastructure installed. This generates cost savings for the company and speeds up the start of production of these fields.

One example was the discovery in 2010 in the area of Brava, which is below the Marlim concession. The field is already producing with the P-20 platform, and Petrobras is currently implementing the oil and gas volume delimitation phase, which may enhance the revitalisation of Marlim. There are also the pre-salt Jubarte and Baleia Azul fields in the Parque das Baleias, which are producing with the P-58 platform and the FPSO Cidade de Anchieta. The reservoirs of Tracaja, which lies in the Marlim Leste field, Carimbé in the Caratinga field and Poraque Alto in the Marlim Sul field are also key elements in the revitalisation capacity of the Campos Basin, after so many years of operations.

Brazil's potential in offshore production will come from its willingness to push the boundaries of technology to exploit new discoveries. Its offshore industry already contributes a huge amount to global supply, but there is much more to come. ■

Let's push things forward



There is a history of digital technology being deployed in oilfields, and its the evolution of technology has required the industry to keep pace with the potential efficiencies it brings. As companies move towards a more efficient and more autonomous future, Halliburton's digital technology leader, **César Bravo**, discusses what the digital oilfield means today.

The oil and gas industry has become accustomed to disruption in recent years, not only from falling commodity prices, but also from rapid change in the technological landscape. As lower oil prices became the norm, oil producers faced enormous pressure to reduce costs and boost productivity. This came at a time when advances in digital technology became available to help

do more with less. The synergy between these two trends led to significant investment in the digital oilfield concept, but the evolution of technology also meant that the definition of this concept has kept changing.

Today, the digital oilfield represents a constant process of innovation and investment in new technologies, at every stage of the value chain. The application of innovative technologies is essential

if a company wants to ensure more efficient recovery, so naturally, future profitability depends as much on digital strategy as on any other single factor in the business model.

Times have changed

"The concept of the digital oilfield has been around for 15–20 years, with oil majors starting to integrate data services in the early 2000s to bring together real-time data,

well models and daily production data,” says César Bravo, industrial internet of things (IIoT) and digital transformation leader for oil and gas production industry at Halliburton. “Then came automation of work processes, which saw the integration of data and applications. When it started, we had different digital technology – the solutions were APIs that enabled the integration of applications.

“In the past five years, the change has been our ability to create flexible solutions through the cloud, as infrastructure costs have fallen, as well as a lot of progress in the IIoT and instrumentation, so we can manage more variables with more intelligent sensors. Since 2007, when the first iPhone came out and proved to be a game-changer, there have been big breakthroughs in digital technology, which came at the same time as the downturn in the oil and gas business. The industry has been forced to look for more efficiency and lower-cost solutions, which has driven the need to look at digital transformation,” he adds.

Halliburton is perfectly positioned to use its knowledge of the life cycle of the reservoir – from locating hydrocarbons and managing geological data, to drilling and formation evaluation, well construction and completion, and production optimisation – to help bring about a digital revolution. Bravo has more than 18 years of experience in the field of research and development, commercialisation and implementation of digital solutions for the industry, and he is the leading advocate of the company’s Voice of the Oilfield programme, which is helping to bring about a profound transformation in the industry.

A decade of digital evolution

Over the past decade, the industry has attempted to use digital technologies to automate aspects of production. The initial digital oilfield concept was based on relatively simple data integration, enabling the automatic monitoring and analysis of production. However, Bravo believes these efforts were too limited in their scope and that the current trend of digital transformation will have a more profound impact, as it relies on a host of new technologies such as edge analytics – which uses automated algorithms to

process data from sensors and other devices – mobile technology, integration platforms and big data analytics.

The paradigm shift that has taken place has affected not only how people access information, but also how many industries view their business model, in the knowledge that it must be sufficiently agile to keep pace with continual change. This flexibility is enabling operators to put in place a smart and connected exploration and production ecosystem to unearth new opportunities, create value from the application of new technologies, and collaborate in an unprecedented way with partners in the industry.

“There are many technologies available and there has been a rapid increase in computing capacity, cloud services and mobile devices, all of which generate terabytes of data every minute. Two technologies that will be very important are the IIoT, which enables us to receive more information, as it is becoming cheaper to get sophisticated sensors, and machine learning, which will allow us to use the data better,” says Bravo.

Untapped potential

Within the huge volume of data that oilfields produce lay invaluable insight, but unearthing it means having a clear idea of what problem you want to solve. Big data is only valuable when it is applied to a specific issue, and in the oil and gas sector that issue is how to better understand the reservoir. There is a high degree of uncertainty in the reservoir management process, as subsurface fluid dynamics are based on simulations, which are built on exploration, drilling and production data.

The first challenge is to accumulate the sufficient data, which is where intelligent instrumentation comes into play. The next is to identify which data is useful and apply sophisticated analytics.

“The main objective is to reduce uncertainty about the dynamics of the reservoir, which is what Landmark, the software business line of Halliburton, focuses on. It looks at how to capture more downhole data and develop better simulations to improve how we manage fluids and how we transport hydrocarbons to the surface,” says Bravo.

The company’s Voice of the Oilfield solution aims to integrate new technologies for data capture, integration and analysis to create an accurate picture of the reservoir. These include IIoT to enhance real-time communication, edge analytics to deploy automated algorithms to process data from sensors, cloud services to deliver the computing capacity and architecture at a reasonable cost, and other solutions to collect and transmit data in real time and run faster simulations.

“IIoT and machine learning are still in their initial phases in the oil and gas industry, but most major companies in this industry have digital transformation programmes, which rely on intelligent sensors downhole and the application of machine learning and big data to process information. Big data and analytics are not valuable per se: they must be used to face specific challenges. However, the availability and quality of data is key to having more efficient infrastructure,” notes Bravo.

“Also, in this industry, there is not only seismic data, well models and production data, but also a lot of information on many other factors such as finance and maintenance. To get a holistic view of the elements that affect a business, you have to look at all of these. Before, we only looked at one dimension of the business, but now we have to look at much more than production data. This is an area where real advances are being made. The industry is starting to look beyond production to put in place a much broader digital transformation programme,” he adds.

Keeping pace with progress

The oil and gas industry has not always been a fast mover when it comes to adopting cutting-edge technology. Instead, it has often waited for other industries to prove the value and maturity of new solutions. When it comes to digital transformation, there may be a pressing need for greater efficiency, but the industry is still not an early adopter.

“Now, operators can not only get more information from intelligent sensors, but also get more meaningful information, and we are in the process of integrating big data and machine learning, so that we can close the loop and provide a level of

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autonomy in operations. The challenge is that we have to keep up with the pace of change and absorb all of the available technology into oil and gas processes, but the industry is not always a leader in technology development. It is a very traditional industry in many ways, so it has to get the benefits of technology created for other industries," says Bravo.

Other industry sectors have already made great progress with IIoT, for example, which seamlessly integrates a large number of devices to feed real-time data from sensors and actuators installed in wells. These devices can connect automatically to a network, perform their own data cleansing and pre-processing activities, and generate diagnostic data about their performance. This functionality has already had a major impact in industries such as manufacturing, agriculture and telecommunications.

Similarly, edge analytics enables real-time data analysis and control applications, using algorithms to monitor and assess a host of variables, including pump failure pattern recognition and chemical injection management. On this, it is possible to build in some automated responses to specific cues and, ultimately, give operations a degree of autonomy through self-monitoring, self-control and self-healing processes.

Foreseeable developments

In the future, artificial intelligence (AI), robotics, drones and other technologies could also come to the fore – in fact, AI is already finding its place.

"IIoT will be a fundamental part of the oil and gas business, and instrumentation technology is becoming cheaper. We have new downhole sensor technology and some very interesting developments around fibre, but we can also measure new things such as video feeds. We have not used this much before, but now we have more intelligent cameras that can recognise patterns and we have better ways to transfer video across our networks, so telepresence is very common. We can visualise a field and analyse leaks and emissions and process that data in the field," remarks Bravo.

"The next big digital technology, however, will be AI. It is the future of business, in any industry, because it allows the automation of repetitive and hazardous tasks, and a better understanding of the business process. Autonomous operations at the well mean fewer people are exposed to hazardous environments. AI is creating new business models in transport, entertainment and many more industries, and the oil and gas sector is no different. In only two or three years, we will see significant development in autonomous operations, as well as getting better well simulations and better field development planning. AI already has a good level of maturity, so the level of autonomy in the industry is rising fast."

The knowledge and skills to develop and implement digital technology are essential, but so is a shift in attitude. If the industry is to innovate, it must learn a new way of collaborating and sharing best practice.

"At Halliburton, we have a dedicated business line that develops new technology to add value for our customers, and we help to automate drilling by putting in place intelligent systems and we ensure we attract the right talent," concludes Bravo. ■

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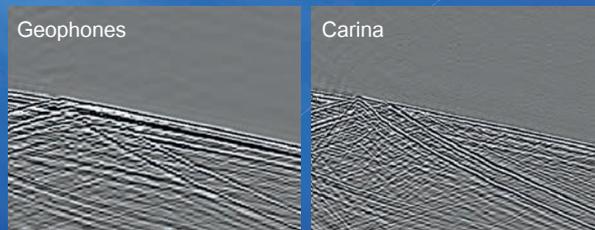
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Stack it and see

As oil companies move into more challenging reservoirs, they need an understanding of what's happening subsurface. Big data solutions are emerging as a way to make more accurate interpretations and discover data quality problems ahead of time. **Bill Shea**, CEO of Sharp Reflections, speaks to Abi Millar about why pre-stack data is the future of seismic interpretation.

It's a fact of life in the oil industry that at a time of dwindling reserves, companies need to get smarter about where they drill. On one hand, this means extracting more from their existing oil fields. But it also means detecting entirely new sources of hydrocarbon, often from unconventional reservoirs in harsh environments.

This task is notoriously tricky. In order to work out which reservoirs might have potential, geoscientists need to build up an accurate picture of what lies beneath the surface, which in turn means using the highest-quality data.

“It's very exciting that we managed to take some general principles of the value of pre-stack information and apply them to a different type of reservoir system.”

For decades, their visualisations have relied on post-stack seismic data – data that has been through a process known as ‘stacking’. Stacking, which was invented over 50 years ago, makes the dataset far more practical and manageable.

Bill Shea, CEO of Norway-based data analysis company Sharp Reflections, has a good analogy – if the stack is more like a JPEG file, then pre-stack is more like the raw file on a digital camera.

“The raw files contain more information,” he says. “It used to be that you could fit only five to ten raw files on a camera card, but hundreds of photos if you convert them to JPEG. We see something similar with migrated pre-stack seismic versus just the stacks.”

He adds that, historically speaking, pre-stack data was underused by most interpreters – merely a stepping stone towards the final product. Computer workstations simply were not up to the task of examining it.

“The size of the data has been a real obstacle to the take-up of pre-stack,” he says. “It has created a clear dividing line between what processing companies do and what data interpreters do, so it's only tended to be very specialised interpreters in oil companies who have made use of the pre-stack data.”

In today's world, however, data is a true differentiator, spelling the difference between a successful operation and a failure. As a result, a number of oil companies are seeking to view their pre-stack data directly.

“With things like seismic inversion, the results are highly dependent on the quality of the inputs – we talk about garbage in and garbage out,” says Shea. “If the data aren't processed very accurately and precisely, the predictions you make from advanced interpretation techniques can ultimately be unreliable.”

Bang on trend

Sharp Reflections was founded in 2010 with an eye to this oncoming industry

trend. With R&D funding from Statoil, the company set to work on its flagship product, Pre-Stack Pro. This software harnesses big data computing techniques, allowing users to easily view and process their pre-stack data. As the company would have it – more data, more often and in more detail. Pre-stack is the future of seismic interpretation.

Such a proposition would not have been viable until recently. It is only thanks to rapid advances in computing power, and increases in storage capacity, that interpreting these enormous datasets is possible.

“We're giving the interpreters the tools to make those decisions themselves,” says Shea. “There have been tools around for 20 years to allow the real specialists to do the work, but it might take one to two weeks to run a batch job on the dataset at their workstation, and that's simply too long. We can get that down by factors of ten to 100 on all kinds of computer systems, so then we're talking hours.”

Early in the software development process, the company homed in on what Shea calls a “game-changing idea”. They realised that when you visualised the pre-stack data, you could see all kinds of artifacts and information that simply wouldn't have been visible post-stacking.

“We got motivated to make a kind of hybrid tool that combined processing and visualisation,” he recalls. “Basically, the visualisation was showing all kinds of problems that you hadn't been aware of, and we were motivated to make tools that would fix them. That jumped us into processing blocks of data.”

“You may drill the reservoir in one location and find it’s very brittle and has a good response to fracking, but move 20km away and you are not so sure,” says Shea. “To actually see differences between different locations in the reservoir you really need the pre-stack data, because now you’re looking at very subtle changes in the amplitude response that are occurring as a function of direction.”

Analysts working with these reservoirs are seeking to make two key predictions – first, what is the stress state of the rocks prior to fracking, and second, how much natural fracturing is there already. This requires an eye for subtleties, which in turn requires high-quality data processing.

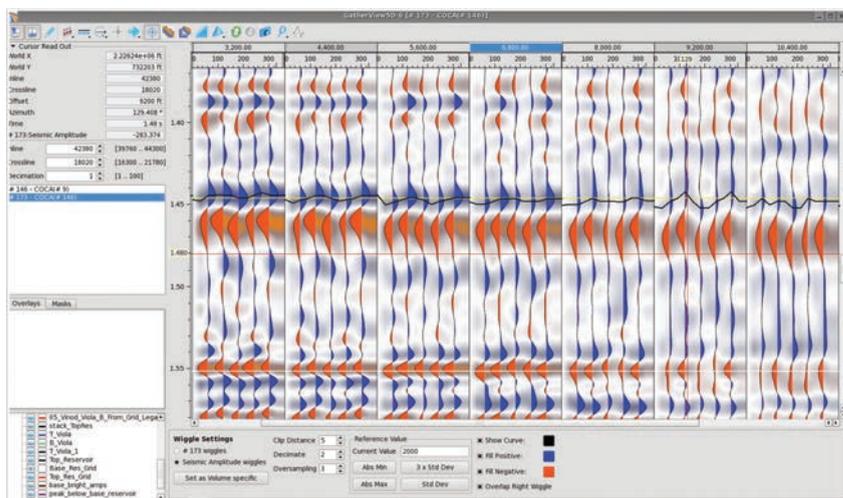
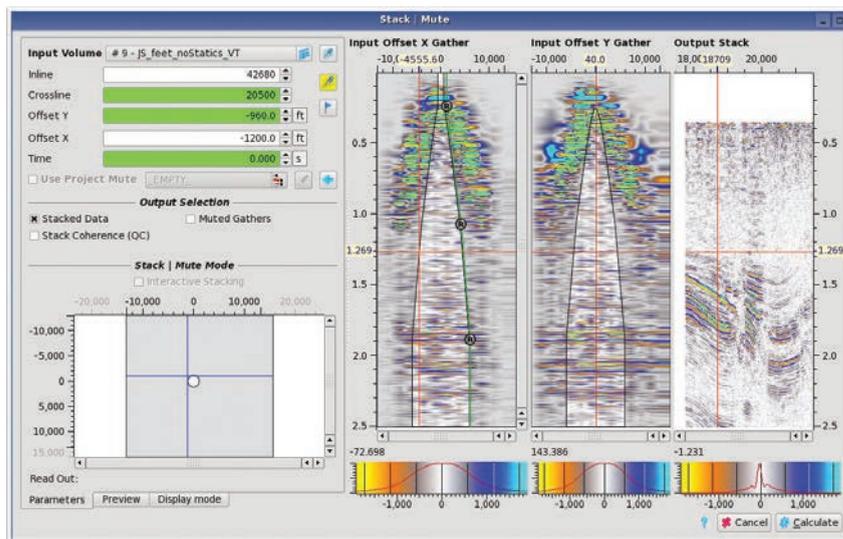
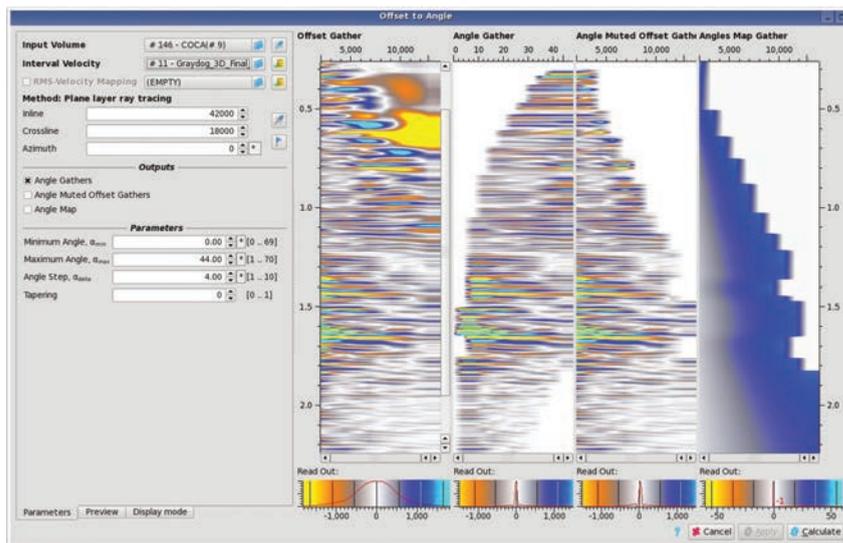
“It is early days, but it’s very exciting that we have managed to take some general principles of the value of pre-stack information and apply them to a completely different type of reservoir system,” says Shea.

Describing himself as a “technology optimist”, he says there will likely be a greater movement towards using pre-stack data in the future.

“Industry scientists who are doing work to extract economic value out of their reservoirs are always going to strive to pull as much information out of their seismic data as they can,” he says. “The industry has proved again and again that when they see value in enhancing technology they’re very swift to adopt it. So, I think in the oil and gas industry the economic value of using pre-stack information is always being assessed and weighted against the costs.”

The general trajectory, of course, is that costs tend to fall as the technology advances. And in this case the technology is moving fast. Already, Sharp Reflections offers its solution in the cloud, which means there is no longer any need for clients to worry about which hardware is most compatible.

“Since they just pay for their hours and the storage they’re using, going fast is the same price as going slow,” says Shea. “If you have 100 computers doing a job that might take an hour, versus one computer doing a job that takes 100 hours, you pay the cloud vendor exactly the same for A or B. So, why not go fast if there is no price pain you have to pay to get there? That’s a big mindset shift for a lot of people.



High-quality data processing and cutting edge technology are required to best ascertain the stress of rocks prior to fracking, as well as the amount of fracturing that already exists.

“Near, mid and far stacks were forced on us as a compromise, or we simply couldn’t do the analysis,” says Shea. “People still have a set of best practices based on using

these techniques because they’ve shown they work very well. But they can work even better if you don’t reduce the data,” he concludes. ■



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The SupaPleat XP filter provides high-quality service at a multitude of flow rates.

Amazon Filters has excellent experience in developing, supplying and supporting a variety of process filter requirements for the international oil and gas market. Its expertise, combined with a comprehensive own-manufactured product range, has always been put to good use when undertaking major oil and gas contracts.

When offering any filtration solution, fully understanding an application is vital. Many applications rely on excellent water quality for injection. The importance of effective water treatment is often underestimated. Water intake quality can vary tremendously due to algae and plankton blooms, silts and other sediments – leading to significant impact upon the performance of downstream water treatment facilities. If not addressed correctly, injection water (produced water and sulphate removal process water), can be of poor quality –

resulting in oil production loss and a drop of reservoir pressure. Amazon Filters specialises in water for injection and its filter cartridges excel at protecting critical downstream membranes used in these processes.

Amazon Filters SupaPleat XP filter cartridges are specifically designed for water injection. Using these filters can maximise membrane life by avoiding cartridge blinding, membrane fouling and interruption to the process. Reduced operational expenditure replacement costs are an additional benefit. The high surface area filter cartridges utilise multiple-layer, pleated depth media technology to provide low pressure losses and high dirt capacity at multiple flow rates. This allows the SupaPleat XP filter to provide a unique combination of long life and reliable performance under varying fresh, sea and produced water conditions.

Value-added service is supplied by expert filtration engineers – as well as laboratory facilities – from project initiation through to delivery and aftercare support.

Further information

Amazon Filters
sales@amazonfilters.co.uk
www.amazonfilters.com

Chalmit LED floodlight returns

Chalmit is reintroducing the recertified HDL106 modular floodlight. Designed for hazardous environments, the LED floodlight combines all of the game-changing features of its Hadar predecessor with the Chalmit stamp of exceptional quality.

Hailed as the ‘future of hazardous area lighting’ when it launched in 2009, the HDL106 range was a revelation. Using the latest in LED technology,



HDL106 has returned to the market with a range of improvements.

the floodlight could generate the illumination as a SON, MBI or other typical HID floodlight with a 40% reduction in weight.

However, shortly after Chalmit acquired Hadar in November 2016, HSE released a bulletin regarding Hadar products. During a routine assessment, CSA-Sira found issues with Hadar’s production process and control measures.

Chalmit has responded to the bulletin by applying its core mantra for safety, quality and reliability. The HDL106 has undergone the same rigorous in-house and third-party testing as all Chalmit products, to ensure that every single fitting exceeds market and site expectations. The luminaires have all been updated with a new polycarbonate with a diffuser that ensures that the HDL106N satisfies the impact requirements and IP ratings for its complete the rated ambient range.

“Our aim with the HDL106N has been to bring back the ‘future of hazardous area lighting’ and we believe we’ve achieved just that,” says Ken Eddleston, lighting product manager for Chalmit. “We’re reintroducing a much-loved product with the assurance of safety and reliability that our customers have come to expect from all Chalmit products.”

The HDL106N range provides:

- instant on crisp white light output
- marine-grade construction

- multiple beam options
- extensive ambient range
- full ATEX and IECEx certification
- zone 1, zone 2 and industrial variants
- multiple mounting options for different applications.
- a lightweight lighting solution
- modular design allowing up to four interlinked luminaires
- high energy efficiency
- 80,000 maintenance free hours at 25°C
- lower power consumption than HID lamps.

Further information

Chalmit
www.hubbell.com/chalmit/en

Bespoke on-site solutions



Hi-Force consistently supplies a broad range of quality services.

The UK’s leading manufacturer and supplier of hydraulic tools has expanded its service offering to offer bespoke on-site bolting services. Hi-Force bolting solutions are designed to maintain the integrity of bolted joints across multiple industries, where the safe movement of hydrocarbons in a leak free environment is absolutely critical.

To complement Hi-Force’s extensive range of bolting tools, its on-site bolting services are tailored to suit unique customer requirements. Customers can select the required support, which extends to labour, supervision and training from a highly competent team of technicians, tool sale or rental agreements, as well as its innovative bolted joint integrity software, BoltRight

Pro and Flange Management database. Hi-Force boasts a flexible approach to offering clients the individual components of its on-site service capabilities ensures a cost-effective and satisfactory service.

The company's on-site bolting containers offer an on-site storage of purchased or leased bolting equipment, an ECITB approved training rig for on-site training and demonstration purposes as well as a repair facility for any service and maintenance required for the tools during their time on-site, limiting costly time delays. Its on-site containers include appropriate tool storage facilities, an air condition environment, on-site training equipment, compressed air, spare parts and additional tooling. Hi-Force readily offers the following:

- full technical support and advice during the pre-construction phase
- tooling specification for correct tightening of all bolts and joints, available for purchase and rental
- special tooling for unique customer requirements, designed and manufactured by Hi-Force engineers
- bolting software and a flange management database
- fully equipped, purpose designed and air conditioned on-site tool store container
- air-conditioned repair and training container, complete with ECITB-approved training rig for on-site training and demonstration purposes as well as repair and maintenance facilities, limiting costing time delays
- qualified and experienced on-site bolting crews, supervisors and trainers
- ECITB-approved training available.

Further information
Hi-Force Limited
www.hi-force.com

Pulling more than its weight



Kley France accommodates offshore, military and oceanographic needs.

With 60 years of experience, Kley France is a recognised supplier in offshore, military and oceanographic fields. The range of products consists of linear winches, risers pulling and mooring systems (RPS) for FPSO, dedicated winch packages and handling equipment for marine and subsea research, including high-tech submarines.

The main applications are FPSO riser connection and mooring, pipe pulling and laying, deep-sea research and coring, ROV and AUV launching (LARS).

Kley France entirely manages all projects until turnkey delivery, including design, calculation, manufacturing, assembly, test, commissioning and worldwide technical support. With more than 70 units operating worldwide, Kley France is the world leader in development of linear winches. Linear winches can have different features as per applications' exact needs, such as continuous or intermittent motion, socket passing possibility under tension, horizontal and vertical positions, ATEX compliance and other such characteristics.

The company produces linear winches with the world's highest capacity (800t) for heavy pipe pulling, and maintains the capacity to deliver a complete set of linear winches and stationary grippers operating through multifalls blocks for installation and operation of heavy closing panels on a Chernobyl

confinement arch. Kley France supplies riser pulling and mooring systems, equipped with linear winches, for FPSO units based in Brazil, Africa, Australia, the Pacific and the North Sea.

Kley France also specialises in handling systems for pipe-laying stingers, traction winches, drum winches, spooling devices, welding rotators for piping works, heave compensators, cable tensioners and push-pulls.

All of the company's packages are delivered with dedicated power and control units, including electric or diesel power packs (HPU) and customised control containers. Additionally, in response to deep offshore needs, it has developed the Annula traction winch, which is dedicated to safe and proper fibre rope deployment (FRDS), with outstanding performance.

Further information
Kley France.
www.kleyfrance.fr
Info@kleyfrance.fr

Inspection as primary business



Oiler focuses on ensuring drill pipes are compliant.

Oiler provides an effective and unparalleled value to clients that require drill pipe inspections for Certificate of Conformance within the oil and gas industry.

It is completely self-sufficient, and inspections can be conducted onshore at client's facilities, on board rigs that are idle or secure suitable premises on location. Oiler's professional inspectors are DS-1-certified and conduct inspections compliant with API RP7, TH Hill DS1 and NS-2 standards.

Oiler is a third-party inspection company, and its main focus is on ensuring the equipment is compliant, fit for use and reliable. The company maintains that inspection is its primary business.

Oiler offers the drilling contractor an unbiased inspection service. This is in respect of the fact that it shies away from offering repairs, such as thread recutting. There is no conflict of interest when inspecting and dispositioning. Oiler simply inspects and interprets to pass, not to fail for rework scope.

The company's inspection results in a lower rate of tool joint repair than OEM inspections. It believes in separating the inspection process on board the vessel from the workshop machine repair. And with its ability to detect any major repairs early, the client is able to save on transport costs due to the reduced number of drill pipes to be transported to the repair facility. Oiler conducts myriad minor repair services such as refacing in the field that limits the amount of equipment that needs to be sent to a machine shop for repair.

On completion its inspectors will provide detailed inspection reports containing all test results and perimeters. Oiler offers API inspection services for drill collars, drill pipe, heavyweight transition drill pipe, and other premium downhole tools.

Inspections include: VTI, API-TI, DI, EMI, FLUT, MT, PT, UT-RSC and UTEA.

Further information
Oiler
www.oilfieldpartner.com

Calling out to sea

The current mobile connectivity landscape for seafarers across the world differs quite a bit. The ability to communicate with their loved ones using mobile handsets at sea varies from vessel to vessel, as well as from country to country. Some



On-Waves allows offshore phone calls to be made anywhere.

vessels use VSAT while others use Inmarsat, Thuraya or Iridium – all services that provide vastly differing capabilities, without a constant mutual benefit.

A commonality with all crew members is the need to be able

to communicate wherever they are by calling, sending SMS or using any type of app through mobile data. In the Crew Connectivity 2018 Survey Report published by Future Nautics, it was stated that only 61% of seafarers have access to crew communications services, most of the time'. Just 2%, or 80,000 seafarers, never get this access.

These findings indicate that crew connectivity and welfare have improved a lot in the past few years. However, the survey also indicated that the general

cargo and bulk sectors remain those with the least provisions.

The ideal scenario for a crew member is that communication at sea matches as it is on land. It should be equally dependable, whether they are sailing the Singapore Straits, Northern Europe or crossing the Atlantic.

On-Waves has served the maritime market with GSM services in every ocean and continent, and managed to connect crew and passengers to their families wherever they are located on the globe. Until

now, there has not been a single GSM provider that has the ability to connect whenever, wherever. Whether at sea or land, On-Waves will keep the customer connected. Through the combination of global terrestrial roaming agreements and global maritime roaming agreements, On-Waves can offer its customers true global coverage. Its single goal is to keep the world connected.

Further information

On-Waves
www.on-waves.com

Index

ACE Winches IBC www.ace-winches.com	Hi-Force..... 25 www.hi-force.com	Olympus..... 30 www.olympus-ims.com/vanta-pmi
ADIPEC 26 www.adipec.com	Hubbell..... 20 www.xseriesled.com	On-Waves 20 www.on-waves.com
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Bea Technologies 42 www.bea-italy.com	Implico..... 34 www.implico.com	Scottish Qualifications Authority 15 www.sqa.org.uk/oilandgas
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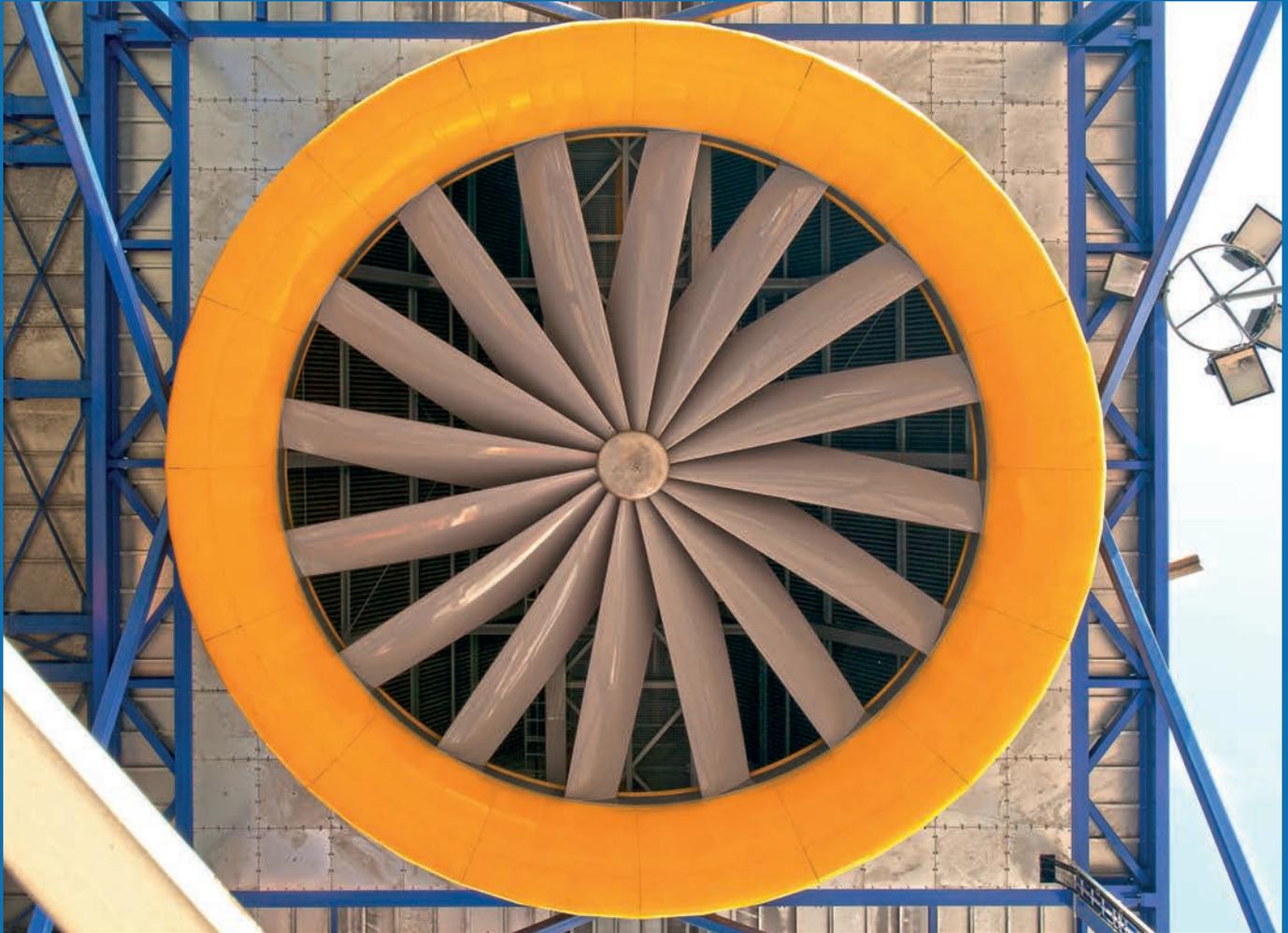
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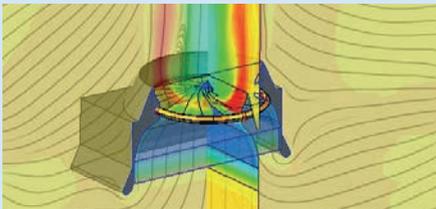


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