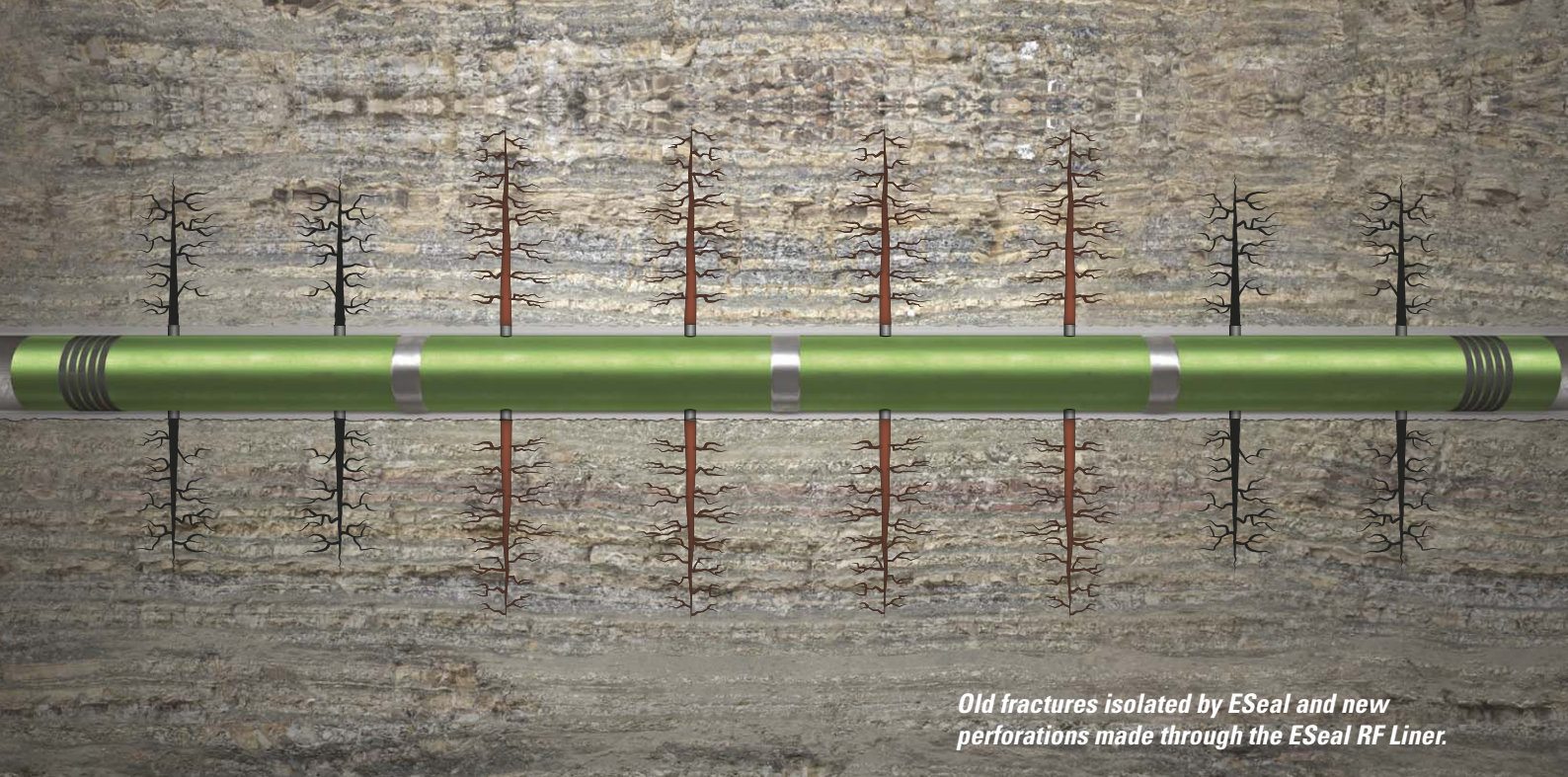


OILFIELD TECHNOLOGY

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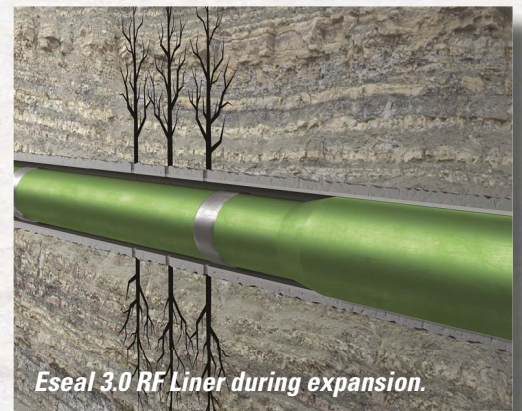




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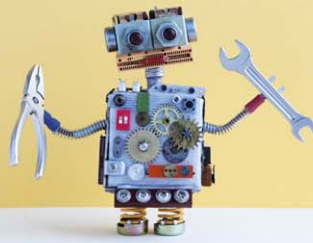


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Comment July 2019

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In today's world, it is near on impossible to avoid the increasing level of technology that has become interwoven into everyday life. Phones are no longer only used to call a friend or family member; they are also our cameras, calendars, alarms clocks, maps, etc., and contain fingerprint and face recognition technology. We use computers to work, cars to get there, and relax in the evening by watching television (which now can connect to the internet, unlocking the potential to use streaming services, or just mindlessly scroll different websites from the comfort of the sofa). Artificial intelligence (AI) is also making an appearance in our homes, with over 1 billion AI assistants sold in 2018.¹ Not only can these devices perform tasks such as play music or turn on lights by a simple voice command, they also interact and respond to instructions, and can occasionally crack jokes. But no need to worry, they are not capable of thinking for themselves. Yet.

While we are still far from the verge of living in a world threatened by the rise of robotic humanoids, the oil and gas industry is definitely experiencing a rise in the use of robots and AI in operations. According to GlobalData, the global robotics industry is set to grow at a compound annual growth rate of 16% from US\$98.2 billion in 2018 to US\$277.8 billion by 2025. Complex industry challenges, particularly in the exploration and production of hydrocarbons, are demanding research into alternative solutions. Across the upstream, midstream and downstream segments, companies are preparing to deploy robotics across a wide range of applications. GlobalData's report, 'Robotics in Oil & Gas' identified oil and gas companies such as Shell, ExxonMobil, Chevron, BP, Gazprom, Repsol, Equinor, Total, Saudi Aramco, Sinopec and ADNOC, as seeking potential in complex engineering robotic solutions to work autonomously or in conjunction with field operators.

Safety is of key concern to those working in dangerous environments, such as in underwater configurations. Thus, technology advancements are helping carry out tasks that have been deemed too risky to be undertaken by field personnel.

In the UK, the defence and subsea sectors have joined forces in a first of its kind collaboration, in order to work on the development of advanced underwater technology including underwater robotics, unmanned operations, sensors and other technological and digital innovations. Subsea UK and its technology arm, the National Subsea Research Initiative (NSRI), have signed a memorandum of understanding (MoU) with the UK Defence Solutions Centre (UKDSC) to work on the R&D of underwater autonomy capabilities and technologies.

'Automation,' 'AI,' 'digitalisation' and 'robotics' are the current buzzwords of the industry with companies seeking safer, more efficient and cost-effective methods to improve operations. Neil Gordon, Chief Executive of Subsea UK, comments: "digitalisation is bringing forward a number of technological solutions we could only have dreamed of before and will help revolutionise our industry."

In this month's issue of *Oilfield Technology*, our cover story by TETRA Technologies highlights the benefits of automating water supply and treatment systems for oilfield services. To learn more, turn to p. 34.

References

1. KINSELLA, B., 'New Report: Over 1 Billion Devices Provide Voice Assistant Access Today and Highest Usage is on Smartphones,' (November 2018), <https://voicebot.ai/2018/11/13/new-report-over-1-billion-devices-provide-voice-assistant-access-today-and-highest-usage-is-on-smartphones/>

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Subscription

Oilfield Technology subscription rates: Annual subscription £80 UK including postage/£95 overseas (postage airmail). Two year discounted rate £128 UK including postage/£152 overseas (postage airmail).

Subscription claims: Claims for non receipt of issues must be made within three months of publication of the issue or they will not be honoured without charge.

Applicable only to USA & Canada: OILFIELD TECHNOLOGY (ISSN No: 1757-2134, USPS No: 025-171) is published monthly by Palladian Publications, GBR and is distributed in the USA by Asendia USA, 17B S Middlesex Ave, Monroe NJ 08831. Periodicals postage paid New Brunswick, NJ and additional mailing offices.

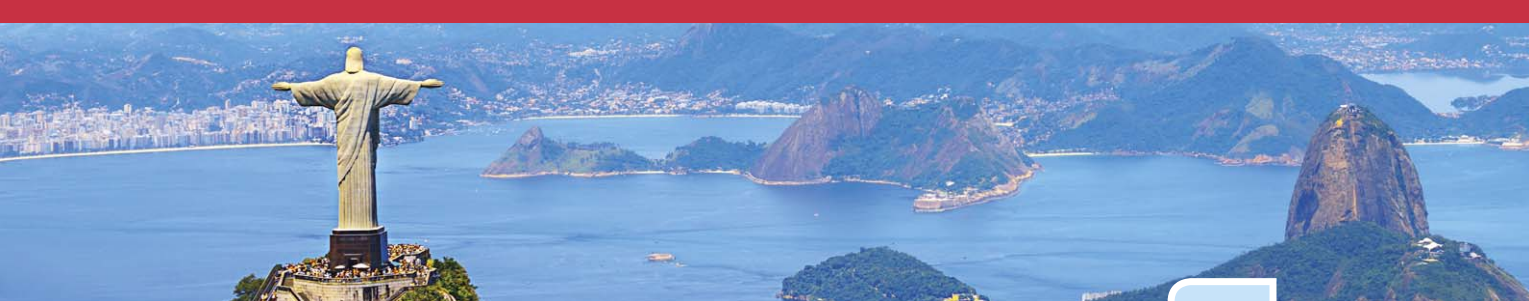
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World news July 2019

Talos Energy completes Zama appraisal programme

Talos Energy has provided an update on the Zama appraisal programme in Block 7, located in the offshore portion of Mexico's Sureste Basin. Talos is the operator of Block 7 in a consortium with partners Sierra Oil & Gas, a Wintershall DEA company, and Premier Oil.

The Zama-3 appraisal well is the third and final appraisal penetration drilled by the consortium to better define the resource potential of the Zama discovery. The Zama-2 and Zama-2 ST1 appraisal penetrations, both drilled in the first half of 2019, generated results that met or exceeded the consortium's expectations. The Zama-3 well was drilled approximately 1.5 miles (2.4 km) south of the original Zama-1 location with the goals of testing the southern extent of the reservoir and capturing additional reservoir description data. It logged approximately 1000 ft of gross true vertical depth (TVD) sand and 748 ft of gross TVD pay bearing section.

The consortium is continuing to evaluate the full universe of data and samples collected from its four penetrations of the Zama reservoir, including approximately 1450 ft of whole core, fluid samples from 30 separate points in the reservoir, 180 pressure points, 25 logging runs and two extended flow tests, with the goal of integrating this data with internal models and sharing it with external auditors to produce an updated contingent recoverable resource report by year end. However, based on the preliminary information collected to date, Talos expects the updated value will fall in the upper half of the previously provided pre-appraisal guidance range of 400 – 800 million boe.

The consortium is simultaneously advancing both its front-end engineering design (FEED) work streams as well as unitisation discussions with Pemex, with the aim of making a final investment decision (FID) on the project in 2020, pending required government approvals. ■

Block Energy to restart production at West Rustavi

Block Energy Plc has entered into an oil storage leasing agreement with Georgian Oil and Gas Corp. (GOGC), the state-owned national oil company of Georgia, that will allow oil production to restart in approximately 7 days, at the company's West Rustavi field.

The agreement secures for the company immediate access to up to 90 000 bbl of storage capacity at GOGC's main facility near the town of Sartichala, located approximately 30 km from West Rustavi and readily accessible from the Khakheti motorway that runs by the field, one of Georgia's main transport arteries.

The next step in the company's programme includes sidetracking of the adjacent and analogous well 38, and three of the field's other wells, two of which will also be tested for their historic gas discoveries. ■

Sparrows Group secures maintenance contract

Sparrows Group has been awarded its first contract for the provision of rigging loft maintenance services in Qatar.

The four-year contract includes the provision of services for the refurbishment, repair, load test and recertification of rigging lofts and contents.

Management of the equipment will also include six-monthly rigging loft changeouts, provision of replacement or new equipment and ensuring availability of properly certified equipment as required offshore.

In order to service the work, the company has established a new rigging loft management workshop within its Qatar facility with investment into new machinery and other office equipment. It has also created job opportunities locally as around seven new positions are required within the workshop. ■

In brief

India

TechnipFMC has been awarded subsea contracts by Reliance Industries Ltd for the MJ1 field located in deepwater offshore India in the Krishna Godavari basin. The contracts cover the fabrication and installation of flexible risers, rigid and flexible flowlines and umbilicals. The MJ1 field is operated by Reliance Industries. The high-pressure high-temperature gas field is located in water depths ranging between 1000 and 1200 m and will be connected to a new floating production storage and offloading (FPSO) facility.

Brazil

The government of the Brazilian state of Amazonas has assigned priority status to Rosneft's project in the Solimões Basin. According to the letter of intent signed between Rosneft Brasil (a 100% subsidiary of Rosneft) and the government of the Brazilian state, regional authorities are to provide conditions for the implementation of the project. The company is developing an upstream project in the basin with gas potential and owns 13 license areas with a total acreage of approximately 32 600 km².

Mexico

Oceaneering International, Inc. has secured a contract to perform a deepwater autonomous underwater vehicle (AUV) survey in Mexican waters. The geophysical survey will be performed for BHP at its Trion development. The company will use the *DP-2 Ocean Investigator*, equipped with OS-VI AUV and light geotechnical capabilities. Oceaneering will also provide light geotechnical services by acquiring 6 m piston core soil samples.



World news July 2019

Diary dates

22 – 24 July 2019

URTeC 2019

Denver, Colorado, USA
urtec.org

3 – 6 September 2019

Offshore Europe

Aberdeen, UK
www.offshore-europe.co.uk

17 – 19 September 2019

Gastech

Houston, Texas, USA
www.gastechevent.com

30 September – 2 October 2019

2019 SPE Annual Technical Conference and Exhibition

Calgary, Canada
www.atce.org/cfp2019

11 – 14 November 2019

ADIPEC 2019

Abu Dhabi, UAE
www.adipec.com

Web news highlights

- ▶ Airborne Oil & Gas awarded second Anasuria contract
- ▶ Union Jack Oil announces gas discovery in West Newton, UK
- ▶ Frac operations on Frost #1-H well completed

To read more about these articles and for more event listings go to:

www.oilfieldtechnology.com

Equinor discovers further oil in Oseberg field

Equinor has, on behalf of the Oseberg partners, made a profitable oil discovery related to Oseberg Vestflanken in the Norwegian Continental Shelf (NCS). The well was drilled by the Askepott rig and the discovery will soon be put onstream via the new, unmanned and remote-operated H platform on the Oseberg field.

Included in the Oseberg Vestflanken phase 2 project, the exploration extension well 30/6-H-9-T4 proved a 112 m oil column in a segment that has not been tested before. Oil was proven in the Statfjord formation in southern parts of the Alpha structure on Oseberg.

Recoverable resources are estimated at 22 million bbl of oil. The partners will consider water injection to further increase recoverable volumes.

At the end of 2017, Oseberg was the third largest oil producer on the NCS having produced around 2.9 billion bbl of oil. Current expectations are that 3.1 billion bbl of oil will be produced during the lifetime of the field. ■

GulfSlope Energy forms Gulf of Mexico JV

GulfSlope Energy, Inc. has announced the execution of a letter of intent with a privately held oil and gas company to form a joint venture (JV) to generate and drill shallow depth prospects in the Gulf of Mexico.

The company will retain and deploy a supra salt evaluation team consisting of three geoscientists and a manager to identify, evaluate and recommend targets for lease acquisition, farm-in and drilling. It will serve as operator and will be compensated for the management and administration of the JV as well as reimbursed for direct general and administrative costs incurred on behalf of the JV. The partner will have the right to participate up to 50% in the drilling of the shallow depth prospects generated and developed by the evaluation team. Additionally, subject to specific performance criteria, the partner will be granted an option to participate in the company's Corvette Prospect on a promoted basis. ■

PTTEP makes gas discovery offshore Sarawak

PTT Exploration and Production Public Co. Ltd (PTTEP), Thailand's national oil and gas company, has announced that its fully-owned subsidiary PTTEP HK Offshore Ltd (Malaysia Branch) has made a discovery of gas at Lang Lebah-1RDR2, the first exploration well in the Sarawak SK410B Project located offshore Sarawak state, Malaysia.

After commencing in March 2019, drilling of Lang Lebah-1RDR2 was targeted at non-associated gas in the primary target of the Middle Miocene cycle IV/V carbonate reservoir and undertaken to a total depth of 3810 m. The well encountered 252 m of net gas pay, indicating a multi-trillion ft³ gas discovery. The well was tested in carbonate main target reservoir with a completion-constrained (2 ¾ in. tubing) rate of 41.3 million ft³/d and 246 bpd of condensate through 4 ¼ in. choke size.

The drilling result of Lang Lebah-1RDR2 is PTTEP's largest ever discovery. The discovery will require further drilling to confirm upside potential.

The Sarawak SK410B Project is located in the shallow waters, approximately 90 km offshore Sarawak, with acreages of approximately 1870 km². The consortium consists of PTTEP HKO (the operator), Kuwait Foreign Petroleum Exploration Co. and Petronas Carigali with participating interests of 42.5%, 42.5% and 15% respectively.

Wood Mackenzie has estimated an indicative size of 2 trillion ft³, which would make it the 7th largest global discovery made so far this year as well as the largest operated field in PTTEP's history, ahead of the Zawtika field, Myanmar. According to the consultancy group, the discovery potentially has relatively 'clean' gas qualities and low impurity content. ■

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World news July 2019

Foothills Exploration expects to close on Montana acquisition in 3Q19

Foothills Exploration, Inc. has provided an update on its proposed acquisition of 7000 acres and 87 oil and gas wells in Montana, US.

The target acquisition is located in Montana's North-Central Basin and is oil-weighted. The properties consist of about 7000 acres and a total of 87 oil and gas wells. These stripper wells currently produce approximately 106 bpd. The oil properties include 58 wells – 12 producing, 25 shut-in proved developed non-producing and 21 injection wells comprising of the Sumatra and Big Wall/Little Wall Fields. The gas properties consist of 29 stripper wells – 10 producing and 19 shut-in. The properties currently generate approximately US\$1.8 million in total annual gross revenues.

The company has devised a field-wide optimisation programme designed to bring production back online from the 54 shut-in wells and expects these workover operations to generate a 100% increase in current production levels.

The US Geological Survey has assessed the continuous unconventional oil and gas resources of the Big Snowy Trough area that includes a majority of the 7000 acres being acquired.

The company expects to close on the acquisition on or around 22 August 2019, subject to approval from the State of Montana. ■

ANH approves Putumayo farm-out

The Agencia Nacional de Hidrocarburos (ANH), Colombia's national hydrocarbons agency, has approved the farm-out agreement between Amerisur Resources and Occidental announced 23 November 2018. The deal relates to four exploration blocks: Putumayo-9, Terecay, Tacacho and Mecaya in the Putumayo region. Occidental will acquire a 50% interest in each block and will fund a US\$93 million exploration and appraisal programme between 2019 – 2021. Funding includes 85% of the 1068 km 2D seismic equivalent and 100% of the planned four well drilling programme.

Amerisur remains operator of the blocks that cover 1.4 million gross acres and hold 448 million bbl mid-case gross prospective resources, based on management estimates.

The company recently completed the Platanillo-26 infill well targeting an undrained area of the Platanillo field. The well reached the target depth of 9350 ft and encountered 46 ft net pay in the upper and lower U sands. The well is now onstream and producing around 710 bpd. ■

PGNiG purchases interest in King Lear field

PGNiG Upstream Norway is to acquire 22.2% of shares in the King Lear field – PL146 and PL333 licenses – from Total E&P Norge. The volume of production in the part attributable to PGNiG may reach 0.25 billion m³ of natural gas annually. The production start is planned for 2025. Due to the potential of further cooperation, the parties have agreed not to disclose the value of transaction.

King Lear is a gas and condensate field located in the North Sea. According to the Norwegian Petroleum Directorate (NPD), the field has documented recoverable resources which amount to approximately 98.6 million boe (including 9.2 billion m³ of natural gas). The operator of the field is Aker BP, which acquired a 77.8% interest in the licenses in 2018 from Equinor Energy.

Both licenses are currently in the development phase. The investment process is planned for the period of 2021 – 2024.

After finalising the transaction the company will hold shares in 25 licenses on the Norwegian Continental Shelf (NCS). It holds the status of operator on four of them. ■

Dominican Republic to hold licensing round

The Ministry of Energy and Mines of the Dominican Republic, in partnership with Wood Mackenzie, has announced its first licensing round is to open at an event in Houston, Texas, US, on 10 July 2019, closing in December 2019.

The Ministry is offering a total of 14 blocks: six onshore blocks in the Cibao Basin, three onshore basins in the Enriquillo Basin, one onshore block in the Azua Basin, and four offshore blocks in the San Pedro basin.

Seismic data for the Enriquillo, San Juan and Cibao Basins is held by the Ministry and recent surface and seismic stratigraphic mapping has clarified the geological story of the area. ■

SBM Offshore awarded letter of intent for FPSO

SBM Offshore has signed a letter of intent (LOI) together with Petrobras for a 22.5 years lease and operate of the floating production storage and offloading (FPSO) vessel *Mero 2*, to be deployed at the Mero field in the Santos Basin offshore Brazil, 180 km offshore Rio de Janeiro.

The Libra block, where the Mero field is located, is under Production Sharing Agreement to a consortium comprised of Petrobras, as the operator, with 40%, Shell with 20%, Total with 20%, CNODC with 10% and CNOOC Ltd with 10% interest. The consortium also has the participation of the state-owned company Pré-Sal Petróleo SA (PPSA) as manager of the Production Sharing Contract.

SBM Offshore will design and construct the *Mero 2* using its Fast4Ward programme as it incorporates the company's new build, multi-purpose hull combined with several standardised topsides modules.

The FPSO will be designed to produce 180 000 bpd and will have a water injection capacity of 250 000 bpd, associated gas treatment capacity of 12 million m³/d and a minimum storage capacity of 1.4 million bbl of crude oil. Delivery of the FPSO is expected in 2022. ■

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A scenic mountain landscape with a road in the foreground and large white text overlaid. The background features rugged, snow-capped mountains under a clear blue sky. In the foreground, a road curves through a valley with trees showing autumn foliage in shades of yellow and green. The text "RACE FOR THE TOP" is written in large, bold, white, sans-serif capital letters, centered vertically and horizontally across the image.

RACE FOR THE TOP

Oilfield Technology

Correspondent, Gordon Cope, explains how the US has sprinted ahead of its international rivals when it comes to oil and gas production, and asks: where does it go from here?

According to the US Energy Information Administration (EIA), output from the US stood at 12.1 million bpd of crude and 79 billion ft³/d of dry gas as of April 2019. In terms of total energy output, it now surpasses Russia and Saudi Arabia as the largest producer.

Permian

By the spring of 2019, production of light crude in the Permian Basin in west Texas and eastern New Mexico had ballooned to over 4.1 million bpd, with the associated output of natural gas approaching 10 billion ft³/d.

Part of the rapid increase has been the arrival of supermajors, which can leverage economies of scale and proprietary technology that independents lack, into the unconventional play. In April 2019, Chevron offered to purchase Anadarko for US\$50 billion, primarily to boost its presence in the Permian Basin and nearby Gulf of Mexico. Occidental Petroleum subsequently made an offer of US\$57 billion, in an effort to become the largest producer of oil in the Permian.

Both companies are looking to follow in the footsteps of ExxonMobil, which recently announced that it plans to increase production in the Permian to 1 million boe/d by 2024. The US-based company has large, contiguous landholdings in the basin, allowing for enhanced drilling and its use of advanced technologies (including subsurface characterisation, subsurface modelling, and data analytics). It currently has 48 rigs working in the basin, with 55 planned by the end of the year. Plans are also underway to develop dedicated transportation to deliver 600 000 bpd of oil and 1 billion ft³/d of gas to its refineries and petrochemical plants on the US Gulf Coast (USGC). Exxon expects to significantly increase recovery and reduce CAPEX per well; in all, the company estimates that it can make a 10% return at a modest US\$35/bbl.

With such rapid growth, transportation companies are scrambling to build new pipelines, including Plains All American's 500 000 bpd Sunrise expansion and the Cactus II 670 000 bpd system, as well as EPIC's 900 000 bpd pipeline. In April 2019, EPIC, based in San Antonio, Texas, was given the green light by the US Army Corps of Engineers to build two new pipelines from the Permian basin to export terminals on the USGC capable of carrying up to 590 000 bpd of liquids a distance of 650 miles to the port of Corpus Christi, Texas.

The shortage of gas lines, especially, is so severe in the Permian that spot natural gas prices at the Waha regional hub in West Texas reached a record low of -US\$4.28 per million Btu in April 2019, as producers paid to have the gas taken away. That same month, Apache Corporation suspended a portion of its Permian gas production, approximately 250 million ft³/d, to avoid excess flaring.

Pipeline companies are scrambling to keep up with gas transportation demand. Kinder Morgan, for instance, is working with various partners to build the Permian Highway Pipeline (2 billion ft³/d) and the Gulf Coast Express Pipeline (1.92 billion ft³/d). Apache, which has contracted over 1 billion ft³/d on Kinder Morgan's new pipelines, expects to resume full production when the two lines come into service later this year and early 2020.

Regardless, the growing basin production means that much more line will be needed; IHS Markit predicts that by 2023, Permian production will reach 5.4 million bpd of crude, 1.7 million bpd of natural gas liquids (NGLs), and 15 billion ft³/d of gas.

Gulf of Mexico

The March 2019 lease sale in the Gulf of Mexico showed renewed interest in the region. The sale notched 257 bids on 227 blocks, totalling US\$244 million, up almost 40% from the last round in August 2018. Shell bid highest, with 87 offerings totalling US\$84.8 million.

Crude exports from the USGC are expected to grow dramatically from the 2 million bpd averaged in 2018. In early 2019, Sentinel Midstream entered the export market, announcing plans to build a crude terminal offshore of Freeport, Texas, capable of loading a 2 million bbl supertanker in one day. The facility will include 18 million bbl of onshore storage, a pipeline, and a terminal capable of handling 85 000 bbl/hr. It joins at least seven other proposals for new and expanded export terminals in the USGC.

North Dakota

Shale production in the Bakken play of North Dakota dropped to 1.39 million bpd in April 2019, down slightly from the record of 1.41 million bpd set in January 2019, mostly due to winter outages and road bans.

However, the long-term prospects for the basin look bright. Since the opening of the Dakota Access Pipeline in 2017, production has been flowing to the Cushing hub in Oklahoma, and hence to the USGC. Mexico's Pemex has been seeking the light, sweet Bakken crude as an

input for its Salina Cruz refinery in the Gulf of Mexico. Bakken crude has also been exported to Singapore refineries seeking a similar grade.

Alaska

Crude production in Alaska has dropped significantly over the last decade as the giant Prudhoe Bay field and other deposits have slowly petered out; where it once produced 2 million bpd, the state now produces 500 000 bpd.

Several new discoveries are expected to reverse the trend. ConocoPhillips' Greater Mooses Tooth (GMT 1) field in the National Petroleum Reserve (NPR) is now online, and is expected to produce 30 000 bpd. The nearby GMT 2 field is expected to produce 40 000 bpd. Along with other North Slope prospects, the company estimates it could be producing up to 300 000 bpd within the decade. Other discoveries, including Hilcorp Alaska's Liberty field, Repsol's Pikka discovery, and ENI's Nikaitchuq oilfield in the Beaufort Sea have the potential to add another 250 000 bpd.

Many more discoveries await. The NPR sits above the Barrow Arch, a structural formation in which most North Slope reserves are located. While the Obama administration set aside almost half of the 22.1 million acre reserve to protect endangered wildlife, the Trump administration has announced plans that would reverse much of its predecessor's policy, which could release an estimated 8.7 billion bbl of crude and 21 trillion ft³ of gas.

Marcellus and Utica shale gas

Natural gas production continues to rise dramatically in the Marcellus and Utica shale formations located beneath the northeast Appalachian states. In its 2019 Annual Energy Outlook (AEO2019), the EIA outlined a growth from current levels of 24 billion ft³/d of dry gas in the region to 50 billion ft³/d by 2050. Over the last decade, takeaway pipeline capacity to New England, the mid-Atlantic and southern states has grown from 5 billion ft³/d to 23 billion ft³/d in order to fuel both growing domestic demand and LNG export facilities. In March 2019, TransCanada received the go-ahead to increase flow on its Mountaineer Xpress (MXP) and enter the new Gulf Xpress (GXP) into service. The US\$3.5 billion MXP project has 170 miles of 36 in. pipe capable of transporting 2.7 billion ft³/d. The US\$600 million GXP project has four new compressors in Kentucky, Tennessee, and Mississippi, adding over 500 million ft³/d of capacity to the TCO Pool and Leach markets on the Columbia Gas Transmission System.

LNG

The EIA's AEO2019 Reference case notes that US LNG export capacity currently stands at 5 billion ft³/d. Cheniere accounts for more than half that capacity; it now has four, 700 million ft³/d trains operating in Sabine Pass, Louisiana, and has been shipping LNG to various consumers in Europe and Asia. The commissioning of a fifth train will give the Sabine Pass terminal 3.5 billion ft³/d capacity.

Houston-based Tellurian continues to advance its US\$15.2 billion Driftwood LNG plant in Calcasieu Parish, Louisiana. The project envisages up to 20 LNG trains, three storage tanks and three marine berths. Tellurian aims to begin construction of the plants and pipelines in mid-2019, and deliver first LNG for export in 2023.

According to the EIA, the US is expected to reach almost 9 billion ft³/d LNG capacity by the end of 2019, 10.3 billion ft³/d by the end of 2020, and 14 billion ft³/d by 2030.

Challenges

East and West Coast offshore

In early 2018, the Trump administration announced plans to allow development on the offshore continental shelf (OCS) regions in the

Atlantic and Pacific coasts – a total of 90% of the US continental shelf. Congress is considering several bills that would keep the US Interior Secretary from unilaterally authorising additional activities in the OCS in the Atlantic, Pacific, and eastern Gulf of Mexico. States bordering Atlantic waters, including South Carolina and Florida, have passed legislation banning offshore activities.

In April 2019, a federal court judge ruled that the Trump administration had overstepped its authority when it cancelled the Obama administration's withdrawals of three federal offshore areas from oil and gas leasing consideration. US District Judge, Sharon Gleason, of the ninth circuit, said the revocation is unlawful under the Outer Continental Shelf Lands Act. The authority rested with Congress, not the President, she noted. Proponents of the withdrawal expect the ruling to be overturned either by the appeals court or the Supreme Court.

Colorado banning fracking

The Democratic Party's majority in Congress is not the only arena in which the US oil and gas sector is facing opposition. The wave of Democrats voted to state office during the midterm elections of November 2018 campaigned on an array of environmental and renewable energy issues. A Colorado proposal to ban drilling within 2500 ft of any homes, wells, and parks was defeated, in part due to donations from major energy producers. In April, however, Colorado lawmakers passed a bill overhauling state regulations, placing a much greater emphasis on public health and safety. In New Mexico, incoming Governor Michel Lujan Grisham announced plans to limit producers from tapping fresh water aquifers at new leases on state lands. Producers in both states say it will make permitting much more onerous.

The future

Exploration technology is rapidly increasing in sophistication. BP has already shown what it can do with advanced analytic and drilling technology in the Permian. Using the latest seismic interpretation technology, the UK-based company added an additional 1 billion bbl of oil in place to the Thunder Horse field. It now intends to use the technology at other fields in order to increase reserves; the goal is to raise BP's current level of Gulf production from 300 000 boe/d to 400 000 boe/d by the next decade.

In the short-term, the fate of the US oil and gas sector will be tied to multiple concerns, including the price of oil, investor demands, and the ability to transport product to market. In late 2018, when oil prices dipped, operators in the Permian temporarily eased their rapid drilling pace. A return to higher prices in early 2019 has negated the pause, but companies are still highly sensitive to price swings. Shareholders are also looking for better returns; companies have been reducing overhead and drilling budgets. As noted, producers are also shutting in natural gas due to pipeline capacity shortage.

In the longer term, the US oil and gas sector's prospects will depend on several factors, including growth in international demand and the expansion of renewable energy. While China has experienced the largest growth in crude demand, it is also adding millions of electric vehicles to its domestic fleet every year. At some point, the latter development will begin to significantly impact the former, and international demand growth will slow.

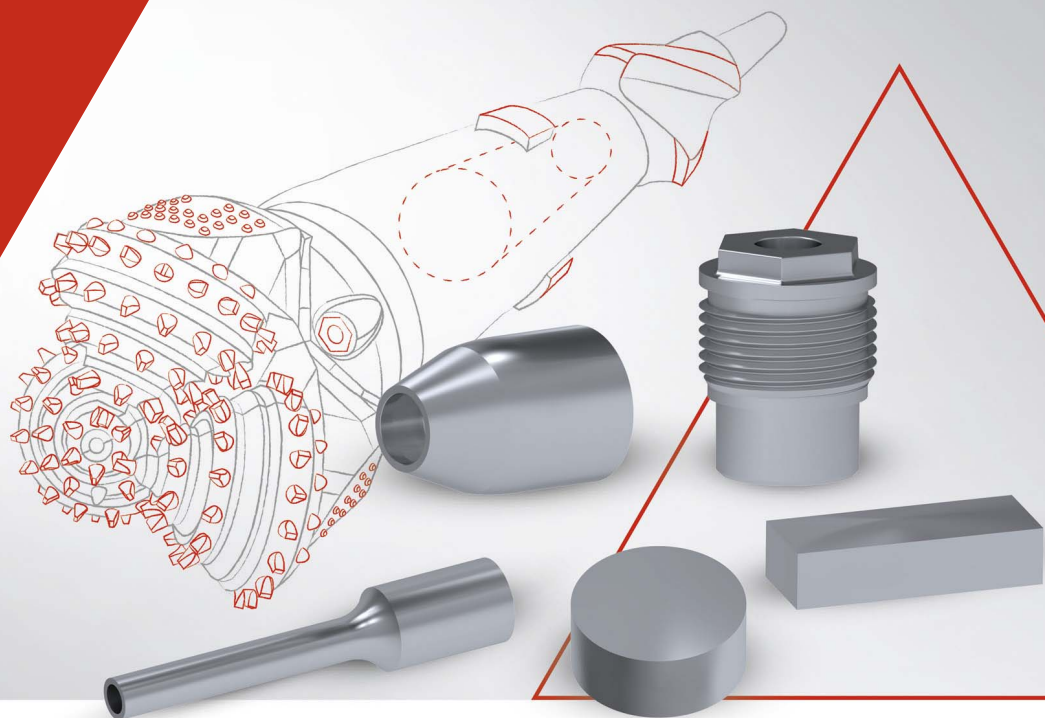
The US has also expanded its output through shale oil wells (output now stands at 8.46 million bpd, or 70% of its total output). Shale oil wells are notoriously short-lived however. If prices fall sufficiently to a point where drilling is no longer economically viable, production will drop dramatically. In the meantime, the race for the top continues. ■

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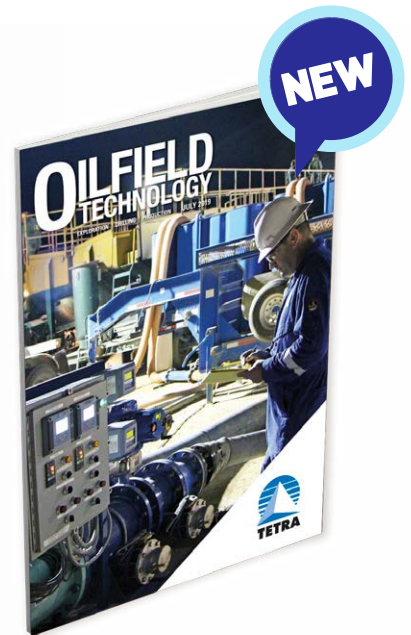
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