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Oil · Gas · Petrochemicals

Middle East

VOLUME 22 | ISSUE 4 2019

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## → Editor's note

PETROLEUM DEVELOPMENT OMAN (PDO) is reaching new heights in oil production, with the deployment of new technologies and more efficient ways of working. Progress made on mega-projects such as Rabab Harweel and Yibal Khuff highlight PDO's well-earned reputation for exploiting complex reservoir systems and hard-to-access deposits. We review the latest developments on p12. While the company's technical director Sami R. Baqi Al Lawati discusses how PDO is turning technical challenges into opportunities (p16).

Also covered are the fertile opportunities for EPCI contractors (p26), the use of dispersants in marine oil response (p22) and the way forward for the Gulf's downstream industry (p24).

Meanwhile, our technology section covers the challenges of accurate interface measurement, the rise of the smart digital twin and a new method of harnessing microbes for oil recovery.

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Cover pic courtesy of PDO

## → Executives' Calendar 2019

JUNE			
17-18	<b>Bahrain Health, Safety &amp; Environment Forum</b>	MANAMA	<a href="http://www.hse-forum.com">www.hse-forum.com</a>
27-28	<b>Iraq Petroleum</b>	BAGHDAD	<a href="http://www.cwciraqpetroleum.com">www.cwciraqpetroleum.com</a>
SEPTEMBER			
2-4	<b>Middle East Heavy Oil Congress</b>	MUSCAT	<a href="http://www.worldheavyoilcongress.com">www.worldheavyoilcongress.com</a>
3-4	<b>Kuwait Health, Safety &amp; Environment Forum</b>	KUWAIT	<a href="http://www.hse-forum.com">www.hse-forum.com</a>
3-6	<b>Offshore Europe</b>	ABERDEEN	<a href="http://www.offshore-europe.co.uk">www.offshore-europe.co.uk</a>
9-12	<b>24th World Energy Congress</b>	ABU DHABI	<a href="http://www.wec24.org">www.wec24.org</a>
17-19	<b>Gastech</b>	TEXAS	<a href="http://www.gastechevent.com">www.gastechevent.com</a>
24-25	<b>Oman Health, Safety &amp; Environment Forum</b>	MUSCAT	<a href="http://www.hse-forum.com">www.hse-forum.com</a>
OCTOBER			
13-16	<b>Kuwait Oil &amp; Gas Show</b>	KUWAIT	<a href="http://www.kogs-expo.com">www.kogs-expo.com</a>
14-16	<b>MEPEC</b>	MANAMA	<a href="http://www.mepec.org">www.mepec.org</a>
15-17	<b>MOC</b>	ALEXANDRIA	<a href="http://www.moc-egypt.com">www.moc-egypt.com</a>
29-30	<b>Basra Megaprojects</b>	ISTANBUL	<a href="http://www.cwcbasraoilgas.com">www.cwcbasraoilgas.com</a>
NOVEMBER			
9-12	<b>ADIPEC</b>	ABU DHABI	<a href="http://www.adipec.com">www.adipec.com</a>
24-25	<b>Dubai Health, Safety &amp; Environment Forum</b>	DUBAI	<a href="http://www.hse-forum.com">www.hse-forum.com</a>
DECEMBER			
2-5	<b>Iraq Oil &amp; Gas</b>	BASRA	<a href="http://www.basraoilgas.com">www.basraoilgas.com</a>

Readers should verify dates and location with sponsoring organisations, as this information is sometimes subject to change.

### Iraq Petroleum to offer gateway to new project opportunities

AS OPEC'S SECOND-LARGEST oil producer with the fourth largest oil reserves in the world, Iraq is of great interest to the global energy industry.

CWC's Iraq Petroleum conference returns to London on 27–28 June 2019, bringing comprehensive updates on the country's new energy vision.

Organised with the cooperation of the new Federal Iraqi Government, the Federal Ministry of Oil, Federal Ministry of Electricity, the Iraqi Federal Parliament and REFAATO, the conference brings together world's oil and gas supermajors to meet with Iraq's Government, contractors, advisers and buyers to discuss market developments and investments.

Iraq Petroleum is followed by a newly-launched Kirkuk and Mosul Megaprojects Day on 29 June, focused on rebuilding and humanitarian efforts in the liberated areas. H.E. Thamiir Ghadhban, Deputy Prime Minister for Energy & Minister of

Oil, Federal Government of Iraq, will participate in both events and will also lead a high level ministerial delegation to participate in a discussion about the reconstruction of Iraq. Leading figures include HE Kameran Ali Hasan, deputy minister of Environment; Dr Falah Al Amri, Ministry's adviser for oil and gas supply affairs; and Nafaa Abdulsada Al-Hmidawi, senior deputy minister at the Ministry of Electricity.

Sessions will cover Iraq's energy vision and policy; supply and demand dynamics; upcoming joint projects with major stakeholders; driving collaboration between the IOCs and the entire energy value chain; Iraq's downstream projects; gas partnerships; electrical demand; energy finance; energy transition; and the relationship between Kurdistan Region of Iraq and Federal Iraq.

The inaugural Kirkuk & Mosul Megaprojects Conference on 29 June focuses on strategic oil and gas projects, infrastructure, partnerships and



Dr Falah Al Amri addressing the 2018 event.

Image Credit : CWC

rebuilding of the liberated areas. It will bring together the foremost oil and gas players in aid of humanitarian efforts to support local community, shape a strong and capable workforce, build infrastructure and generate jobs, in a bid to bring economic stability to the region.

For further information see the website at [www.cwciraqpetroleum.com](http://www.cwciraqpetroleum.com) and [www.kirkukmosulprojects.com](http://www.kirkukmosulprojects.com).

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# Joint evacuation drill to feature at Bahrain HSE Forum

A unique joint evacuation drill conducted by BAPCO and Bahrain Civil Defence / Fire Brigade will be the highlight of the Bahrain Health, Safety & Environment Forum, to be held from 17-18 June at the Wyndham Grand Manama, Bahrain.

**B**UILDING ON THE success of previous events in Dubai and Kuwait, the Bahrain Health, Safety & Environment Forum takes place under the patronage of Bahrain Ministry of Labour and Social Development, and will provide a platform for the sharing of ideas and expertise on critical issues across the spectrum of health and prevention, safety, risk management and environment.

The event will provide valuable insights into effective health and safety programmes, highlighting best practices, process improvements, technology advances and innovative applications to enhance occupational health and safety performance.

## First of its kind joint evacuation drill

A highlight of the Forum will be a first of its kind joint evacuation drill, bringing together the world-leading expertise and capabilities of BAPCO and Bahrain Civil Defence / Bahrain Fire Brigade. It will showcase several elements of excellence performed by the Civil Defence / Fire Brigade and BAPCO's HSE team, with Civil Defence / Fire Brigade overseeing the whole operation. Key figures involved are Jack Waldron, working at heights specialist, BAPCO and Captain Hamed Swar, head of Fire Brigade.

"Mock evacuation drills have featured at health and safety events before – but this unique collaboration is in quite a different league," said Martyn Black, head of Events & Training at Alain Charles Publishing. He explained that the drill will have no less than four different elements to it:

- Rescue and recovery from height
- Rescue and recovery from smoke-filled and confined space
- Rescue assistance using mobility tools and implements
- Pre-medical treatment onsite, pre-transfer.

BAPCO's Jack Waldron will also present at the Forum on working at height, and Ahmed Khalil, director HSE, BAPCO, will give the opening keynote address. The Forum will include presentations on fire prevention and



Mock fire drills have featured at previous events.

Image Credit : Alain Charles Publishing

hazmat (hazardous material) from Bahrain Civil Defence (Fire Brigade).

Bahrain may be a small country, but it punches above its weight in terms of health, safety and environment standards. At the session on safety, Hesham Abdulla, head of safety at Aluminium Bahrain, will speak on the company's culture of 'extreme ownership of safety' which engages the entire workforce in the commitment to achieving the highest safety standards. Also speaking will be Ali Mahdi, occupational engineer at the Ministry of Labour and Social Development, who will address the role of legislation in controlling occupational accidents.

The business benefits of having a happy and healthy workforce are increasingly recognised. A session on health and prevention, moderated by Dr Maha Shehab, general secretary, Bahrain Health and Safety Society, will cover health risk assessments in workplaces and providing comprehensive healthcare through integrated and curative services.

In the area of risk management, Mazharuddin Shaikh, safety engineer, Kuwait Oil Company, will present on barrier-based inspection and training for excellence in risk management.

With the Fourth Industrial Revolution having a transformative impact on the

workplace, a strong theme will be the role of modern technology in improving overall performance. A session on the future of OHS in the digital age will explore the use of drones for site inspections and risk reduction; IoT to enable companies to monitor potential hazards within the working environment; reducing risks using the EHS 4.0 framework and smart and connected firefighting systems.

"Health and safety practices continue to evolve in the Middle East," said Soumen Chakraborty, conference producer. "EHS professionals need to keep pace with the latest trends, technology and best practices to create a healthier and safer workplace while adapting to changing demographics in the workforce. It is also vital to learn how data analysis and new technology can prevent illness and injury.

"The Bahrain HSE Forum 2019 will bring visionary speakers from multiple sectors amidst an audience of industrial hygienists, occupational health professionals, EHS specialists, safety professionals, risk management professionals, and others responsible for safety, health, and the environment at their organisations." ■

For further information, see the website at [www.hse-forum.com](http://www.hse-forum.com).

## North American tight oil now second cheapest source of new global oil volumes

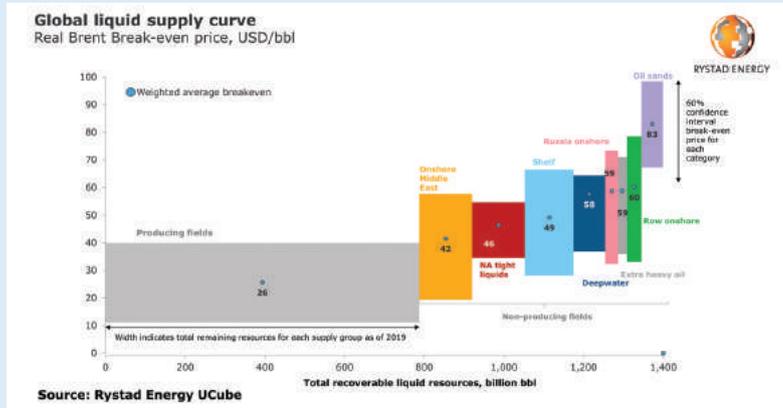
NORTH AMERICAN TIGHT oil is emerging as the second cheapest source of new oil volumes globally, just behind the Middle East onshore market, according to Rystad Energy.

“As the majors are struggling to replace conventional liquids, a wealthy source of additional resources is tight oil,” says Espen Erlingsen, head of Upstream Research at Rystad Energy.

Tight oil – such as onshore shale oil in the USA – has witnessed an impressive turnaround over the last few years. In 2015, North American shale ranked as the second most expensive resource according to Rystad, with an average breakeven price of US\$68 per barrel. The average Brent breakeven price for tight oil is now estimated at US\$46 per barrel, just four dollars behind the giant onshore fields in Saudi Arabia and other Middle Eastern countries.

“The North American tight oil industry has changed considerably since 2014, as it has proven to be a competitive supply source in a low price environment,” Erlingsen added. “While costs for tight oil have been reduced, the resource potential has grown considerably over the last four years.” Rystad Energy estimates that total recoverable resources from North American tight oil have more than tripled since 2014.

Whereas offshore normally needs seven to 12 years to recover



costs, tight oil typically requires only two to four years.

“Tight oil is a short cycle investment with a relatively brief lead time from the sanctioning of new wells to the start of production. This gives E&P companies the flexibility to adapt to market conditions and easily change activity levels,” Erlingsen remarked. “In the ever-changing oil price environment, this implies tight oil investment has less uncertainty compared to offshore.”

US shale operators are on course to increase oil production by 16 per cent in 2019, according to Rystad Energy.

## Al-Falih recommends driving down oil inventories

KHALID AL-FALIH, SAUDI Arabia's energy minister, has said that he recommends 'gently' driving oil inventories down at a time of abundant global supplies, and that OPEC would not make hasty decisions on output ahead of its June meeting.

“Overall, the market is in a delicate situation,” Falih told reporters before a ministerial panel meeting of top OPEC and non-OPEC oil producers, including Saudi Arabia and Russia.

While there is concern about supply disruptions, inventories are rising and the market should see a “comfortable supply situation in the weeks and months to come,” he said.

OPEC would have more data at its next meeting in late June to help it reach the best decision on output, Falih added.

“It is critical that we don't make hasty decisions – given the conflicting data, the complexity involved, and the evolving situation,” he said, describing the outlook as “quite foggy” due in part to the trade dispute between the USA and China.

“But I want to assure you that our group has always done the right thing in the interests of both consumers and producers, and we will continue to do so,” he stated.

OPEC, Russia and other non-OPEC producers, an alliance known as OPEC+, agreed to reduce output by 1.2m bpd from 1 January for six months, a deal designed to stop inventories building up and weakening prices.

Alexander Novak, Russia's energy minister, told reporters that different options were available for the output deal, including a rise in production in the second half of the year.

Suhail Al-Mazrouei, the UAE's energy minister, added that the UAE did not want to see a rise in inventories that could lead to a price collapse, and that OPEC would act wisely to maintain sustainable market balance.

Oil prices dropped in the last week of May to below US\$70 due to rising US inventories and the US-China trade war.

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## KBR wins BED and FEED for Sonatrach/Cepsa JV project in Algeria

KBR HAS BEEN awarded a contract by Sonatrach and Cepsa to provide basic engineering design (BED) and front end engineering design (FEED) for the Rhoudel Krouf Field (RKF) redevelopment in Algeria.

The RKF field, located in the Algerian desert south-east of Hassi Messaoud, includes an oil and gas central processing facilities (CPF) with gathering network and all associated structures.

The redevelopment is set to add an additional oil and gas treatment train to the existing facilities. This project is part of Sonatrach's and Cepsa's objectives to support the increase of Algeria's oil and gas capacity. The project will be executed from KBR's London and Chennai offices over an eight-month period.

Jay Ibrahim, president for energy solutions and services at KBR, said, "This project will demonstrate KBR's ability to utilise its global resources to provide the full capabilities of engineering and FEED services."



Image credit: John R Perry/Pixabay

The RKF field is located in the Algerian desert south-east of Hassi Messaoud.

## Bapco completes financing of modernisation programme

THE BAHRAIN PETROLEUM company (Bapco) has announced that its multibillion-dollar refinery modernisation programme has reached a financial close.

Estimated to cost more than US\$4bn, Bapco aims to boost its refining capacity from 267,000 bpd to 380,000 bpd.

Bahrain's Prime Minister Prince Khalifa bin Salman Al Khalifa laid the foundation stone for the project in the presence of Prince Salman bin Hamad Al Khalifa, crown prince of Bahrain, deputy supreme commander and first deputy premier on 5 March. The expansion is expected to be completed by 2022.

Financing was formally secured on 20 December 2018 with BNP Paribas, HSBC Middle East and Verus Partners acting as financial advisors to help Bapco meet the conditions required to successfully complete the financing process.

Sheikh Mohammed Khalifa Al Khalifa, minister of oil in Bahrain, said, "Given the size and scale of the programme, this is a mutually beneficial conclusion for a wide variety of partners from across the globe, because it means we can provide a wider product offering and meet higher demand from our customers."

## UAE determined to ensure uninterrupted global oil supplies

HH SHEIKH MOHAMED bin Zayed Al Nahyan, crown prince of Abu Dhabi and deputy supreme commander of the UAE Armed Forces, has reaffirmed the determination of the UAE to ensure uninterrupted global supplies of oil.

Underlining the country's keenness to continue consultations and exchange of views with Egypt over the latest regional and international developments, Sheikh Mohamed said, "The myriad challenges besetting the region entail an efficient pan-Arab reaction that protects the supreme interests of Arab nations and helps achieve their peoples' ambitions for security, stability and peace."

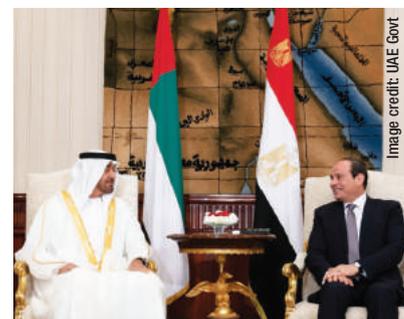


Image credit: UAE Govt

The leaders reaffirmed their solidarity with Saudi Arabia against all attempts to undermine its security and stability.

"Targeting tankers and oil facilities is a grave development that poses a significant menacing threat to the entire world, not to the affected countries only," he added, expressing his appreciation of the supportive stance adopted by Egypt toward the UAE and Saudi Arabia in this regard.

He made the statements during his meeting with Egyptian President Abdel Fatah el-Sisi.

Abdel Fatah el-Sisi reiterated his condemnation of the sabotage acts against four commercial vessels off the UAE waters and oil facilities in Saudi Arabia, denouncing both developments as a menacing threat to regional and international security.

The leaders reaffirmed their solidarity with Saudi Arabia against all attempts to undermine its security and stability, with the Egyptian president emphasising that the Gulf region's stability is an integral part of Egypt's national security.

They underlined the importance of maintaining the highest level of coordination to confront the besetting challenges and counter all threats to Arab security and stability.

## Grandweld Shipyards launches tenth boat for KOC fleet

THE UAE-BASED GRANDWELD Shipyards has launched its sixth pilot boat for Kuwait Oil Company (KOC).

According to a contract signed in May 2017, the MESKAN is the final boat of ten – four crew transport boats and six pilot boats – that Grandweld was required to build for KOC's fleet.

The total number of six deliverable pilot boats has been completed with this launch. In addition, after full inspection and testing for sailing performance, the remaining four boats that were already launched before will be delivered in June 2019.

Jamal Abki, general manager of Grandweld Shipyards, said, "Ensuring our clients' utmost satisfaction and safeguarding their business opportunities are our top priorities. Despite the fact that the agreed upon contract stipulated a speed of 22 knots for MESKAN, we have exceeded project specifications by designing and building it to reach a speed of up to 24 knots."

MESKAN is considered remarkable in build, combining both steel and aluminium in the structure of the hull to achieve greater stability in sailing, and ensuring optimal safety. In addition, the high quality materials used to manufacture the boat, hailing from the USA, Europe and Japan, offer strong manoeuvrability.



Image credit: Grandweld Shipyards

The boat has a maximum speed of up to 24 knots and a sailing range of up to 250 nautical miles.

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## Positive outlook for exploration in 2019 - Wood Mackenzie

THE OUTLOOK FOR exploration in 2019 is positive and the industry has returned to profit, according to the results of Wood Mackenzie's 11th annual Exploration Survey, based on responses from senior energy leaders and exploration professionals from across the global exploration sector.

Dr Andrew Latham, vice president, Exploration said, "We're seeing a continued recovery in the exploration sector, and this borne out by the drilling plans and new licences we're seeing.

"A number of key themes emerged in our survey. Conventional exploration is still viewed as the primary resource replacement option. And lower costs, both for exploration and development, are key to exploration's return to value creation."

High-quality prospects in deepwater sweet spots, such as Brazil, Guyana, the Gulf of Mexico and the East Mediterranean, are attracting the most attention.

According to the survey, the global exploration budget will total about US\$40bn in 2019. Drilling will account for around half of that, while 25 per cent is earmarked for geological and geophysical surveys. Digitalisation accounts for about eight per cent

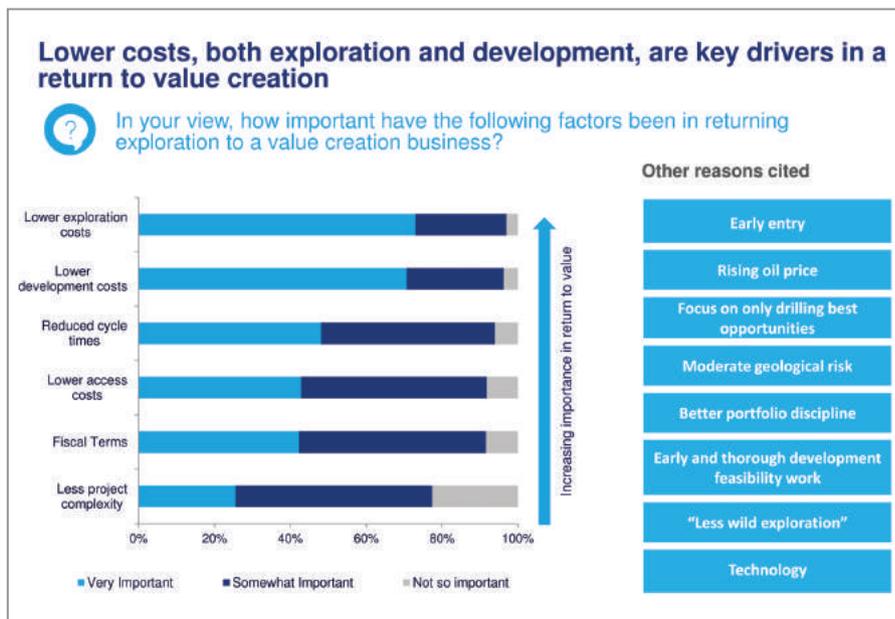


Image Credit : Wood Mackenzie

of the total spend, but this will increase as new seismic processing techniques, machine learning and AI become fundamental tools for explorers.

Dr Latham said, "Digitalisation offers exploration the possibility of better resolution of the subsurface, better seismic modelling and growing use of automated interpretation. The survey results back up our expectation that the exploration industry, led by the majors, will spend billions each year on digitalisation."

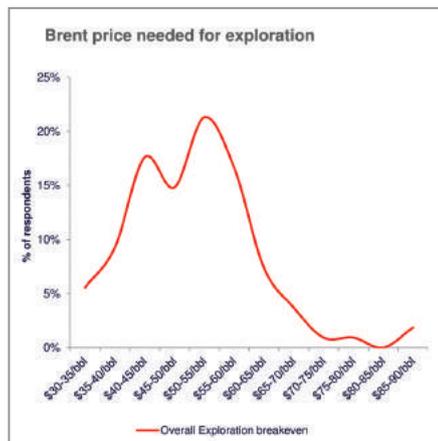
Dr Latham said that efficiency gains – hard-won during the downturn – mean that doing more with less is now standard. And while there is more investment in the exploration pipeline, that cash goes farther than before. According to the survey, the industry is confident that it can break even with an average oil price of around US\$50 per barrel.

According to survey respondents,

exploration's economics have been improved by the move towards less project complexity. Explorers are looking at prospects in less challenging basins, and as Dr Latham noted, this not only cuts costs, it helps improve drilling time – in some cases by as much as 30 per cent – and allows for quicker project development.

Around 36 per cent of those surveyed said they would be investing more on exploration this year, while only 13 per cent had reduced their budgets from last year. An even greater number (38 per cent) said they planned to drill more wells this year while just 10 per cent of respondents expect their well count to be lower than in 2018.

The oil price and political instability in key producing areas are the top concerns for 2019, along with the extent to which changes to fiscal terms and industry reforms will affect exploration activity.



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## Dana Gas starts Egypt drilling

SHARJAH-BASED DANA GAS, has announced it commenced drilling operations on 20 May at its Merak-1 well, offshore Egypt.

The exploration well is located in 755 m of water in the North El Arish concession, also known as block six.

The Merak-1 well will be drilled with the sixth generation dynamically positioned drillship 'Tungsten Explorer' on hire from ADVantage Drilling Services SAE – a joint venture between ADES International and Vantage Driller II Co (a subsidiary of Vantage Drilling).

The well is expected to take around 70 days to drill, Dana Gas revealed.

The prospective resources to be added from this well in case of successful exploration could reach four tcf of natural gas, the company noted.

In 2007, Dana Gas purchased Centurion assets onshore the Nile Delta in Egypt. Since then, 48 exploration wells have been drilled with a success rate of 67 per cent, resulting in 25 new pool discoveries. Dana Gas production from Egypt is currently more than 34,000 boepd.



Image Credit - Iurij/Shutterstock

*Dana Gas has commenced drilling operations in its North El Arish concession.*

## HOA signed for Port Arthur LNG

SEMPRA LNG AND Aramco Services Company have signed a heads of agreement (HOA) relating to the Port Arthur LNG export project.

The HOA anticipates the negotiation and finalisation of a definitive 20-year liquefied natural gas (LNG) sale-and-purchase agreement (SPA) for five million tonnes per annum (mtpa) of LNG offtake from Phase 1 of the Port Arthur LNG export project under development. It also includes the negotiation of a 25 per cent equity investment in Phase 1 of Port Arthur LNG.

Amin Nasser, Saudi Aramco's CEO and president, said, "The agreement with Sempra LNG is a major step forward in Saudi Aramco's long term strategy to become a leading global LNG player. With global demand for LNG expected to grow by around four per cent per year, and likely to exceed 500 mtpa by 2035, we see significant opportunities in this market and we will continue to pursue strategic partnerships which enable us to meet rising global demand for LNG."

Jeffrey W. Martin, chairman and CEO of Sempra Energy, added, "At Sempra Energy, we are developing one of the largest LNG export infrastructure portfolios in North America, with an eye towards connecting millions of consumers to cleaner, more reliable energy sources."

"We are pleased to partner with affiliates of Saudi Aramco to advance the development of Sempra LNG's natural gas liquefaction facility in Texas and enable the export of American natural gas to global markets," he stated.

The proposed Port Arthur LNG Phase 1 project is expected to include two liquefaction trains, up to three LNG storage tanks and associated facilities that should enable the export of approximately 11 mtpa of LNG on a long-term basis. It could become one of the largest LNG export projects in North America, with potential expansion capabilities of up to eight liquefaction trains or approximately 45 mtpa of capacity.

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*PDO has seen a massive upsurge in upstream production.*

# PDO: reaching new heights in oil production

Oman's lead producer continues to lift crude oil output as the nation's energy future brightens. Martin Clark reports.



Image Credit: PDO

**P**ETROLEUM DEVELOPMENT OMAN (PDO) continues to push Oman's all-important energy sector forward. That includes new investments in clean energy technologies and other initiatives, as well as bolstering traditional upstream production. The two are, in fact, coming together.

PDO said recently that it is planning to drive up crude oil production to 670,000 bpd in the next five years. It continues a massive surge in upstream production, with 2018 yielding its highest oil output since 2005.

Last year's total oil production averaged 610,170 bpd – a massive improvement after settling at 550,000 bpd for much of the last decade.

Collectively, during 2018, PDO delivered a combined daily oil, gas and condensate output of 1.205mn bpd.

More is to come, according to PDO's managing director Raoul Restucci.

"As we head into the next decade, we are stepping up the deployment of new technology and pursuing ever more efficient ways of working to achieve enhanced productivity in our exploration and production business," he told international media at the end of March in a business update.

At the same time, while oil and gas remain fundamental to PDO's future plans and, indeed, Oman's energy mix, work is ongoing to scale up the use of renewables, such as solar, leveraging new technology to improve overall energy efficiency.

## Oil and gas

In the upstream segment, Restucci said "good progress" is being made on PDO's so-called mega projects, at Rabab Harweel and Yibal Khuff.

At the former, Rabab Harweel – the largest capital project in PDO's history – production is expected to come on stream imminently, in mid-2019, to add further reserves of more than 500mn barrels of oil equivalent (boe). Yibal Khuff, an integrated sour oil and gas development, is scheduled for start-up in 2021, developing in excess of 327mn boe.

It highlights PDO's long reputation as a pioneer in the region for exploiting complex reservoir systems and hard-to-access deposits.

“High tech seismic has also identified new play areas in Central Oman.”

In fact, despite the use of increasingly sophisticated technology and equipment in the field, such as state-of-the-art seismic data acquisition, PDO's discovery costs remain remarkably low, at a unit cost of just US\$0.3 per boe.

High tech seismic has also identified new play areas in Central Oman, reaffirming the significant prospectivity in PDO's vast concession area.

The company holds a large tract of land

covering much of the country, alongside its partners Royal Dutch Shell, Total and Partex, and is by far Oman's top producer.

As well as lifting crude oil production, PDO is similarly targeting natural gas. Last year, it celebrated 40 years of uninterrupted gas production, which has helped fuel domestic and industrial development, as well as generate valuable export revenues for the country. The company is not only hunting more reserves in the field, but tightening up on wasted gas with various initiatives supporting its Gas Conservation Strategy.

At the end of last year, UK engineer Petrofac was awarded a US\$115mn contract by PDO for the development of the Qarn Alam co-generation power project, 350 km southwest of Muscat. It includes installation and commissioning for a gas turbine generator package with one heat recovery steam generator at the plant, built to support oil extraction in Oman's central region.

But PDO's energy conservation strategy also includes the greater use of renewables. The Miraah solar plant in Amal and the award of the Amin solar photovoltaic independent power project (IPP) are examples.

Restucci says the company is working hard to eliminate routine flaring from its operations well before the World Bank's 2030 target.

## Other activity

PDO is not the only active player in Oman's vibrant energy industry, however. BP and

Oman Oil Company Exploration & Production (OOCEP) are currently proceeding with the development of Ghazeer, the second phase of their giant Khazzan gas field. It follows the successful start-up of Khazzan's first phase in 2017, which is now producing at design capacity of around one billion cubic feet of gas a day (bcf/d) and around 35,000 bpd of condensate. The Ghazeer project is expected to come onstream in 2021 and deliver an additional 0.5 bcf/d and more than 15,000 bpd condensate production.

“ The company is working to eliminate routine flaring from its operations.”

Together, the Khazzan and Ghazeer developments are expected to deliver total production of 10.5 tcf of gas and around 350mn bbl of condensate through the lifetime of the concession.

BP also said this year that it would team up with Italy's Eni to pursue “a significant new



*There is a new buoyancy in Oman's energy sector.*

Image Credit : PDO

exploration opportunity in Oman” on Block 77 in the central part of the country. Block 77 sits 30 km east of the BP-operated Block 61 which contains the Khazzan and Ghazeer fields.

Shell is likewise busy with its involvement in Oman LNG, which is majority owned by the state, and includes other co-investors

including Total and a group of Asian partners.

First production from BP's giant Khazzan gas field is helping to reverse a decade-long decline in output from the 10.4 million-tonnes-per-annum-capacity (mtpa) LNG plant.

Oman LNG recently awarded a front-end engineering design (FEED) contract to KBR for

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a debottlenecking of its export plant at Sur, which is aimed at further boosting production at the site. KBR also landed work on a new 120 megawatts (MW) gas engine power plant for Oman LNG last year, a project designed to reduce fuel gas consumption and greenhouse gas emissions from the site.

“Oman’s energy companies are playing smarter to boost Omanisation efforts.”

**In-country value**

These initiatives highlight a new buoyancy in Oman’s energy sector, among PDO and other investors.

For much of the past decade, falling LNG exports stemmed from a government policy of prioritising gas for domestic electricity and industrial demand. But Khazzan’s estimated 10.5 tcf in recoverable gas resources offers a new source of feedstock for Oman LNG and other purposes.



PDO continues with its focus on in-country value.

Image Credit : PDO

Oman Gas Company (OGC) is expected to open its Salalah LPG plant this year. The US\$800mn plus project, which will extract all propane, butane and condensate associated with the natural gas pipeline from the Salalah area, will benefit the local economy and boost exports – around 90 per cent of production is to be exported.

At the same time, all of Oman’s energy companies are playing smarter in the allocation of work and contracts to boost so-called Omanisation efforts. Last year, PDO ramped up the value of its in-country value programme, awarding contracts worth US\$3.7bn to nationally registered firms. It is estimated to have generated 17,027 employment opportunities for Omani jobseekers, with a target to create 21,000 jobs in 2019. That’s a policy that remains just as vital for PDO as it does for the future of Oman and its citizens.

In June, PDO signed a pact with Oman LNG to coordinate efforts, with plans to jointly fund training and skills programmes for jobseekers in various economic sectors. OGC is likewise prioritising in-country value at its Salalah LPG project, supporting new jobs and local enterprises. ■

**KBR bags Oman LNG contract**

ENGINEERING FIRM KBR has announced that it has been awarded a front end engineering design (FEED) contract by Oman LNG L.L.C for the debottlenecking of its facility at Sur in Oman.

Under the terms of the contract, KBR will provide FEED services for the debottlenecking project to increase production at the facility. This FEED stipulates KBR performing full FEED services including licensor and vendor management and associated services.

Jay Ibrahim, KBR president, energy solutions – services, said, “This project builds on KBR’s

extensive track record of developing and implementing LNG projects and providing solutions to complex developments around the world.”

KBR stated that it will act as an extension to Oman LNG’s project team and help manage the overall project execution including supply management and ensure that all compliance and security areas are adhered to.

The contract underpins Oman LNG’s strong commitment to knowledge sharing and enhancing staff competency in dealing with such

complex projects, while enhancing Oman LNG’s enriched in-country value (ICV) efforts.

“We are excited to be a part of this important project and to continue to grow and maintain our presence in Oman,” Ibrahim added. “This indicates KBR’s strategic commitment to deliver our differentiated services and develop our presence and long term commitment to Oman, support its in-country value initiatives and to develop a highly skilled in-country engineering capability,” he continued.





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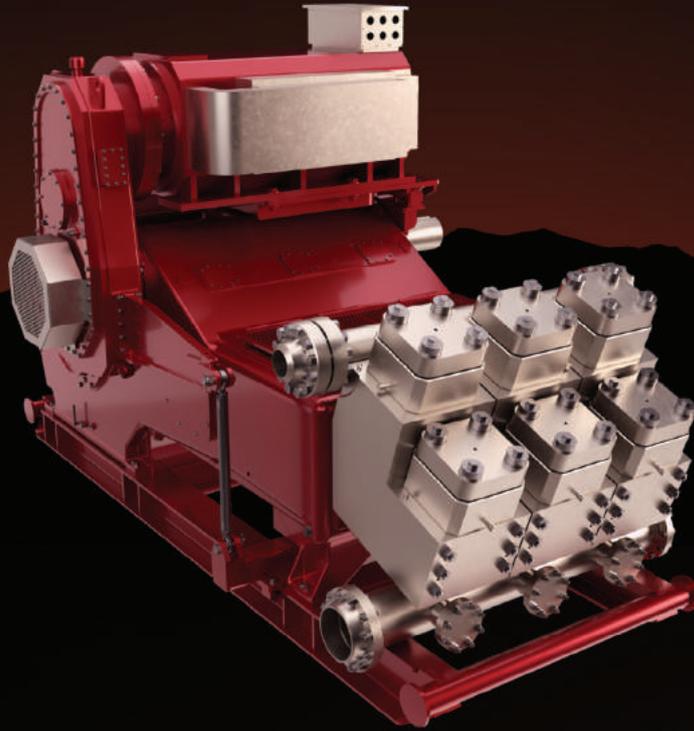
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# Turning challenges into opportunities

Petroleum Development Oman (PDO) continues to push the boundaries in technology advancement, and is turning technical challenges into opportunities. *Oil Review Middle East* spoke to Sami R. Baqi Al Lawati, PDO's technical director.



**O**IL COMPANIES THROUGHOUT the world face numerous technical challenges – and PDO is no exception. Given PDO's commitment to HSE as its overarching priority, Sami said that the first area that comes to mind is asset integrity, health, and safety, which cuts across the entire business.

"The issue is that we have built an industry where historically, people have been more concerned about production and less about process safety. We have ageing facilities and much equipment where the status of integrity is unclear, so it has been a challenging task to establish the integrity status and health of our assets and be sure that we are safe.

"To overcome this challenge we embarked upon the journey of various programmes related to total reliability and asset integrity, so we can understand what is going on inside our equipment, pipes and wells. We have stepped up our intelligent inspection programmes, ensuring that health of wells and facilities are properly monitored and

measured and the appropriate actions taken. We have a significant asset register verification programme to ensure our assets are accurately reflected in drawings, and SAP asset registers are complete with maintenance and inspection details and with correct mapping of the functional locations.

"The second challenge, which specifically affects PDO, is that we produce more water than oil – we produce nine to 10 barrels of water to one barrel of oil. Disposing of this water is a very energy-intensive operation. A significant amount of water is injected back into the reservoir for production support, but large volumes had to be disposed of into deep aquifers. But we have found more intelligent and alternative disposal methods which also bring value."

A good example of this, and where PDO has, in fact, turned a technical challenge into an opportunity, is the Nimr Water Treatment Project, where one million bpd of produced water from the Nimr oilfields is used to irrigate the Nimr wetlands and reed beds, at a fraction of the cost and energy intensity of conventional deep-water disposal. The largest industrial constructed wetland system in the world, consisting of a series of sloping reed fields and evaporation ponds, it has become home to more than 100 species of birds as well as insects, small reptiles and fish.

"It's a very innovative and environmentally-friendly way of disposing of water and helps with reducing greenhouse gas emissions – a great example of providing an integrated solution to a technical challenge with an environmental solution," commented Sami.

PDO's pioneering efforts in the use of solar steam for enhanced oil

“ We have ageing facilities and much equipment where the status of integrity is unclear, so it has been a challenging task to establish the integrity status and health of our assets and be sure that we are safe”

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recovery (EOR) can be seen in a similar light. The 1 GW Miraah solar plant at the Amal oilfield, which is set to be one of the largest solar projects in the world when complete, harnesses the sun's rays to turn oilfield water into steam for the extraction of heavy and viscous oil, as an alternative to steam generated from natural gas. It will generate an average of 6,000 tonnes of solar steam daily, saving 5.6 trillion BTUs of natural gas a year, thus providing a sustainable solution for EOR steam.

"The third technical challenge is in the area of sustaining profitable business, which depends on continually exploring new horizons," Sami continued. "Exploration plays a very strong role, and technology in exploration has enhanced over the years – for example the quality of seismic data allows you to see what you have not been able to see in the past, and allows the booking of significant oil and gas volumes across PDO's concession area."

A good example is PDO's major discovery at Mabrouk north in 2018, with estimated recoverable reserves of more than four trillion cubic feet, which was made following the acquisition of high resolution 3D Wide Azimuth seismic data in the region. The introduction of Ultra High Productivity technology has resulted in a huge improvement in seismic data acquisition.

## Leading in EOR

An area in which PDO is a leader in the region, and indeed globally, is EOR, where it is operating a range of commercial-scale EOR projects including chemical EOR, miscible gas injection, steam injection and polymer flooding. It is anticipated that by 2025, more than 23 per cent of PDO's projects will come from EOR projects.

"Our reserves are not easy to extract; significant oil resources are in tight reservoirs, or sour, or deep," explained Sami. "It is not just a matter of drilling and producing. We moved to EOR some years ago and have made significant advances. A few years ago, we carried out a miscible gas injection project in Harweel, which is running very successfully. On the back of that, we launched the Rabab Harweel Integrated Project, the biggest ever project in PDO's history in terms of spend, equipment and complexity."

“Areas we are looking to focus on in the future include turning water into an opportunity, growing renewable energy business, improving well drilling intensity and minimising declines”

The project involves the production of oil and gas from the Harweel oil reservoirs using miscible gas injection, and production of gas with condensate from Rabab.

"This project is an integrated oil and gas project with the miscible gas injection project. We expect it to be commissioned this year; it will add around 500mn bbl to PDO reserves."

Polymer and water flooding has been used successfully at Marmul, where the oil is in the range of 20,000 viscosity points. Marmul started producing in 1980, and thanks to EOR techniques, it is now producing at its highest level for over 30 years, with production from Greater Marmul standing at around 80,000 bpd.

"We are also trialling polymer in number of other fields. In addition, thermal EOR projects are being executed in two big projects at Amal and Qarn Alam," Sami continued. "The oil in the Amal field is very heavy, around 40,000 viscosity points. Here we have a mix of steam flood and cyclic steam injection." Sami added that steam injection in Qarn Alam's fractured carbonates is a rare technique, as you would not associate injection with fractured carbonates.

With demand for gas ever increasing for residential as well as commercial and industrial purposes, gas development is a key focus of PDO's activities.



Image Credit: PDO

**Sami R. Baqi Al Lawati, PDO's technical director.**

"The market and the industry are growing strongly," said Sami. Again, this poses technical challenges. "75 per cent of remaining reserves are in tight reservoirs, and around 66 per cent of remaining wells come from tight gas reservoirs. The key to the game is cracking our tight reservoirs."

While PDO is exploring technologies such as compression and form lifting, hydraulic fracking is the way to go, said Sami, as it has the potential to produce a breakthrough in productivity and bring down costs.

"We're focusing on fracking as we believe it can make a difference," said Sami. "Fracking has been used successfully elsewhere, but we need to make it economically and commercially sound for us. It requires collaboration between developers, service providers and contractors. We see it as a game changer in producing from tight reservoirs."

## Technology trials

At any point in time, there is a huge number of different technologies PDO is trialling.

"We currently have 82-85 different technologies at various stages of R&D," said Sami. "That's in addition to 70 projects in various research centres, from Shell to universities, both local and international." These range from projects such as water shut off in wells, to HSE technology, and span the full scale of the business needs.

"One area that stands out is artificial lift, which is used in almost all of PDO's production," said Sami. Here, small improvements to extend well life will make a big difference in production and operating costs. A number of different techniques and pumps are being trialled.

Another area is aquaculture in the Nimr wetlands. "We are scaling up trials to see if we can bring more value added, by growing crops that are commercially viable, such as cotton, castor oil and jojoba," said Sami. "This is a great example of integrating a technical challenge with adding value, and turning a challenge into an opportunity."

"Areas we are looking to focus on in the future include turning water into an opportunity, growing renewable energy business, improving well drilling intensity and minimising declines," concluded Sami. "These are the big-ticket items. Our technology trials and R&D projects mainly focus on these areas." ■



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Middle East oil can be produced sustainably at low cost.

Image Credit: Andrey Burmakin/Adobe Stock

# A strong national oilfield services company



Sherif Foda, chairman and CEO, NESR.

NESR, the Middle East's leading national oilfield services company, continues to experience success in the region and beyond. Sherif Foda, NESR chairman and CEO, is upbeat about the future of the Middle East's oil and gas industry.

**S**PEAKING TO OIL Review Middle East, Foda comments that the recent developments in NESR have been very positive.

"We are targeting two new countries, which we have successfully managed to enter. The first is Kuwait, where we have won a cementing contract. This is significant for us as it provides a long-term, sustainable revenue stream for the production group, as well as close contact with the customer.

"The second is Chad, where we have won a contract for coiled tubing services," he continues. He points out that Chad is a landlocked country lacking good infrastructure and the logistics are complicated. Here the company's strong social responsibility and national content capacity building ethos is coming into play, as it is building the necessary infrastructure to support the business, thereby benefiting the country as a whole. "That's why it's unique and has involved interaction with the government, the ministry and the client. It's a first for us."

Moreover, in Algeria NESR has been involved in upgrading the infrastructure. "We're putting in a lot of investment, contrary to the rest of the industry. I think you should always invest in a downturn, do the opposite to the market. Invest, put in the infrastructure and hire people so you are ready for growth. I believe the growth is there for the long term."

So, does Foda see potential for further expansion in Africa? "We like Africa and believe it has growth potential, but we have to be selective. We can't be everywhere because we don't have the size, and we don't want to dilute our image."

“ There are rich resources here to develop.”

## Positive growth prospects

Certainly, NESR is being kept busy in its core Middle East markets such as Saudi Arabia and Oman, and Foda is positive about the region's growth prospects.

"I think the market in the Middle East will grow much higher than the analysts are predicting, at around 10 per cent year on year," asserts Foda. "Our target is to double the growth of the region. It's an aggressive target but it should be, because we are the first national company to be listed in New York on the Nasdaq and the largest indigenous oilfield services company." He adds that just as the Middle East is home to strong and successful national oil companies, it befits the region to have a strong national oil services company.

Commenting on the long-term outlook for

the region, he says that while OECD oil and gas demand is forecast to fall due to energy efficiency measures and the growth of renewables, global demand will increase, mainly from Africa, Asia and Middle East, adding that one third of the world still lacks access to electricity.

"If you look at the supply side it's going to come from two places – the Middle East and US shale," he says. "US shale growth over the last four years has been based on Wall Street rather than on geology, and the return on investment has been negative, with investors exiting the energy sector and those remaining being much more selective. The measure is free cash flow, not EBITDA growth."

Other factors constraining the growth of US shale are the 'parent-child' phenomenon, where the wells are drilled as children to the parent, which means they are taken from the same area and only give a small return; and the lack of infrastructure for transporting the associated gas.

In contrast, the Middle East is blessed with oil which can be produced sustainably at a low cost.

"So I'm very positive about the Middle East, as there will be an increase in demand which will need to be satisfied by this region," concludes Foda.

"That's why we are selective in our markets; there are rich resources here to develop." ■

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# The use of dispersants in marine oil response

Oil spills can present an immediate hazard to ocean life.

A new report from the USA's National Academies of Sciences, Engineering, and Medicine examines the effects and efficacy of using dispersants in marine oil spill response.

**F**IELD AND MODELLING studies show that dispersants can be a useful tool for oil spill response, says the report. Dispersants reduce oil at the water's surface by promoting the formation and diffusion of small oil droplets that may biodegrade more readily, thereby reducing response personnel's potential exposure to hazardous compounds in oil and lessening the extent of surface oil encountered by marine species. Dispersants may also reduce the fouling of shoreline habitats by reducing the amount of surface oil that is blown ashore.

Whether the result of an oil well blowout, vessel collision or grounding, leaking pipeline, or other incident at sea, each marine oil spill will present unique circumstances and challenges, the report notes. The oil type and properties, location, time of year, duration of spill, water depth, environmental conditions, affected biomes, potential human community impact, and available resources may vary significantly. For example, dispersants are more effective on lighter oils than on high viscosity oils. Furthermore, each spill may be governed by national or regional policy guidelines.

Dispersants are one of a variety of options – each with advantages and disadvantages. Other response options include mechanical recovery of the oil using skimmers and booms, burning of the oil, and monitoring of the environment to assess how it recovers naturally over time. Decision-makers should use Net Environmental Benefit Analysis (NEBA) tools to assess the comparative environmental benefits and drawbacks. These tools should be expanded to address the health of response personnel, community health, and socio-economic impacts of various response options as well.

Protecting human health and safety is the first priority. Volatile organic compounds in oil create a risk to response personnel through inhalation of these toxic components, which are also highly flammable. Dispersants may be used to decrease these hazards by reducing the volume of floating oil in the vicinity of response operations. However, while modern dispersants have been formulated with less toxic chemical constituents, questions have been raised about whether dispersants themselves pose health risks,

While two studies examined the health effects of dispersants on responders after the Deepwater Horizon spill, and reported respiratory and skin irritation, limitations of the studies make it difficult to distinguish the effects of dispersants from the effects of oil and of dispersed oil. The report recommends that the requirements for details

for worker health and safety should be improved, with a clear focus on whether workers were exposed to dispersant.

The report notes that health impacts of oil spills in both workers and community members are likely to be at least partly dependent on the duration of the recovery period from the oil spill. If dispersants shorten the duration, presumably overall impacts on worker and community health would lessen.

Oil can present an immediate hazard to ocean life, both at the surface and below. At the surface, oil can harm animals such as seabirds, turtles, and marine mammals through physical smothering, ingestion, inhalation, and aspiration of oil. Dispersants have been used in part to reduce these hazards of surface oil. However, the action of dispersants increases the amount of oil in the water column, where fish and other species below the water's surface may be exposed through ingestion or absorption.

A key question has been whether dispersed oil is more toxic to marine life than oil alone. Concerns over the substantial use of dispersants during the Deepwater Horizon spill triggered an expansion of research on the toxicity of oil, dispersed oil, and dispersants, the report says. However the results have been unclear, at least in part due to a lack of consistency in methodologies. The report recommends a standard methodology that better accounts for the toxicity of individual oil and dispersant components.

Data from recent toxicity tests indicates that the influence of dispersants on oil toxicity depends on the concentration of oil in the water. At concentrations below approximately 100 mg oil/L, the toxicity of chemically dispersed oil is comparable to that of untreated oil. However, at concentrations above approximately 100 mg oil/L, dispersants appear to increase toxicity. Oil levels measured during spills are typically well below 100 mg oil/L, the report notes.

The report says that in making choices about dispersant use, it is important to recognise the hazards due to the toxicity of the oil itself. Unmitigated floating oil slicks pose a significant hazard to wildlife. Decisions on dispersant use should consider the risks posed by oil relative to the risk of dispersed oil. ■

*The Use of Dispersants in Marine Oil Spill Response can be downloaded at <https://www.nap.edu/catalog/25161/the-use-of-dispersants-in-marine-oil-spill-response>.*



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# The way forward for the Gulf downstream industry

José Alberich, partner, A.T. Kearney Middle East, discusses how GCC players can leverage the inevitable shift in the downstream industry.

**M**ANY OIL & GAS companies, especially NOCs, plan to expand downstream as they seek to extract greater value from their hydrocarbon resources and secure market access for their crude and fuel products. Downstream businesses also offer attractive growth rates and shareholder returns.

In recent years, the oil & gas refining and marketing sector has grown faster in developing markets than in mature ones. Going forward, the difference will become more pronounced as the oil demand from mature markets experiences a slow and steady decline, driven by the transformation of the transportation sector, regulations promoting better fuel economy and electric vehicles, and e-mobility trends.

In light of the global demand evolution and projected refining capacity, there are several significant events that are likely to impact both the refining and marketing sector as well as the chemicals industry.

Market participants in the refining and marketing sector are adapting their business models, positioning and asset portfolio as some IOCs have divested downstream assets where they were unable to achieve the desired performance. Traders, meanwhile, have now joined investors and asset managers as the main buyers of IOCs' midstream and downstream businesses and developed much more asset-focused business models. NOCs are also increasing their focus on downstream integration, with GCC NOCs leading the trend.

Global trade imbalances will persist in the medium term, with western markets (Europe and North America) showing the biggest imbalances, and Asian markets the largest deficit in oil producers.

We are also witnessing trends away from heavy fuels and towards cleaner fuels, and robust growth in the consumption of middle distillates, and expect to see this trend intensify in 2019 and beyond.

Feedstock diversity and competitiveness is becoming key, with players incorporating new feedstocks in addition to the traditional liquid and gas-based feedstocks. Technology

R&D is heavily focused on biomass-based alternatives, but around 90 per cent of feedstocks are still derived from oil and gas. Gas-based players continue to be the cash-cost winners. Feedstock complexity and volatility will continue to drive volatility, together with the pace and magnitude of capacity additions, on-purpose technologies, behaviour of state players, and protectionism and trade disputes.

Consolidation of the industry will continue, with a flurry of mega deals finally closing. Many chemicals executives expect M&A activity to remain brisk in the short term.

The environmental impact of the industry is under close scrutiny as ever, and energy efficiency is another key focus, together with biomass-based feedstocks growth. It is also important to note that state-driven players are gaining weight, with NOCs and other state-run entities becoming increasingly important in chemicals, eager to secure markets for their hydrocarbons in a world that will become less reliant on oil.

Finally, but no less important, the chemicals industry is expected to see a big impact from new digitally-enabled business models, as previously digital transformation has been limited with players predominantly leveraging digital to boost process efficiency.

“The environmental impact of the industry is under close scrutiny.”

## The way forward for GCC players

Given the above changes, it is vital that GCC players make modifications to their business and operational models:

### a) Consolidation of business models:

Several GCC players have attempted to consolidate their positions in refining and marketing by acquiring assets in

developing markets with strong fuel-demand growth potential. However, they must still develop the skills required to manage global and multi-local businesses in an integrated way

### b) Aggressive management of capital projects:

In a highly competitive downstream market, regional players need to build up their own engineering capability throughout the capex lifecycle, becoming less reliant on EPC contractors

### c) Operational excellence:

GCC players do not use one standard programme but often a mix of approaches driven by their JV set-ups. GCC players need to build their own strong excellence culture and develop tailored programmes suited to their needs

### d) Synergies between refining and chemicals:

Synergies in the integration of combined refining and petrochemicals businesses and pure chemicals businesses can be captured at every step of their respective value chains

### e) Competitive shared services:

Integrated-site services have evolved over decades in more mature markets and have, in many cases, reached levels of excellence that generate a competitive advantage

### f) Strong market and customer access:

GCC players must improve their direct market access and customer intimacy, which will be important success factors in the future, especially when expanding towards specialty chemicals and formulation businesses

### g) Proprietary technologies:

GCC players will need to develop their own leading technology position if they want to compete successfully with leading global chemicals players. Intellectual property is available, but it has not been properly monetised yet

### i) M&A and partnership models:

Given the magnitude of change required for future success, companies from the GCC should challenge a purely organic-growth strategy and use M&A to gain accelerated market and technology access. ■

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# 2019

# Rich pickings for EPCI contractors

The Middle East Engineering, Procurement, Construction & Installation (EPCI) market is buoyant, with major projects such as Saudi Arabia’s offshore developments providing fertile opportunities for business.

**T**HE MIDDLE EAST and North America are together forecast to be the biggest EPCI markets from 2019 to 2023, according to the latest research from Rystad Energy, each with a share of 21 per cent of the market (see Figure 1). The Middle East, which accounted for only 13 per cent of the market from 2014-2018, is in fact the only region where activity levels – in terms of greenfield spending – will be higher than 2023 than 2014, when the oil price plummeted.

Globally, EPCI contract awards have been on the rise since 2017, according to Rystad Energy. As shown in Figure 2, the EPCI sector locked in around US\$70bn in greenfield contracts per annum in 2017 and 2018. In the first recovery year of 2017, US\$47bn was awarded in onshore projects and US\$23bn in offshore projects. Going forward, Rystad expects offshore greenfield awards to reach US\$31bn in 2019 and US\$48bn in 2020.

The increased award volume offshore is driven partly by big projects in Saudi Arabia (Berri, Zuluf expansion and Marjan), Qatar (North Field Expansion T8, T9, T10, and T11), the UAE (Hail & Ghasha and Upper Zakum), Mauritania (Tortue West), and Brazil (Carcara, Lula and Atapu North).

In the period from 2018 to 2023, Rystad Energy expects the global EPCI market to achieve a growth rate of five per cent per annum, with increased greenfield activity the main growth driver.

The market for construction and installation services – which includes onshore topside and structure construction, and offshore construction – is expected to grow by five per cent per annum, according to Rystad. The market for procurement, construction and installation equipment, such as rotating equipment, cables, electro, pipes, and valves, is expected to grow by five per cent per annum. Engineering services such as FEED, studies, project management, and detailed engineering, are expected to lag, with an estimated growth of one per cent per annum.

## EPCI purchases 2014-2018 vs 2019-2023 Billion USD

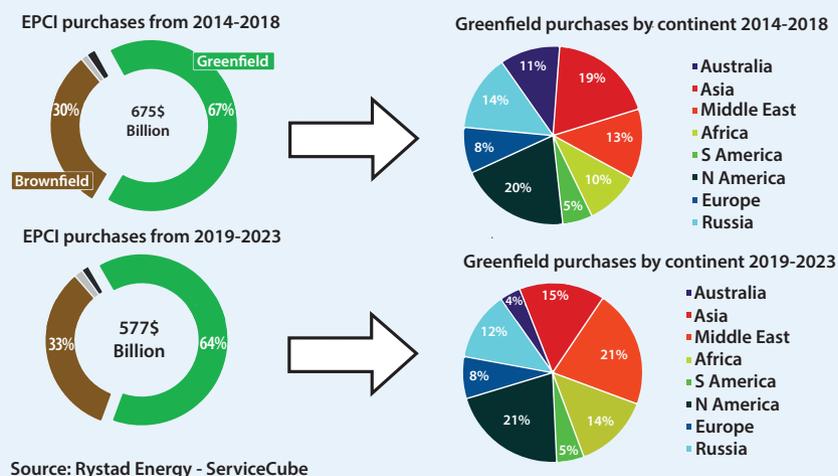


Figure 1: The Middle East is forecast to have a 21 per cent share of the EPCI market from 2019-2023.

## EPCI greenfield contract awards on the rise Billion USD

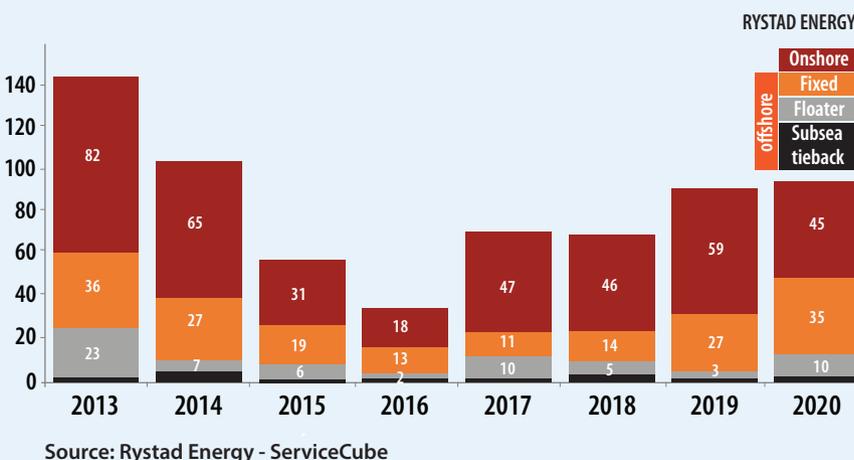


Figure 2: EPCI global greenfield contract awards worldwide are on the rise.

The dominance of the Middle East is corroborated by Global Data's latest *Quarterly Oil & Gas Industry Contracts Review*, according to which EMEA recorded the most contracts in the oil and gas sector in the first quarter of 2019 with 569 contracts, representing around 48 per cent of the total awarded, followed by the Americas region with 366 contracts, accounting for 31 per cent of the total awarded contracts.

### Middle East contracts

EPCI contracts awarded in the Middle East and North Africa region in 2019 include:

**Saipem** – two contracts worth US\$1.3bn from Saudi Aramco for the design, EPCI services and implementation of subsea systems in addition to the laying of pipelines, subsea cables and umbilicals, platform decks and jackets for the development of Berri and Marjan fields, offshore Saudi Arabia;

**TechnipFMC** – in consortium with MMHE (Malaysia Marine and Heavy Engineering), six-year Offshore Agreement with Saudi Aramco covering engineering, procurement, fabrication, transportation and installation of offshore facilities for the development of Saudi Aramco's offshore projects;

**TechnipFMC/Maire Tecnimont/Worley** – FEED for the world's largest mixed feed cracker at the Ruwais Petrochemical Complex, Abu Dhabi for Borouge;

**National Marine Dredging Company** – US\$1.36bn contract from ADNOC for the provision of dredging, land reclamation and marine construction of artificial islands and causeways, as well as to expand existing Al Ghaf island to drill and produce gas from offshore sour gas fields, Abu Dhabi;

**Petrofac** – US\$1bn contract from Groupement Isarene for the Engineering, Procurement, Construction and Commissioning (EPCC), start-up and performance testing for the Ain Tsila field development project in Algeria;

**Subsea 7** – Two EPCI (Engineering, Procurement, Commissioning and Installation) contracts with L&T Hydrocarbon Engineering for three oil production deck manifolds and subsea pipelines in Zuluf Field and subsea pipelines in Berri field, offshore Saudi Arabia for Saudi Aramco;

**McDermott** – Contract award from Saudi Aramco for EPCI services in the Marjan field, offshore Saudi Arabia. Includes the design, procurement, fabrication, and installation, testing and pre-commissioning of the TP-10 tie-in platform, six gas lift topside modules and associated pipeline and subsea cables;



Image Credit: Bilfinger

*Bilfinger is among those companies awarded EPC contracts this year.*

“ The new facility will localise expertise in multiple industry-related disciplines.”

– FEED services for ADNOC Refining relating to Refinery Offgases project at Ruwais Refinery, Abu Dhabi. Includes evaluation of technical configurations and options for recovery of hydrogen, ethane and sales-grade LPG;

– Basic engineering, technology license and catalyst for an integrated Low Pressure Recovery (LPR) and Olefins Conversion Technology (OCT) unit at KIPIC's Petrochemical Refinery Integration Project (PRIZe), Al Zour, Kuwait;

**Larsen & Toubro Hydrocarbon Engineering (LTHE)** – EPCC (Engineering Procurement, Construction & Commissioning) for central processing facilities for three gas fields, for Sonatrach, Algeria;

**KBR** – basic engineering, design and FEED for Rhoude el Khrouf field development, Algeria for Sonatrach/CEPSA, including oil & gas central processing facilities, with gathering network and associated structures;

**Bilfinger** – three multi-million EPC contracts for turnkey installation, replacement and modification services for ADNOC's Ruwais refinery. Including design, supply and installation of upgrade solution for

hydrocracker and hydroskimmer units, and specialised EPC services for the installation of Bernoulli filters for the seawater network of the hydrocracker unit, as well as LPG transfer pumps and progressive cavity pumps at the hydroskimmer plant.

### Focus on local content

A growing feature of EPC contracts and activity in the region is the requirement for local content development. The announcement of TechnipFMC's award with Saudi Aramco, for example, states that the company will continue to hire and train Saudi engineers in support of Saudi Arabia's iktva (localisation) initiative.

In March, it was announced that McDermott Arabia Company, a McDermott International subsidiary, will establish a fabrication facility located within the King Salman International Complex for Maritime Industries in Ras Al-Khair on the east coast of the Kingdom near Jubail Industrial City.

The new facility will be used for large-scale fabrication of offshore platforms and onshore/offshore modules. In order to further enhance project execution capabilities in Saudi Arabia, McDermott will expand its in-country engineering and procurement offices as well as establish a new marine base in the eastern province to support the installation of offshore platforms, subsea pipelines and cables, skids and associated structures and assemblies. It will localise expertise in multiple industry-related disciplines and is expected to create around 7,000 jobs.

It is hoped that the facility will serve as a major EPCI hub for not only the kingdom, but for the GCC region. ■

# The benefits of data validation & reconciliation

At Belsim's 21st Users' Meeting Event held in Marseille in April, clients and partners of the leading software and engineering company came together from across the globe to share their experiences of the company's VALI Data Validation and Reconciliation (DVR) software.

**F**ORMED AS A spin-off from the University of Liège, Belgium back in 1986, Belsim is the worldwide pioneer and leader in the field of Data Validation and Reconciliation (DVR).

Belsim's VALI Software Suite, invented by the company's founder Professor Boris Kalitventzeff, uses DVR and state-of-the-art modelling techniques to transform process data into consistent, accurate and reliable information, that can help to operate processes correctly, detect problems in time, and eliminate inefficiencies. VALI automatically computes key performance indicators with a high level of accuracy and reliability. Users can add their own constraints, rules and equations to the process model in a user-friendly way. When process parameters cannot be measured directly, VALI uses a soft sensing system to calculate their value. The same technique can be used to reduce the investment in expensive measurement equipment, such as multiphase flow meters in the oil and gas industry.

VALI installations include applications on continuous processes in a wide range of industry sectors where accurate measurement data is critical. At the Users' Meeting, which provided a forum for a lively exchange of insights and experiences, case studies were presented by clients and partners from upstream oil & gas, refining and power generation, among others.

These included one of Belsim's earliest customers, Air Liquide, which has used VALI to improve performance in various industrial processes such as steam methane reforming, coal gasification and purification by adsorption. The company is now spearheading R&D in the use of DVR to exploit data from pilot plants, using VALI as a design tool.

"Compared with other data validation tools, VALI has many features allowing the user to analyse results very effectively, and interpret to what extent the measure data are good or not," said Air Liquide's Philippe Arpentinier. "Now we are applying data



*The Belsim team with clients and partners at the Users' Meeting in Marseille.*

validation to our pilot plants. Our engineers use the data validation tool to interpret measurements obtained in experimental pilots. It has taken a long time to develop this competency, the benefits being more accurate data. We use reconciled data to calibrate our simulation models, and using this methodology we built a pilot and measured a lot of variables, reconciling all these variables through the use of VALI. We obtain mass balance around our pilot, and on the

reconciled mass balance we can calibrate a simulation model which will be used by our engineering department for the design of an industrial plant."

The meeting also heard from Belsim's Timothy Jadot about the new and enhanced features of VALI 5, launched in 2018 and taking on board feedback from its customers. These include new architecture providing improved security and possibility of installing VALI 5 on the Cloud in the future; ValiStudio, a new integrated user interface; improved modelling; new diagnostic tools; web-reporting functionality, and more seamless integration between different parts of the application.

"VALI 5 has many valuable features and will make it easier to present results to our management," said M. Arpentinier, a sentiment echoed by other users.

“ VALI has many features allowing the user to analyse results very effectively.”



Image Credit : Belsim

Pascal Leurquin, Belsim's CEO (right) with Frank Todd, True North (centre) and Amin Amin, COO of Belsim's North America operation.

## Looking ahead

Belsim's CEO Pascal Leurquin commented that VALI 5 is a "big improvement" on previous models. "Our vision today, based on what we hear and see, is that the company has a great product. We want to share it with companies throughout the world."

“ A key aim is to expand partnerships with universities around the world.”

He said that the company's ambition is to double sales growth every year. As well as expanding VALI's use in sectors such as power and oil & gas, it is looking to extend to new applications such as ammonia plants and concrete plants, and to increase the focus on cyber security. Building on its strong presence in Saudi Arabia, Belsim also aims to diversify its geographical markets and expand its presence in the Middle East, Europe, North and South America, North Africa and the Far East. It recently signed a contract in Egypt, a new market for the company.

The USA is at the top of the list, and is set to become the company's second largest source of revenue. Through the partnership

with True North, which has closed major deals with nuclear and conventional power plants, there is strong potential for further growth, said M. Leurquin.

Belsim has always had strong links with academia and the scientific community. A key aim is to expand partnerships with universities around the world to share its product and exchange expertise. M. Leurquin noted that the future cyber protection base of its product will be developed in cooperation with a university in the USA. He mentioned that Liège University, HELMO Gramme and EPFL offer a course in VALI, and students can do internships with Belsim, which can lead to employment with the company. Belsim is looking to replicate this at universities elsewhere. As well as helping with recruitment, this serves to promote the product's visibility.

The future looks bright for Belsim, as it heads into a new growth phase.

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## Benefits of VALI

- Fully integrated process modelling interface
- Proven VDI 2048 compliant DVR engine
- Web-based user interface
- Based on latest Microsoft .NET technology
- Role-based user management
- Windows AD support
- Multiple data sources in one application
- Three highly efficient solvers
- Unique Gross Error Elimination techniques
- Dedicated Production Accounting reports
- Comprehensive thermodynamic library
- Seamless integration of mass and energy balance modelling
- KPI calculation inside the model along with their uncertainties

## A true partnership

AT THE BELSIM Users' Meeting, Belsim's CEO Pascal Leurquin highlighted the role of the company's implementation partners in opening doors and spreading the word about VALI.

The USA's True North Consulting has been instrumental in introducing VALI into the USA's conventional and nuclear power sector and raising awareness about the benefits of DVR. It has been educating clients on how VALI can help them evaluate, understand and interpret data to improve performance.

True North gave the case of an Electric Power Research Institute (EPRI) study illustrating the use of data reconciliation to improve power plant heat rate monitoring in a brand new combined cycle gas-fuelled power plant in the USA. The VALI model found a significant fuel flow discrepancy of 4.2 per cent. High redundancy allowed VALI to place high confidence in the reconciled flow, which was 4.2 per cent higher than the plant heat rate. The discrepancy was narrowed down to an error in the total fuel flow meter. On further investigation, it was found that variation was caused by the fact that the vendor had used an assumption for the fuel gas constituent that did not match the local gas it was actually using. The upshot was that the plant was overpaying for its fuel gas by 4.2 per cent.

The plant management was very impressed with these results, and the findings were sent to EPRI as further evidence of the value in what VALI can do. True North will reassess the plant after implementing a fix.

True North also gave a case study on a three-unit nuclear power plant, where consistent difference in gross generation between units had been identified, and where DVR modelling was employed to identify the cause of the difference.

True North's Frank Todd sees huge potential in expanding the use of VALI in the USA, where DVR is still relatively unknown. True North is working with the Nuclear Regulatory Commission, EPRI and ASME for DVR to be written into the relevant codes in relation to measurement uncertainty.

"When that happens, a process that has been foreign to the USA will become almost indigenous, and its use will be pretty big," he said. "We're already in the process of installing VALI in Exelon, the USA's leading power generating company, and we've done work for many years now with EPRI and other organisations to have it evaluated. Now we're at the point where it's been evaluated, people like it, and I'm hoping it will change our paradigm."

# Data as a strategic asset

Elena Huff, senior manager, advisory services at EY, gave a keynote presentation at the Belsim Users' Meeting on data as a strategic asset, highlighting how organisations can be liberated by taking control of their data.

**E**LENA HUFF NOTED THAT there have been buzzwords around new technologies such as AI but stressed “everything starts with good quality data”, underlining the importance of validating and reconciling data. “You can’t capitalise on these new innovative solutions without that foundation.”

Measurement data is key in the oil and gas industry, she stressed. “Trusted production data, converted into robust action, will improve performance in various processes in the oil and gas industry,” she said. “For example, you can optimise well production, conduct surveillance of your wells better, know what to do to boost the performance of the well. You can understand the characteristics of the reservoir better and improve your drilling programme. All this leads to more drilling rigs, more producing wells and improving free cash flow.”

However all too often, data is not trustworthy, complete or fully known. It has been estimated that in the USA alone in 2016, US\$3.1 trillion was wasted due to poor quality data. (Thomas C. Redman, Harvard Business Review, Sept. 22 2016). There are still issues with siloed data and processes; for example multiple versions of raw data inputs may exist in different projects and different user archives. This is particularly the case in the oil and gas industry, where production data owners in the field are far removed from the data consumers at the office. Business users often spend more time searching, cleaning and assembling data than actually using it for analysis.

“This can be mitigated by the use of powerful enabling technologies such as VALI. VALI collects data from multiple measuring points and reconciles it, showing you where there are any exceptions, then you are able to make informed decisions based on that. Data tells a story; it shows the systems, paints a picture of where there are issues – but it is up to people to take action on it – for example, calibrating meters correctly.”

“Validating data from the start is the most efficient way to avoid setbacks, re-engineering and poor decisions,” she added.

## Nine-step governance framework

Powerful enabling technologies such as VALI need to be combined with appropriate data governance organisation. Mrs Huff outlined a nine-step governance framework that requires partnership and collaboration between all functional domains:

- Determine organisational priorities and define scope – for example start with ten or fifteen key data elements such as temperature, pressure etc.
- Invest in change management, which is critical for adoption and sustainability
- Establish data governance organisation demonstrating comprehensive leadership support
- Connect and align teams through a fit-for-purpose data catalogue which needs to be respected by all – define what data elements mean, owners, availability; establish systems of record – enabling



Image Credit: Belsim

Elena Huff with Frédéric Lecoq, Belsim's COO.

the one “source of truth”

- Establish data governance policies to support priorities and the regulatory landscape
- Define the new operating model by transforming policies into new ways of working
- Design enabling technologies to ensure seamless integration of data across systems – DVR is a good example
- Implement ongoing data quality and availability monitoring – metrics and KPIs to measure performance
- Ensure sustainability via period audits based on defined KPIs.

Organisation change management is often the area that oil and gas companies struggle with the most, said Mrs Huff. “Change management permeates throughout the entire lifecycle of the data governance framework. I can’t emphasise enough how important this is. You can’t run an organisation the old way and expect new results! It involves a complete change of mindset and culture. It’s not a sprint or even a marathon, it’s a complete lifestyle change.”

“Be a change advocate,” she advised. “Tell your people why treating data as a strategic asset is important for the company and them personally, and how it can help free up time. In the energy space in particular, there is a huge lack of understanding of data lifecycle flow and all the points where data can get compromised, from the point of data capture, to the time when it is actually used. Educate your organisation on the data lifecycle.”

“Companies who are at the forefront of taking on this data-centric mindset, focusing on data as a strategic asset, will be the ones to realise their competitive advantage earlier,” she stressed. “Those that don’t, will not survive.”

“Data is the oil of the digital era. Raw data must be refined for its value to shine brightly. VALI is a great tool to make sure your data is accurate and to highlight the challenges with it, but it needs the proper framework around it,” she concluded. ■



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# The challenges of accurate interface management

Interface measurement is a key concern for the oil, gas and petrochemical industries. MAGNETROL has developed a white paper addressing the challenges and considerations around interface measurement and currently available technologies for process optimisation.

INTERFACE OR MULTIPHASE level measurements exist throughout the oil and gas as well as petrochemical streams. While level measurement technologies have come a long way in effectively measuring liquids and solids, multiphase level measurement continues to be the biggest challenge and opportunity that exists today for which there is no perfect technology. However, experience has shown that process optimisation and increased uptime can still be achieved in many separator applications through reliable, best-in-class, level technology.

## The basics of Interface

In the oil & gas and petrochemical industries, the need for reliable interface measurement arises whenever immiscible liquids, those incapable of mixing, reside within the same vessel. The lighter medium rises to the top and the heavier settles at the bottom. In oil production, for example, water or steam is used to extract oil from a well. Well fluids then



A production separator on an offshore oil and gas platform.

route to production separators where they settle into their primary constituents as a hydrocarbon over water interface.

Interfaces can form between liquids and solids, liquid and foam, and liquid and gas; but the emphasis here will be concentrated on liquid/liquid interface (often with a vapour space above the top/lighter liquid). Immiscible liquids meet along an interface layer where they undergo some amount of emulsification. This emulsion layer (also referred to as a “rag” layer) may form a narrow, distinct boundary, but more frequently it is a broader gradient of the mixed liquids. Generally, the thicker the emulsion layer, the greater the measurement challenge.

While monitoring the top, or total level, is critical for safety and overflow prevention, knowing the level of an interface is necessary for maintaining product quality and operations efficiency. If there is water in oil that is not separated effectively (water carryover), then this can induce processing problems, equipment failures and unplanned shutdowns.

If there is oil in water (oil extraction), then there can be production loss, environmental fines, penalties and forced shutdowns.

Of all the level switches and transmitters available, only a handful are suitable for reliable interface measurement. The leading interface measurement technologies include guided wave radar (GWR), buoyancy-based displacers and magnetostrictive, RF capacitance, nuclear/ gamma radiation and thermal dispersion. Ideally, the technology utilised for interface applications does not have to differ from other level instruments installed at the facility in order to maintain familiarity with users. Standardising on a technology helps reduce training, installation and commissioning, maintenance and downtime. Of course all of these have an associated cost.

## Current level technologies utilised for interface measurement

There is no perfect, one-size-fits-all technology for interface applications. Outside

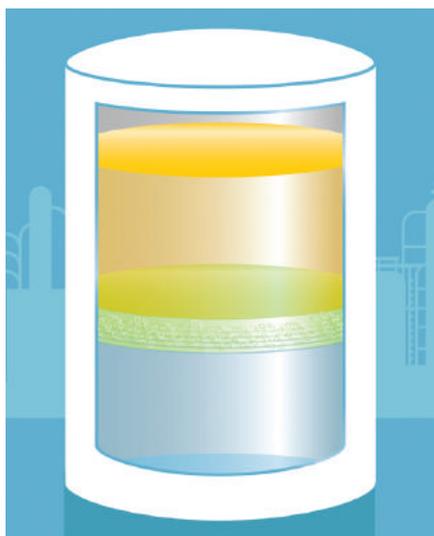


Figure 1: Multiphase level often includes hydrocarbon at the top, emulsion (rag layer) in the middle and water at the bottom.

Image Credit : MAGNETROL

Image Credit : Adobe Stock

of considering reliability and price points, familiarity often plays a pivotal role in determining the level measurement solution. This is particularly true for established technologies such as differential pressure (DP) and displacer-based products.

DP is still the most widely used level measurement technology, as seen in the *Control Market Intelligence Report* in March 2017, where more than 40 per cent of instrumentation users / respondents advised that they prefer and use DP in approximately one-third or more of their applications as a percentage of all instruments. However, DP is not a preferred technology for interface measurement. Extensive calibration is required, along with assumptions that density and total level are constant.

Utilising this technology typically results in one inferred interface measurement near the middle of the emulsion layer as opposed to

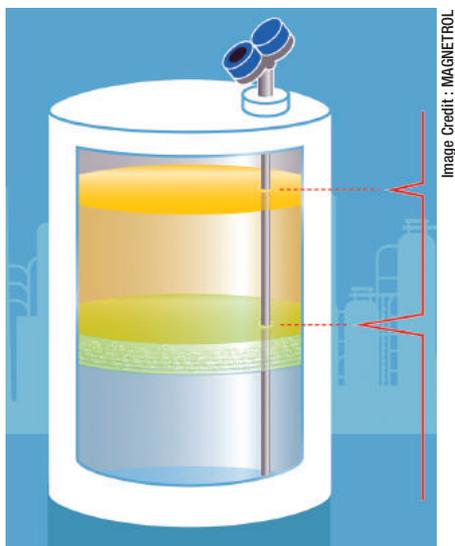


Figure 2: GWR with signal reflections down probe.

both total level and interface measurement. Variation in the thickness of the emulsion layer affects density, and can therefore induce significant inaccuracy.

Referencing that same Control report, the second most preferred technology as a percentage of all instruments and applications is GWR. More than 25 per cent of respondents preferred GWR in approximately one-third of their applications. The ability to use GWR for total level (potential overflow prevention) and interface applications greatly increases user familiarity, allowing the technology to be applied correctly while decreasing training and commissioning time. GWR may also have limitations for interface, but these are often mitigated with demulsifiers or increasing process temperature to assist the separation of heavier oils.

Magnetostrictive technology is also used for interface measurement. It is based upon buoyancy principles, therefore specific gravity-related drawbacks exist, but it has

advantages particularly in applications with large or swelling emulsion layers. Consideration must be taken for solids buildup, such as paraffin or asphaltene adhesion, due to moving parts.

Other interface technologies, such as displacers (mechanical) and RF capacitance, are preferred by only 12.6 per cent and 8.2 per cent of respondents respectively in one-third of their applications. Heavy oils may present major inaccuracies when coating probes or building up on floats, which can also increase maintenance intervals. However, there is a comfort level with these technologies for oil & gas sectors in particular.

The Interface whitepaper on [interface.magnetrol.com](http://interface.magnetrol.com) gives an Interface Level Technology Comparison table. It displays a condensed look at the primary technologies used in interface, along with their strengths and limitations. A figure is also included to highlight the importance of addressing density, or API gravity, for technology consideration. High specific gravity (low API) heavy crude oils impact the emulsion layer and can potentially add to the maintenance requirements.

### Field experience for process optimisation and increased uptime

In the oil & gas and petrochemical industries, there are numerous interface applications that potentially produce an emulsion layer. Having a reliable level measurement will help optimise processes while increasing uptime. The following are applications and case studies highlighting the challenges faced for level technologies and the importance of this measurement.

It should be noted that no matter the technology, optimal installation conditions will assist in maximising device performance. For instance, when inlet crude oil from a well enters a separator, retention time may be the most important factor to allow for the desired instrumentation performance, and therefore, process optimisation. In other words, if the feed comes into a horizontal separator, the optimal installation location of the level measurement device is further away from the inlet (closer to the weir) where separation of the crude and water becomes more uniform. Demulsifiers assist with emulsion breakdown but can be reduced (estimated US\$1,500-2,000 per ton) when working in concert with reliable interface level measurement.

When device performance is maximised, a tighter control of the top of the emulsion layer is possible. The top of the emulsion is an indicator of water present in oil. With the primary goal of the separator to remove water from the oil, the level measurement can now allow operation closer or further away from the weir to optimise separator efficiency and retention time. If the separator-type is primarily for water storage, with a thin layer of oil on top, then tighter interface control will also

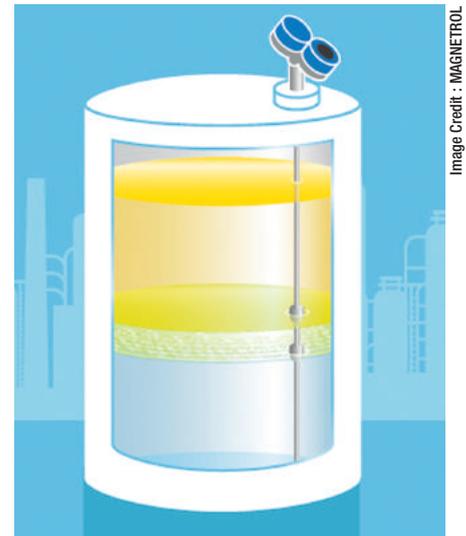


Figure 3: Direct-insertion magnetostrictive transmitter measuring emulsion layer.

provide a more accurate representation of how much water (only) is present in the vessel. This allows improved truck utilisation, ensuring full truckloads during water extraction from storage vessels.

This ideal installation may not always be possible on a retrofit, but ideally instrumentation location is taken into account during separator design.

What is important to consider in any application, regardless of whether it is interface or total level, is what can occur during upset conditions or startup and shutdown.

Most devices may work fine in normal interface operation; however, reliable measurement is required in those upset cases as well:

- When only one liquid exists (only water or only oil)
- When chamber is flooded with only oil and water – no gas phase exists)
- Multiphase oil, water and gas including overflow prevention

The first industry that comes to mind when discussing interface is upstream oil & gas or exploration and production (E&P). The initial challenges begin at the wellhead separators and resonate through the remaining hydrocarbon streams. Aside from this initial separation, an increasingly influential interface measurement for unconventional plays utilising hydraulic fracturing is at saltwater disposal (SWD) facilities.

These types of interface challenges exist through midstream tank farms and storage terminals, into downstream boots and desalters at refineries, and even petrochemical quench towers in the quench settlers/quench water separation drums. ■

Download the Interface whitepaper at [interface.magnetrol.com](http://interface.magnetrol.com) and learn how to achieve reliable interface measurement to optimise process and increase uptime.

# A new approach to Middle East water management

Finn Erik Mohn Berge, Hammertech AS, discusses a commercially viable alternative to traditional well testing, water cut and multiphase meter operations, which can result in reduced water production, and ultimately higher recovery rates.

**W**ITH THE GROWTH in enhanced oil recovery projects in mature fields, rising water cuts and a broad range of well and field conditions, water management in the Middle East is becoming an increasingly important factor in oil and gas operations.

Such a trend is also likely to continue with the continued growth in brownfield developments. Rystad Energy predicts almost US\$30bn of extra capital expenditure in the E&P subsea segment over the next six years, with the majority of expenditure directed to brownfield sites. The same is the case onshore, where Wood Mackenzie estimates that upstream capital investment across the Middle East is expected to rise by nine per cent year-on-year to US\$56bn – with much targeted at brownfield sites.

With all produced water requiring treatment, management and either disposal or reuse – alongside the significant costs, and production and environmental issues – how to maximise water reuse and minimise costs and risks has become a critical question.

There is also a need for operators to measure water production and water salinity in real-time. Such information plays a vital role in steering reservoir management and well optimisation strategies – ensuring that water doesn't gather in pipelines and inhibit oil production, that re-injected water is pushing

oil to the centre of producing wells, and that threats to production from water salinity, such as water breakthrough, corrosion and hydrates, are pre-empted.

### Choosing between two extremes

Yet are today's technologies giving operators the information they need when it comes to produced water?

Too often, operators are left with two stark choices – neither of which really meet their needs.

On one side, there are low cost water-cut meters that generally don't work in multiphase flow, and traditional well testing. While water-cut meters are able to provide real time measurements across the full range of water cuts from 1-100 per cent, they come with significant data gaps in only providing information in water and oil rather than in multiphase flow.

When it comes to traditional well testing, well testing crews will – on average – test a well only once a month (sometimes the testing frequency is even longer) with data generated and interpreted one well at a time. Yet, what happens if a water breakthrough takes places just after a well test? In such cases, there is a real danger that water could be filling up the pipelines and separators without the operator knowing about it for over a month or more.

On the other side, there is the more complex multiphase meter. While providing comprehensive multiphase flow information and accurately characterising flow regimes, such meters are often cumbersome, expensive, and require considerable maintenance with the need to input pressure, temperature, volume (PVT) information. It is also economically unfeasible to deploy one multiphase meter on each well.

In summary, operators have one alternative providing incomplete water production information and the other being too expensive and complex. Not an ideal solution!

### A new water management solution for the Middle East

It is against this context that Norwegian-based company Hammertech AS has introduced a new innovative water management solution to the Middle East region.

The AquaField Water Fraction and Salinity Meter provides direct, robust, and cost-efficient water fraction and water salinity detection topside (with a subsea version likely to be released in the next few years). The AquaField, which can be placed on every well, also detects changes in multiphase flow and gas, due to its ability to track both total water content and salinity.

The technology behind the AquaField's measurement principle is called the High Frequency Magnetic Field Technique (HFMT) – a variant of the eddy current measurement technique where an eddy current creates a magnetic field that opposes the change in the magnetic field that created it (see Figure 1). The eddy currents then react back on the source of the magnetic field (Lenz's law).

When a conductor – in this case the water – is exposed to a varying magnetic field, eddy currents are induced in the water. These eddy currents induce a magnetic field which opposes the original field and power is lost, due to the eddy currents in the water but only in the water portion of the multiphase flow.

The loss of power is proportional to the water content, with large amounts of water

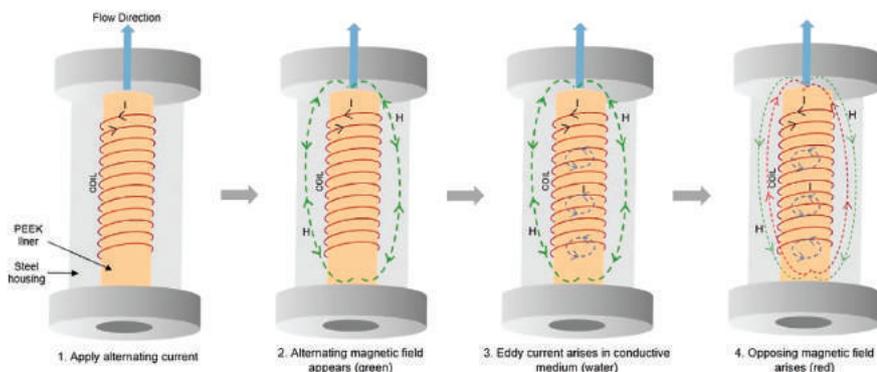


Figure 1 – The eddy current measurement technique.

resulting in large amounts of energy loss and small amounts of water resulting in small amounts of energy loss. The salinity of the water will also affect the energy loss.

The AquaField then measures the water salinity and differentiates between energy loss caused by the amount of water or energy loss caused by the different levels of salinity. Salinity is then calculated for the water in multiphase flow based on the measured complex permittivity of the water. To date, all tests of the AquaField have demonstrated uncertainty specifications of water fraction at ± five per cent (with recent tests showing closer to ± three per cent) and salinity at ± 0.5 S/m.

**A complete overview and increased production**

The result for the operator is a complete overview of the field through the online trending of water content in multiphase flow. By measuring water fractions, the operator can trend the water level, and if there are no changes (or a slight steady increase), they can be confident that the well is stable and producing as expected. In such cases, expensive well testing crews aren't required.

As soon as there is a change in the water

level, however (as detected by the Aquafield) then the operator can dispatch a well testing crew to investigate, instantly pinpointing problematic wells (such as when there is excessive water production from the wellhead) and instigating immediate remedial action.

Furthermore, since the AquaField also detects the salinity of the water, the operator can identify immediately if the water production is a result of too hard water injection. This is because the salinity of the injected water and the produced water is different.

The result is online, real-time measurement at the wellhead; real-time water salinity trending; the immediate identification of water breakthrough; and a pre-empting of the danger of separator water flooding.

We also conservatively estimate an increase of 0.5% per cent in production from the AquaField, providing a significant impact on investment returns from often mature assets.

**Cutting down costs, simplifying deployments**

Another key benefit of the AquaField is reduced CAPEX and OPEX as well as ease of deployment.

The costs of the AquaField are equal to

just two to three well tests, providing the operator with the ability to have online water fraction and salinity detection capabilities on each production well. Well test savings combined with increased oil production can result in US\$29mn in added value, based on a field of 200 wells, with an average production of 500 bpd, and a very conservative oil price of US\$55.

The lightweight simple, non-intrusive 'plug and play' design of the AquaField is also significantly more cost-effective compared to complex multiphase meter deployments.

According to our estimates, replacing an installation of a multiphase meter per well on a five-well configuration, with an installation of a combination of one AquaField per well and a multiphase meter on the manifold can lead to savings of up to US\$500,000. For a typical field with 50 wells using this configuration, the savings can be more than US\$5mn – all simply down to replacing technologies.

Furthermore, the fact that the meter is not dependent on PVT data, doesn't include radioactive elements, and has no moving parts ensures low maintenance, lower regulatory hurdles and no time consuming and expensive requirements for calibration. ■



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# Mobilising microbes for enhanced oil production

Kenneth J. Gerbino, founder and chairman, Titan Oil Recovery, Dr. Colin Hill, chief scientist, Titan Oil Recovery & Roger Findlay, general manager, Organic Oil Recovery, outline a new method of harnessing microbes for oil recovery.

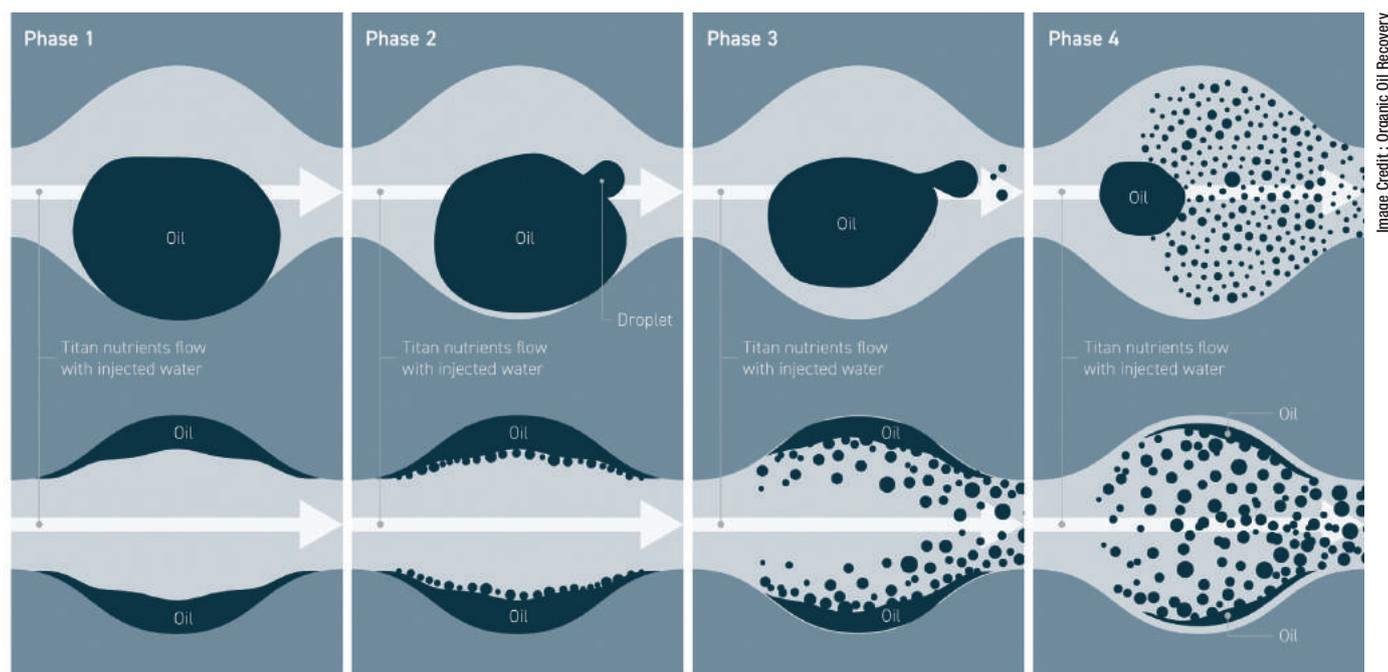


Image Credit : Organic Oil Recovery

## Microdroplet formation

Injected nutrients disrupt the oil surface, creating microdroplets

Figure 1: Microdroplet formation.

**A**DVANCEMENTS IN ENGINEERING science, equipment improvements, well management and other technology have yet to solve two critical problems that persist in the oil industry:

- Nearly 65 per cent of oil remains trapped in existing oilfields, globally
- The global decline rate is now estimated at six per cent per year (International Energy Agency).

The time for a new technology and science to emerge is now, and Organic Oil Recovery is answering this call. This proven science finally unlocks the potential of using microbes to cost-effectively release and recover trapped oil.

## The microbial empire

Every day, a microscopic group of organisms allow life on earth to persist. Plants, trees, vegetables, animals and humans can't survive without them. They are microbes, tiny single cell organisms which are one of the building blocks of life itself. Ten million microbes fit on the head of a pin, and one teaspoon of garden soil can contain one billion microbes.

After 35 years of research and development, Organic Oil Recovery (OOR) has unlocked the science behind the use of microbes to increase oil production, reduce hydrogen sulfide (H<sub>2</sub>S), alter declines and clean up well bore damage. OOR's technology has been successfully applied in more than

300 well applications on four continents, averaging 92 per cent production increases onshore and offshore with all-in costs of US\$6-15 per incremental barrel recovered.

For decades scientists tried to harness microbes to duplicate standard well-enhanced oil recovery chemical treatments. Microbes were developed that could produce certain chemicals by using certain foods to help oil production. This method encountered various natural problems including 'mass balance' issues.

Specific microbes were developed to create certain in-situ chemicals, pumped down the well bore and then fed, resulting in feeding the entire reservoir ecology, often to

the detriment of oilfield operations.

The OOR process produces a state of hydrophobic (repelled by water) cell change to only a few targeted species of microbes. These species cluster around oil and physically deform the oil globules into unique micro oil droplets.

## The Organic Oil Recovery method

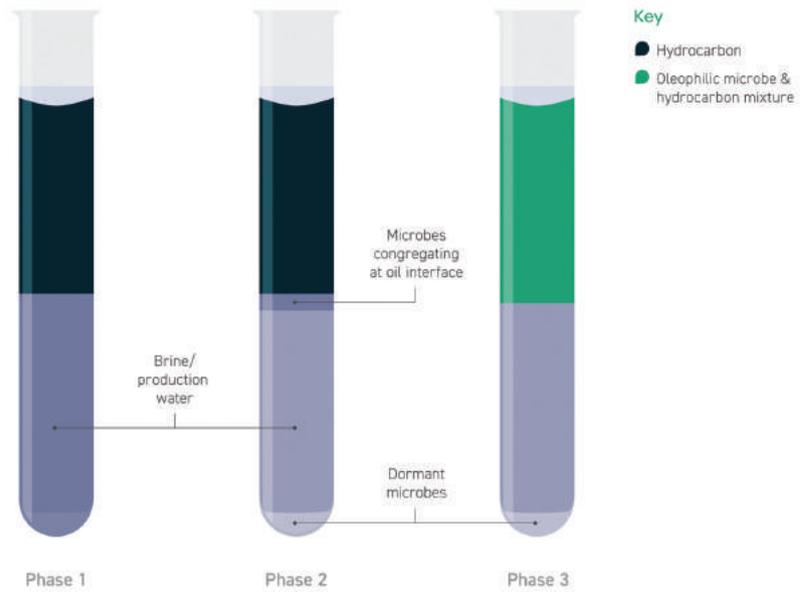
This new approach studied the microbial populations and ecology of the reservoir where life exists in anaerobic (without oxygen) conditions.

The process applies the science of mobilising microbes that are resident in reservoirs to increase oil production. By batch treating with supplemental nutrients, the process significantly increases a specific microbial population. As part of their life-cycle, they move to the oil/water interface, reducing surface tension resulting in the release of trapped and residual oil – see Figure 1.

Microbial life moving around the reservoir creates energy within the reservoir pore space. Also, the microbes reduce the interfacial tension between oil and water and oil and rock. This ‘tension’ is actually held in place by energy. This energy is now released in the pore space, creating more movement and helping flow. This local energy helps create a movement of fluids within the pore spaces which with the help of microbes, micro droplets and normal reservoir pressure can create a vacuum in pore spaces where fluids have departed. This vacuum results in adjacent pore spaces where fluid resides wanting to move into the vacuum that has been created. This effect can result in an entirely new subset of reservoir fluid movement, which combined with the reservoir pressure gradient, moves fluids toward the well bore. The micro oil droplets also require less energy to flow through the pore matrix. Due to their smaller size the droplets can squeeze through the small pore throats that usually trap larger oil globules.

Microbes, if fed enough food, can grow exponentially, and many species can multiply rapidly. A single microbe can split in two every 20 minutes. This exponential growth can result in one cell becoming two billion or more within 24 hours. The OOR process creates an army of microbes which in turn create trillions of micro oil droplets that can be recovered from producing wells and water flood injection units.

“ OOR has been demonstrated to significantly reduce H2S levels within the reservoir”



Microbial oil and water interaction in the lab

Figure 2. A graphical representation of a lab experiment. It shows the chronological effect of the microbes in relation to water and oil.

Another factor in OOR improved and enhanced recovery is the altering of reservoir wettability, due to the breakdown of the oil into micro droplets and lowering apparent viscosity, again which is due to the reduction in oil droplet size.

## H2S reduction

H2S is a deadly gas produced by Sulfate Reducing Bacteria (SRB's) microbial species. H2S causes corrosion, HSE risks and sour oil, penalising refinery revenues.

OOR has been demonstrated to significantly reduce H2S levels within the reservoir by understanding the microbial ecology, studying the driving forces in the oil/water interface and found nutrient issues that could be changed to enhance oil recovery and/or reduce H2S production by changing the balance of microbe growth.

When supplied with a unique OOR nutrient package, only the targeted OOR microbial species eat the food (other species do not), thus the targeted OOR population multiplies dramatically. This increased population of the targeted microbial species out-competes the SRB population for their natural food source. As a result, the SRB's have little or no food source, therefore dying out and leading to a reduction in H2S levels.

## Staged implementation

OOR has created a five-step process for customer de-risking:

- Field Screening of Reservoir Characteristics (approx. 50% of global fields would be amenable to the technology)
- Laboratory/DNA Analysis

- Well Pilot Test (under field conditions)
- Targeted Water Flood Implementation
- Full Field Application

## Organic Oil Recovery technical parameters (Sweet Spot)

- Oil Gravity from 16-42 API
- Water pH between 6-8
- Reservoir Temperature: areas in reservoir that are < 95° C
- Formation Water Salinity of  $\leq 140,000$ ppm TDS
- Reservoir Porosity of > 20 per cent of Formation Volume (higher the better in general)
- Reservoir Permeability > 1mD (higher the better in general)

Examples of peer-reviewed SPE papers on the success of the Organic Oil Recovery process are SPE 124319, SPE 129742, SPE 145054 and SPE 154216. These applications were conducted under various reservoir conditions with the process successfully improving oil production in 98 per cent of the injector well applications performed.

## Conclusion

The challenges of trapped oil, steep production declines, excessive water production and H2S have been a costly and persistent negative aspect of oilfield production for over a century.

The Middle East has these challenges, and Organic Oil Recovery provides a solution which is scientifically complex, yet elegantly simple in application and low cost, requiring no capital expense and a short planning stage of only a few months. ■

# The rise of the smart digital twin

JP Global Digital COO & co-founder Daniel Coronado underlines the role of the digital transformation in the oil and gas industry.



Image Credit : leowolfer/Adobe Stock

*A smart digital twin is an invaluable tool in the digital transformation of any oil and gas company.*

**O**VER THE LAST two centuries, the energy industry has experienced many transformations. In the past, the availability of multiple energy sources encouraged competition for companies in the heat and power markets. Today, oil and gas players are also experiencing challenges and increased competition in an already delicate market, leading them to seek better efficiency through digital transformation.

Using data gathered to enhance performance has become nearly universal in every industry. However, the use of asset digitalisation technology is proving to be just as, if not more, beneficial when integrated with existing data.

## A smart digital twin

A smart digital twin proves to be an invaluable tool in the digital transformation of any oil and gas company. It is a 3D model created from the quick, safe and non-invasive data capturing of any asset. Data capturing is typically achieved by 3D laser scanning, drone

photogrammetry and gathering all available documentation. After the capturing process, an as-is 3D model is created and combined with all available documentation and information, generating an editable and improvable smart digital twin of an operation.

A few years ago, a task as simple as building scaffolding in a plant, involved multiple physical visits to the location, to assess the space, detect conflicts and perform manual measurements. This practice caused downtime in the field and increased the risk to maintain updated infrastructure data. With a smart digital twin, these physical visits are dramatically reduced, lowering cost and improving safety.

## It is only useful if it is accessible

In the past, specialised hardware and software were needed to access 3D facility models, thus restricting the benefit of models to very few within companies. The rise of online 3D visualisation tools provides the capability of secure remote access by operators and engineers, in addition to

executives, developers, project managers, and any other authorised personnel who could benefit from easy access to their smart digital twin from any device. This access gives decision-makers the ability to efficiently visualise and analyse data while performing what-if scenarios from any location, worldwide.

There is great value in a standard 3D model of assets, combined with accurate documentation and accessible via a secure internet connection, or internal network. The primary benefits include reducing costs due to inefficiency, avoiding maintenance delays and retrofitting expenses, but the game-changing factor is the ability to maximise the life cycle of an asset.

Digital transformation involves many beneficial aspects for any business. For the oil and gas industry, the real value comes in the form of maximising returns, lowering costs, and increasing safety. JP Global Digital predicts that, in the not too distant future, only businesses which adopt these new technologies will thrive in the market. ■



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# Technology for marine environmental challenges

Innovation is driving advanced monitoring and control technologies for environmental and safety compliance in the marine sector, says Gérard Baldellou, marine business unit manager at CMR Group.

**T**HE MARINE DIESEL power sector continues to face significant challenges, particularly in areas where emissions resulting from combustion inside engines, along with fuel consumption levels, need reducing. Escalating operating costs, tighter margins and pressures in the oil and gas sector signal challenging times for ship owners and fleet operators. Because of this, there is more focus than ever before on achieving savings and operating efficiently wherever possible.

It is clear that the marine sector must strive to cut costs and operate more efficiently and effectively – and the latest in advanced instrumentation and control systems can help here. New technology is firmly on the wish list of shipping operators, who are looking to drive up performance levels while cutting operating costs in tough trading conditions. Many are turning to sector specialists for added value technologies supported by advanced digital solutions and installation engineering capabilities.

## Importance of partnership

Furthermore, moves by instrumentation and control manufacturers to partner ever closer with engine OEMs are also underway to meet the reliability and lifetime challenges for industrial engine sensors, in efforts to try to minimise final engine delivery cost. The approach can typically deliver savings without any compromise around the quality and standard of the final solution. How can this be achieved? As an independent operation, global specialists like CMR Group are focused on the business of providing effective and high-quality precision engineered solutions, built around meeting individual requirements and delivered through partnership strategies.

Working systems and procedures dovetail to reflect this single-minded purpose, and processes are entirely geared to ensuring that work is carried out efficiently, in line with the technical standards required and with close attention to planning and project management. This focus enables us to work closely with customers and end users to ensure that projects are completed as quickly as possible and that vessel downtimes are reduced to a minimum.

International Maritime Organisation (IMO) regulations for MARPOL Annex VI Tier III, which is aimed at reducing pollution emissions, have also led to upheavals for diesel engine manufacturers when it comes to control and power management systems. In turn, this has directed CMR



Image Credit : CMR Group

**New technology is firmly on the wish list of shipping operators.**

to develop a new generation of advanced engine and IAMCS (integrated alarm, monitoring and control system).

Now being designed and built around ‘smart’ wiring, instrumentation and engineering packages for wider applications in the marine sector and featuring proprietary J-SENSE technology (analogue to digital conversion electronics are embedded within the sensor, allowing for a direct CAN connection to the engine ECU), IAMCS can be directly linked to CAN smart sensors and harnesses, as well as data transfer onshore for predictive analysis, intervention and maintenance.

Marine vessel owners and operators value, perhaps more than ever, the availability of their craft. This means that routine engine maintenance schedules must be optimised and planned very carefully. So, in achieving this, the need to pay close attention to the details in the project management and planning of system jobs is paramount; and partner suppliers can often be better placed to provide this.

Understandably, OEMs have priority interests in manufacturing and new product development, sales of new engines and warranty support. External suppliers like CMR can respond to these interests, adding value through wholly focusing on providing a fully responsive engineering service – one that is geared towards meeting the specific timing, location and technical needs of the customer. In this way, with strong pressures on operating costs and assured vessel availability, sector specialists are responding and adapting to changing market needs, demonstrating their capabilities and system solutions. ■

*CMR Group supplies instrumentation, controls and power management for offshore platforms and vessels, marine, engine and industrial applications around the world. [www.cmr-group.com](http://www.cmr-group.com)*

“ Moves by instrumentation and control manufacturers to partner ever closer with OEMs are underway.”



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“ It was a pleasure meeting with like-minded people and those with very similar concerns and challenges and good to learn how other organisations and experts are meeting those challenges. ”  
- Salman Abdulla, Executive Vice-President, HSSEQ - EGA

“ There were some good informative sessions and allowing people to attend such conferences challenges our thinking and we should always be looking to evolve the safety profession. ”  
- Shaun Hannan, Head of Safety, International Airport Operations, DNATA, Emirates Group

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## Schlumberger's look-ahead-while-drilling service

SCHLUMBERGER INTRODUCED THE IriSphere look-ahead-while-drilling service at OTC 2019, which provides the industry's first application of electromagnetic (EM) technology for detecting formation features ahead of the drill bit in oil and gas wells.

The service uses EM-based resistivity measurements more than 100 ft [30 m] ahead of the drill bit, which are then compared to a prepared model that incorporates offset and other data to reveal a true downrange representation of the formation while drilling. This enables operators to make proactive decisions rather than reacting to measurements at or behind the bit while drilling wells.

"IriSphere service was created in response to the needs of our customers for risk reduction, improved drilling efficiency and optimal casing point selection," said Tarek Rizk, president, Drilling & Measurements, Schlumberger. "Knowing what conditions lie ahead of the bit while drilling enables operators to reduce uncertainties and minimise costs by identifying geological features and deciding which actions to take before encountering them."



Image credit: Schlumberger

*The IriSphere service multifrequency transmitters and multireceiver BHA provide continuous resistivity that detects formation features far ahead of the drill bit.*

## Halliburton launches Flex MPD System

HALLIBURTON HAS RELEASED Flex Managed Pressure Drilling System (MPD), a scalable and mobile technology that can be configured to address specific operator challenges and deliver greater rig efficiency. The tiered system allows operators to select the right level of service to help maximise the cost/benefit of managed pressure drilling services.

The standard Flex MPD offering is a tablet-controlled solution with a single, straightforward display so the driller can control backpressure or choke position while drilling, tripping and making connections. When additional control is required, Flex Pro MPD incorporates rig data for intelligent automated response to adjust backpressure based on flowrates and bit depth.

The system can also run as a full MPD solution using real-time hydraulic modelling to control downhole pressure, limit formation fluids from entering the wellbore and help reduce lost circulation. Each tier utilises a smaller equipment footprint, reducing rig-up and rig-down time.

"In situations where drilling challenges change from well to well, the system allows operators to respond quickly with a highly mobile unit and apply the right service intensity for each job," said Daniel Casale, vice president of Testing and Subsea.

## FutureOn introduces FieldTwin digital twin platform

FUTUREON HAS LAUNCHED its digital twin platform FieldTwin, a cloud-based platform which enables the digital twin of the subsea field from first concept to first oil and beyond. FieldTwin digital data visualisation of the offshore field allows for smarter, more collaborative, and efficient field planning and operations – getting companies to first oil faster.

"Forward-thinking companies understand the tremendous opportunity of Big Data analytics to gain a competitive advantage and deliver greater value from their significant investments offshore," said Paal Roppen, chief executive officer of FutureOn. "FieldTwin visualises and centralises data into a single source to increase collaboration, increase transparency, reduce costs, speed timelines and improve operations."

"Our E&P customers eventually want to unman the platforms, and remotely monitor and maintain their offshore operations and assets," Roppen continued. "FutureOn's FieldTwin allows all stakeholders to now see the same information at the same time to make more impact on a project's outcome and make more efficient decisions that save time, reduce errors and mitigate risk."



Image credit: Business Wire

*FutureOn's FieldTwin enables the digital twin of the subsea field.*

## Expro adds to subsea intervention portfolio

EXPRO HAS EXPANDED its subsea intervention capabilities, introducing two new well access solutions in addition to its established subsea landing string system technologies.

The Intervention Riser System (IRS) will safely establish and maintain well access throughout riser to surface operations, replicating the functionality of the blow-out preventer and providing a safe and reliable means of well control, connected directly to the production tree. With increased coil tubing cutting and disconnect capability, the IRS system provides an alternative dual barrier, through-tubing system.



Image credit: Expro

*Expro's IRS solution will safely establish and maintain well access through riser to surface operations.*

The new Riserless Well Intervention (RWI) system provides a field proven, established and reliable wire through-water integrated solution for carrying out cost effective intervention and/or abandonment operations on all types of subsea wells. With a dedicated intervention vessel, all operating, deployment and retrieval efficiencies can be delivered safely and efficiently to clients.

These solutions further bolster the company's established subsea offering, which also includes Subsea Test Tree Assembly (SSTTA) solutions, which form an integral part of a subsea landing string.

Expro's latest development to the SSTTA is the Next Generation Landing String (NGLS), designed to fully comply with all aspects of the industry's new API17G standard. It features a range of new functionality across its 7 3/8 valves, and dual seal protection to both environment and control systems.

Colin Mackenzie, Subsea vice president at Expro said, "This expanded product portfolio allows Expro to offer our clients any one of the three means of subsea well access, depending on the exact customer requirements."

"By offering a full service solution to subsea well intervention operations, we can bring multiple services under one contract to lower the cost, enabling operators to maximise their return on investment, whilst maintaining well integrity throughout."

## New Engine Idle Reduction System from Caterpillar Oil & Gas



Image credit: Caterpillar Oil & Gas

*EIRS comes both with factory-installed option or a retrofit.*

CATERPILLAR OIL & GAS' new Engine Idle Reduction System (EIRS) is an advanced way of optimising fuel usage and non-productive engine idle time.

With the ability to decrease idle time by 60 per cent, EIRS can provide significant reductions in equipment operating costs by eliminating unnecessary idle fuel consumption and extending preventative maintenance intervals. Additionally, EIRS reduces manpower and maximises equipment utilisation.

"EIRS is all about value. It enables pressure pumping customers with a cost-effective way to reduce spend on fuel and maintenance, and lower emissions, all without compromising on the long-standing reputation for durability which defines Cat engines," said Jason Herlehy, product definition manager for Caterpillar Oil & Gas.

While the engine idles in between pumping stages, EIRS will automatically stop the engine and then use an electric starter to restart it as needed to keep the equipment ready to work. An integrated engine pre-lube system ensures that the engine continues to deliver industry-leading durability even with the more productive duty cycle. And, by eliminating the need for additional operator intervention throughout the run time, EIRS makes operating the equipment both easier and safer.

The new Engine Idle Reduction System is available as a factory-installed option or as a retrofit for both the Cat 3512C and 3512E engines. Additionally, engines equipped with EIRS will continue to meet the EPA Tier 4 Final emissions certification.

## Arup, EnerMech launch digital inspection process

ARUP AND ENERMECH have announced a new digitised inspection service – Arup Inspection MInteg (AIM) – to enhance and revolutionise the inspection process for the oil and gas industry.

Created by Arup, the innovative inspection technology – the first of its kind – digitises the entire inspection workflow by leveraging automation, overhauling the current paper-based and outdated manual process. EnerMech's specialist inspection division

MInteg and Arup have signed a three-year agreement to complete inspections with AIM.

By using AIM, oil and gas organisations can expect to see inspections completed in significantly less time, resulting in reduced risk and costs. As part of the service, operators and asset owners will be able to access their interactive inspection data instantly at any time, to make informed decisions about asset repairs, replacements or improvements.



Image credit: bobot1980/Adobe Stock

*The potential time savings and subsequent cost reductions are considerable.*

## Weir Oil & Gas debuts intelligent pressure control

WEIR OIL & GAS has launched SPM SafeEdge automated relief valve control (ARC) system. This intelligent valve system enables operators to remotely set and control SPM's proven line of back pressure relief valves while monitoring treating-line pressure and helping prevent over-pressuring of treating iron. The SPM SafeEdge ARC reduces non-productive time through its autonomous reporting and monitoring capabilities, while enhancing personnel safety.

SPM SafeEdge ARC is one component of Weir SafeEdge along with the SPM Flow Line Safety Restraint (FSR) System. SafeEdge helps minimise the occurrences and impact of site incidents caused by over-pressured iron. Part of Weir Oil & Gas' total iron offering, this also includes high-pressure flow iron and valves for operators across the globe and time-saving RFID technology with AMP mobile app which reduces iron inventory time by 97 per cent.

The entire offering is backed by Weir Edge Services with stocked trailers for on-site access and engineered repair services. The new SPM SafeEdge ARC is more compact than its predecessor and equipped with a network infrastructure built into a durable field case that allows the operator to control the system through a web interface and WiFi-enabled device.

With five millisecond monitoring and recording capabilities, the valve can react and relieve pressure faster than other similar systems, according to the company. If a pressure-relief event occurs, the SPM SafeEdge ARC system automatically logs high-speed data locally and publishes it to a secure web portal. Quick reset and adjustable reaction filtering help minimise downtime.

## ABB's NiTemp accurate temperature sensor

ABB'S NEW NITEMP non-invasive temperature sensor offers a simpler and safer way of measuring process temperature without the need to shut down a pipeline, drill a hole, or install a thermowell. With its innovative double sensor architecture and specially developed calculation algorithm, NiTemp greatly enhances safety and reduces installation costs without sacrificing the quality of the measurement.

The device is designed for surface measurement and eliminates the need for a thermowell, avoiding process intrusion altogether and greatly increasing the safety of people, plants, and the environment. As such, it can be used in a range of applications, including processes with hazardous media, special hygiene requirements and/or stringent cleaning requirements and high-pressure processes with high bending loads or use with abrasive media.

The NiTemp approach is safe, compliant with safety standards, and simplifies environmental aspects. With the sensor able to be installed and maintained without shutting down a process, plant availability is improved and system costs are lowered, helping to reduce CAPEX costs by at least 30 per cent.

The new temperature sensor uses innovative technology with proven components, such as standard in-sets widely utilised in industry. It has been developed through direct testing and feedback from key customers in the oil and gas, chemical, and food and beverage industries.



Image credit: ABB

*The NiTemp belongs to ABB's product family SensyTemp TSP.*

# Project Databank

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## OIL, GAS AND PETROCHEMICAL PROJECTS - OMAN

Project	City	Facility	Budget (US\$)	Status
Oman Gas Company - Saih Nihayda to Duqm Special Economic Zone Gas Pipeline	Duqm	Gas pipeline	100,000,000	Construction
Orpic - Liwa Plastics Industries Complex - NGL Pipeline	Sohar	Gas pipeline	400,000,000	Construction
Duqm Petroleum Terminal Company - Duqm Liquid Jetty (IP7)	Duqm	Oil storage terminal	600,000,000	Construction
Orpic - Liwa Plastics Industries Complex - Polyethylene and Polypropylene Units	Sohar	Polyethylene	800,000,000	Construction
Orpic - Liwa Plastics Industries Complex - Steam Cracker	Sohar	Ethylene	2,900,000,000	Construction
PDO - Rabab-Harweel Integrated Plant (RHIP) - Overview	Harweel	Gas processing	3,000,000,000	Construction
Masirah Oil Ltd - Block 50 (Masirah Bay Offshore) - Exploration	Masirah Basin	Exploration	250,000,000	Construction
Orpic - Liwa Plastics Industries Complex - NGL Extraction Units	Sohar	Natural gas liquefaction (NGL)	700,000,000	Construction
Orpic - Liwa Plastics Industries Complex - Overview	Sohar	Polyethylene	6,500,000,000	Construction
PDO - Yibal Rejuvenation	Yibal	Gas production	500,000,000	Engineering & Procurement
Oman Lasso Exploration and Production Karwan - Block 54 Onshore Exploration and Production	Al Wusta	Exploration	50,000,000	Engineering & Procurement
Salalah Liquefied Petroleum Gas (SLPG) - Salalah LPG Extraction	Salalah	Liquefied petroleum gas (LPG)	650,000,000	Construction
Medco Arabia - Block 56 Onshore Exploration and Production	Adam Ad Dakhliya	Exploration	20,000,000	Engineering & Procurement
OOCEP - Block 60 Concession - Onshore	Oman	Oil & gas field	1,100,000,000	Construction
BP - Block 61 - Ghazeer Field Development	Al Dahirah	Gas field development	5,000,000,000	Construction
OOCEP - Block 48 Onshore Exploration and Production (Malih Block)	Al Dahirah	Exploration	30,000,000	Engineering & Procurement
PDO - Marmul Polymer Phase 3 (MPP3)	Marmul	Oilfield development	270,000,000	Engineering & Procurement
PDO - Yibal Khuff Sudair Field Development	Northern Oman	Oilfield development	3,000,000,000	Construction
Florexx International Investments - Biofuels Refinery	Sohar	Biofuels	800,000,000	FEED
Port of Duqm Company - Floating Storage Regasification Unit (FSRU)	Duqm	LNG regasification	500,000,000	Feasibility Study
Ministry of Oil & Gas - Iran to Oman Subsea Natural Gas Pipeline	Sohar	Gas pipeline	600,000,000	EPC ITB
OTTCO - Ras Markaz Crude Oil Park	Duqm	Oil storage terminal	400,000,000	Engineering & Procurement
BP - Block 61 - Khazzan and Makarem Gas Fields Development	Al Dahirah	Gas field development	24,000,000,000	Construction
MOG - Block 57 Onshore Exploration and Production	Dhofar	Exploration	3,000,000	Engineering & Procurement
Project Development & Management International - Chlor-Alkali PVC Plant	Adam Ad Dakhliya	Chlor alkali	1,500,000,000	FEED
PDO - Flare Gas to Power Schemes	Adam Ad Dakhliya	Gas recycling	200,000,000	EPC ITB
DRPIC - Duqm Refinery & Petrochemical Complex - Duqm Refinery - Main Process Units	Duqm	Refinery	4,000,000,000	Construction
DRPIC - Duqm Refinery & Petrochemical Complex - Duqm Refinery - Offsites and Utilities	Duqm	Refinery	2,000,000,000	Construction
DRPIC - Duqm Refinery & Petrochemical Complex - Duqm Refinery - Overview	Duqm	Refinery	7,700,000,000	Engineering & Procurement
DRPIC - Duqm Refinery & Petrochemical Complex - Duqm Refinery - Package 3	Duqm	Oil storage terminal	800,000,000	Engineering & Procurement
OTTCO - Main Line Oil - Ras Markaz Crude Oil Terminal Pipeline	Duqm	Oil pipeline	300,000,000	FEED
ENI - Block 47 Onshore Exploration and Production	Northern Oman	Exploration	40,000,000	Engineering & Procurement
Hydrocarbon Finder - Block 7 Onshore Exploration and Production	Al Wusta	Exploration	160,000,000	Construction
Oman LNG - LNG Plant Upgrade	Qalhat	Liquefied natural gas (LNG)	100,000,000	Project Announced
PDO - Mabrouk North East Deep Gas Field Development	Saih Rawl	Gas field development	5,000,000,000	FEED
MOG - Block 58 Onshore Exploration and Production	Dhofar	Exploration	25,000,000	EPC ITB
PDO - Amal Steam Phase 1C-2	Amal Oilfield	Oilfield development	500,000,000	EPC ITB
DRPIC - Duqm Refinery & Petrochemical Complex - Petrochemical Complex	Duqm	Aromatics	9,000,000,000	Feasibility Study
Shumookh Investment and Services - Sur Refinery and Petrochemical Complex	Sur	Refinery	10,000,000,000	Project Announced

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# Project Databank

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## Project Focus

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### Project Summary

<b>Project Name</b>	DRPIC - Duqm Refinery & Petrochemical Complex
<b>Name of Client</b>	DRPIC - Duqm Refinery and Petrochemical Industries Company
<b>Estimated Budget (US\$)</b>	9,000,000,000
<b>Facility Type</b>	Aromatics
<b>Status</b>	Feasibility Study
<b>Location</b>	Duqm
<b>Project Start</b>	Q3-2006
<b>End Date</b>	Q1-2026
<b>Award Date</b>	Q2-2021

### Background

The Oman Refineries and Petrochemicals Company (OMRC) is planning a new petrochemical complex in Duqm. The total investment is estimated at US\$8 - 9bn. The complex is part of the government's plans to develop the area, in which a port and associated facilities are being built. Seven or eight petrochemical plants are envisioned for the complex. Output from the refinery will include diesel, jet fuel, naphtha, LPG, sulphur and pet coke as its primary products. While the refined products will be marketed internationally by the marketing arms of shareholders Oman Oil Co and KPI, naphtha and other products from the steam cracker are proposed to be processed into a wide range of commercially valuable petrochemicals and intermediate products for further value addition. Around 10 different types of petrochemicals and intermediate products will be produced by the petrochemicals complex when it is fully operational. The list includes ethylene glycols, high density PE (HDPE), oxo chemicals, polypropylene, butadiene, MTBE and aromatics. A natural gas liquids (NGL) extraction plant, as part of the scheme, will be located in central Oman, connected via an NGL pipeline to a steam cracker in Duqm.

### Project Status

Date	Status
22 Apr 2019	Negotiations for the FEED contract are underway.
31 Mar 2019	A Final Investment Decision (FID) on the project is expected 18 months after the FEED contract is awarded. Construction will take four years. 2025-26 is the expected timeline for the completion of the project.
13 May 2018	The feasibility study covering the scope of the complex has been completed.
13 May 2018	The JV partners, OOC and Kuwait Petroleum International (KPI), are preparing the groundwork for the development of the petrochemical complex.

### Contractors

Contract Type	Pre-Qualified	Bidders	Awarded
FEED	Wood Group	Wood Group	-

### Project Scope

The scope of work will include:

- Aromatics plant
- Hydrotreater
- Reformer unit with hydrogen booster compressor
- Adiabatic reactors and heaters
- Regeneration columns
- Aromatics stabiliser
- Olefins hydrogenation unit
- BT extraction unit
- Paraxylene unit with absorption and extraction columns
- Isomerisation unit with reactors and heaters, xylene recovery column and hydrogen booster compressor
- Transalkylation unit
- Polymerisation



## Middle East & North Africa

The Baker Hughes Rig Count tracks industry-wide rigs engaged in drilling and related operations, which include drilling, logging, cementing, coring, well testing, waiting on weather, running casing and blowout preventer (BOP) testing.

Country	THIS MONTH			VARIANCE From Last Month	LAST MONTH		
	Land	OffShore	Total		Land	OffShore	Total
<b>Middle East</b>							
ABU DHABI	36	19	55	0	36	19	55
DUBAI	0	2	2	0	0	2	2
IRAQ	73	0	73	6	67	0	67
JORDAN	0	0	0	0	0	0	0
KUWAIT	43	0	43	2	41	0	41
OMAN	55	0	55	3	52	0	52
PAKISTAN	23	1	24	3	20	1	21
QATAR	3	10	13	0	3	10	13
SAUDI ARABIA	100	20	120	5	97	18	115
SUDAN	0	0	0	0	0	0	0
SYRIA	0	0	0	0	0	0	0
YEMEN	0	0	0	0	0	0	0
<b>TOTAL</b>	<b>333</b>	<b>52</b>	<b>385</b>	<b>19</b>	<b>316</b>	<b>50</b>	<b>366</b>

### North Africa

ALGERIA	52	0	52	0	52	0	52
EGYPT	22	3	25	-1	23	4	26
LIBYA	14	1	15	6	14	1	9
TUNISIA	2	0	2	0	2	0	2
<b>TOTAL</b>	<b>90</b>	<b>4</b>	<b>94</b>	<b>5</b>	<b>91</b>	<b>5</b>	<b>89</b>

Source: Baker Hughes

وتطبيق النتائج على عملية المصادقة على نظام التحكم، وهو ما يعني أن الجهة المُصنَّعة لن تضطر إلى بذل جهد إضافي لاختبار أنظمتها في بيئة افتراضية».

## الحوسبة السحابية

ذكر أولاند أنهم قاموا بتعديل عملية التأهيل لجعلها أكثر مواءمة للمعايير الصناعية ولإضافة القيمة للمستخدم النهائي في سلسلة التوريد. فقال: «عندما يطلب أحد الملاك جهازاً ما، يتم التحقق من أداء البرمجيات أيضاً بشكل منفصل حسب الأداء الآمن. هذه العملية توفر الكثير من التكاليف والوقت، إلى جانب تحسين الكفاءة التشغيلية».

ويقول أيضاً إن الخطوة التالية هي الاختبار القائم على الحوسبة السحابية. «بوسعنا مضاهاة نظام التحكم وتحمله على برنامج الحوسبة السحابية، واختبار التحسينات المقررة، ومن ثم تضمينها في منصة المحاكاة. ونحن نعكف حالياً، بالتعاون مع منظمة SINTEF وغيرها، على إقامة مشروع صناعي مشترك بهدف المحاكاة المشتركة للنماذج الموحدة على منصة محاكاة مفتوحة المصدر». ويصف بير أولاند معايير شركة «ديت نورسك فيريتاس جي إل» على أنها ملتقى صناعي جديرٌ بالثقة في سلسلة التوريد، وذلك بفضل التحقق من سلامة البرمجيات في أثناء العملية.

«تعتمد نظم السلامة، وغيرها من النظم الحرجة لعمليات التشغيل الآلي والتشغيل عن بُعد إلى جانب عمليات التشغيل الذاتي المستقبلية، على البرمجيات في إدارتها. ولدينا شبكات كاملة من الأجهزة والنظم المعقدة التي تُستخدم البرمجيات للربط بينها في تناغم. وإذا كنا ننشد تحقيق تقدم ملموس في عمليات التشغيل الذاتي، فيجب أن نتحلى بحس الضرورة في هذا المجال ونتبع عمليات أكثر شمولاً لاختبار النظم التي تعتمد بشدة على البرمجيات». تم إنشاء هذا المقال بعد الحصول على تصريح من شركة «ديت نورسك فيريتاس جي إل».

## أمثلة على أحدث التطورات التي شهدتها تقنيات التشغيل الآلي عن بُعد

انتهت شركة iSURVEY مؤخراً من مشروعها الذي ورد أنه أول مشروع على الإطلاق لتحديد مواقع منصات الحفر عن بُعد.

حوّلت شركة إكوينور منصة Valemon الخاصة بها بحيث أصبح يمكن التحكم بها عن بُعد من البر، كما افتتحت منصة جديدة تعمل آلياً بشكل كلي ويتم التحكم بها عن بُعد في حقل أوسبيرغ في 2018. هذا، وقد افتتحت أيضاً مركزين شاطنيتين، أحدهما لتقديم الدعم المركزي للعمليات المتكاملة والآخر لعمليات الحفر.

أطلقت شركة أوشنيرينغ مركبة جديدة يتم التحكم بها عن بُعد تعمل بالبطارية وقادرة على العمل لفترات زمنية ممتدة دون الحاجة لإعادةتها إلى السطح. وهي تستخدم أيضاً تقنيات التعلم الآلي بالرؤية والواقع المعزز.

## البرمجيات حلّ رئيسي

يُدي بير أولاند، مدير تطوير الأعمال ضمن فئة حقول النفط البحرية في شركة «ديت نورسك فيريتاس جي إل»، برأيه وبثّر مسألة التعقيد المتزايد لنظم التحكم القائمة على البرامج في مجال النقل البحري وحقول النفط البحرية، فيقول: «لا يتفق أسلوبنا الخاص للتعامل مع أداء البرمجيات هذه الأيام - تماماً - مع مستوى تعقيد النظم المستقبلية التي يطراً عليها التطوير اليوم تلو الآخر، ويجب علينا الأخذ في الاعتبار أن هذا التوجه نحو التعقيد سيتصاعد بمرور الوقت».

ولمواكبة هذه التطورات، تعكف شركة «ديت نورسك فيريتاس جي إل» اليوم على تطبيق مخطط يسمح بالتحقق من سلامة البرمجيات بشكل منفصل كجزء من عملية المصادقة المعتادة على نظام التحكم. ويشمل ذلك انتقاء مجموعة من النظم المهمة ليتم تثبيتها على متن السفن والوحدات البحرية المُصنَّفة من قبل الشركة، وهي تتضمن معدات الحفر، ونظم مد الكبلات وخطوط الأنابيب، فضلاً عن سلام السفن الخاصة بنقل الأفراد ورافعات حقول النفط البحرية.

يوضح أولاند هذه العملية بقوله: «تعتبر المهام التي نؤديها في إطار استعدادنا لتكثيف أعمال التدقيق للنظم المركزية باستخدام البرمجيات، عنصراً مهماً يمنحنا القدرة على إجراء المزيد من عمليات التشغيل الذاتي والعمليات الخاضعة للتحكم عن بُعد ضمن وظائف حقول النفط البحرية». وأضاف: «بعد اختبار البرمجيات القائم على المحاكاة منهجاً مجدياً من حيث التكلفة للتحقق من السلامة والأداء حسب قواعد ومعايير شركة «ديت نورسك فيريتاس جي إل». ونحن نتعاون الآن بشكل وثيق مع موفري خدمات النقل البحري وحقول النفط البحرية لإعداد هذه البرمجيات واختبارها».

## كيف يتم اختبار البرمجيات عن طريق المحاكاة

يوضح أولاند أنه «بدلاً من استخدام الأصول المادية، ننشئ نظاماً افتراضياً في جهاز محاكاة. ويكون النموذج المعروف نظاماً رقمياً مشابهاً وليس مماثلاً. إذ أن بإمكاننا جعل النطاق يقتصر على نماذج لأدوات الاستشعار والمشغلات والمعدات المادية التي تعد جزءاً من حلقة نظام التحكم. ويوفر استخدام منصات الاختبار الافتراضية القائمة على المحاكاة إجراء الاختبار سريعاً ويتفادى تعريض الموظفين أو الأصول أو البيئة للمخاطر». ويضيف أن: «يمكننا أيضاً إجراء الاختبار في مرحلة مبكرة من عملية التطوير وتضمن المزيد من الموارد، من دون أي قيود جغرافية».

وقد أدمجت شركة «ديت نورسك فيريتاس جي إل» منهجيتها في الخطط المعتادة للتصديق على نظم التحكم، وهو ما عزز قدرتها على معالجة وتقييم مستوى مشاركة البرمجيات في عمليات التحكم ككل وأداء نظام السلامة. «يمكن أيضاً ربط الاختبار بعملية تطوير التصميم». يمكننا استخدام جهاز المحاكاة الخاص بالجهة المُصنَّعة لإجراء الاختبار

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السفن الذكية تعزز من كفاءة الطاقم والعمليات

## التحكم آلياً عن بُعد - تقنيات الجيل التالي

في هذا المقال، يناقش خبراء من شركة «ديت نورسك فيريتاس جي إل» آخر التطورات والآفاق والتحديات التي أفضت إلى التحول إلى التشغيل الآلي والذاتي عن بُعد لعمليات حقول النفط البحرية. فالاعتماد المتزايد على استخدام النظم الآلية، سواءً على صعيد دعم اتخاذ القرارات أو إدارة العمليات عن بُعد أو التشغيل الذاتي، يسهم في تحسين مستويات السلامة والكفاءة والأداء البيئي لعمليات الشحن وعمليات حقول النفط البحرية. ومن أجل الاستغلال الأمثل لكافة إمكانات العمليات التي تتم عن بُعد، تحتاج صناعة حقول النفط البحرية إلى مجموعة من المعايير الفعالة التي تتيح للنظم الجديدة الوصول إلى السوق والتأكد من تطبيق هذه التقنيات بشكل آمن.

للعمليات المؤتمتة وتلك التي تتم عن بُعد، وذلك بسبب انخفاض تكلفة طواقم العمل». وقد أوضح أيضاً أن بالإمكان خفض النفقات الرأسمالية في بعض الحالات، إذ أن وجود عدد أقل من المستخدمين لإدارة عمليات المنصة يعني الحاجة إلى عدد أقل من النظم المطلوبة لإيواء العمال وتوفير سبل الحماية لهم.

السبب التالي هو السلامة، بشرط أن تساعد التقنية في رفع مستويات السلامة للطواقم عبر السماح لهم بالعمل من بيئة بعيدة مثل غرفة تحكم موجودة في منطقة برية، وليس على متن منصة أو سفينة. ويمكن أن تسهم نظم التحكم والإنذار الآلية أيضاً في تقليل مخاطر الحوادث.

أما السبب الثالث فهو حماية البيئة. «تنعكس المزايا البيئية لخفض الانبعاثات على العمليات اللوجستية ويكون من السهل تحديدها، مثل إمداد المنصات، ولكن قد لا يكون من السهل تتبع تلك المزايا من خلال تشغيل المنصة. وربما تكون الميزة الرئيسية للأتمتة هي تقليل مخاطر الانسكابات». ويذكر يورغنسن - بوجه عام - أن أكبر مزايا الأتمتة والتحكم عن بُعد هي تمكين شخص واحد من أداء عدد أكبر من المهام. «ليس فقط مُشغّل واحد مسؤول عن تشغيل بئر واحدة أو قبطان واحد على سفينة واحدة، وإنما شخص واحد مسؤول عن تنفيذ العديد من المهام والإشراف عليها».

ذكر آر يورغنسن، مدير مشروعات شركة «ديت نورسك فيريتاس جي إل»، في معرض حديثه عن التوجهات، أن «شركة ديت نورسك فيريتاس أصدرت توجيهات تصنيف للسفن ذاتية التشغيل والتي يتم التحكم بها عن بُعد في سبتمبر/أيلول 2018». وأضاف: «نريد الإسهام في إرساء ثقافة الاستخدام الآمن للتقنيات الجديدة الخاصة بالسفن ذاتية التشغيل التي يتم التحكم بها عن بُعد. ومن المعلوم أن الكثير من هذه المعلومات وليس كلها يمكن تطبيقها على عمليات حقول النفط البحرية. على صعيد الشحن، قسّمنا وظائف السفن إلى قسمين، وهما النظم الهندسية والملاحية. ونحن نعتقد أنه يجب تصنيف فئات لحقول النفط البحرية أيضاً، مثل عمليات التوريد والتركيب، حتى يمكن تحديد مقدار الجهد المطلوب لتنفيذ عمليات التشغيل الذاتي بشكل آمن في مناطق محددة».

### الأسباب الثلاثة الكبرى للتحول إلى الأتمتة

يذكر يورغنسن أن هناك ثلاثة أسباب رئيسية للتحول إلى الأتمتة لا يرتبط أي منها بالأتمتة بشكل محدد. ويقول أيضاً: «السبب الأول هو حالة العمل، وما إذا كان ذلك سيساعد المشغل في جني المزيد من الربح. ولا تزال نفقات التشغيل هي الميزة الرئيسية

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ملخص محتويات القسم الإنجليزي:

تقارير خاصة: شركة تنمية نفط عمان، العراق.

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