

# Oil Review

Oil · Gas · Petrochemicals

## Africa

VOLUME 16 | ISSUE 4 2021

# South Sudan: A new dawn for the oil industry?

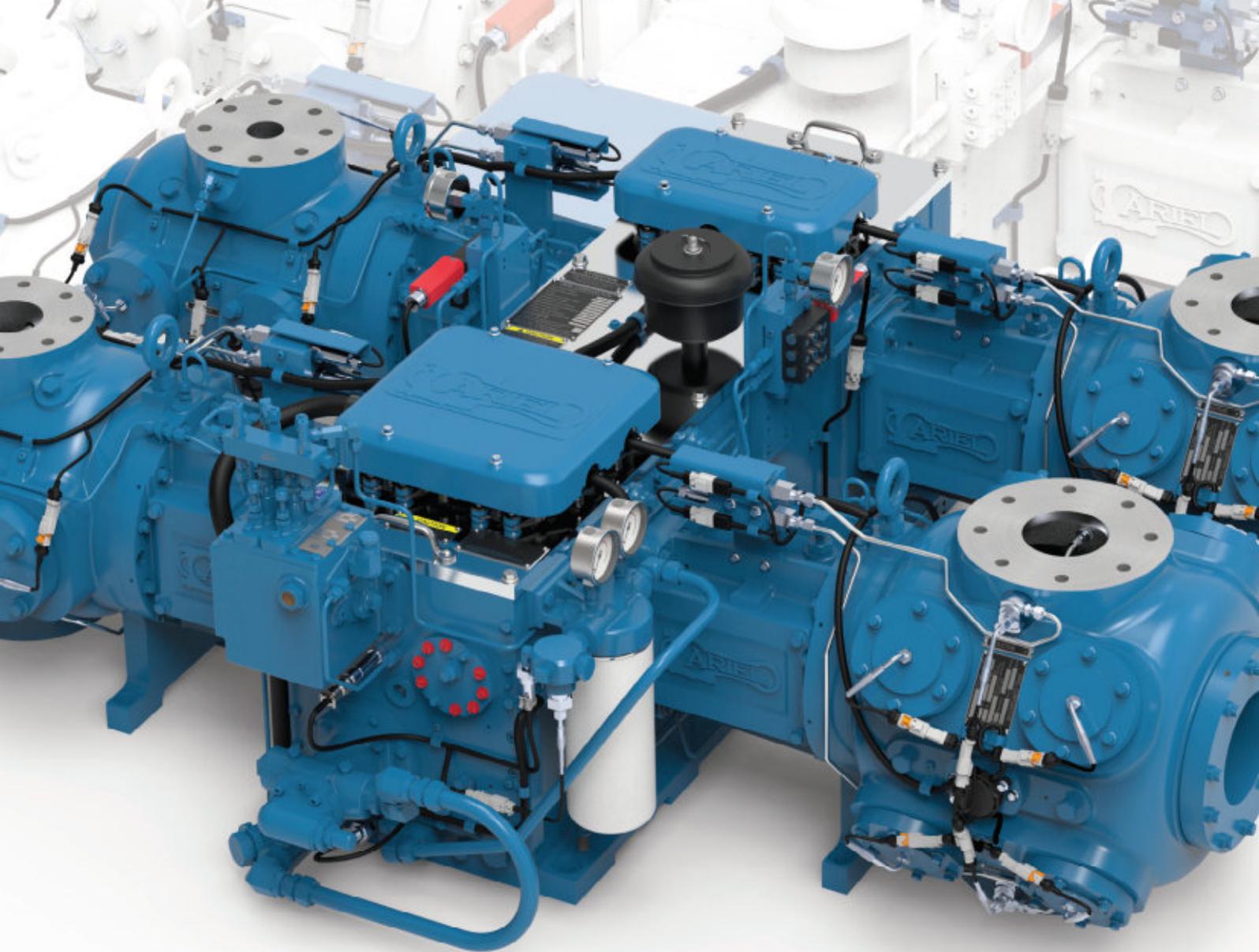
Progress from North Africa

Monitoring pipelines in extreme conditions

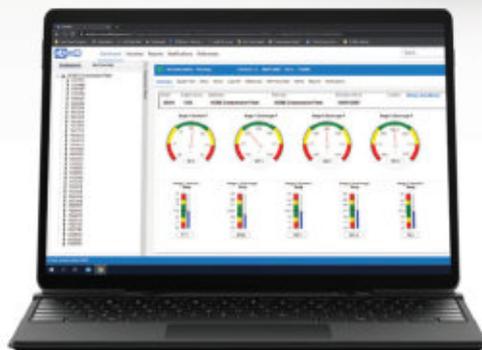
Floating production, compressors, storage, satellite mapping to track methane emissions, role of digital meters in reducing costs



*Importance of gender inclusivity in Uganda's oil and gas industry. (p18)*



# ARIEL SMART COMPRESSOR

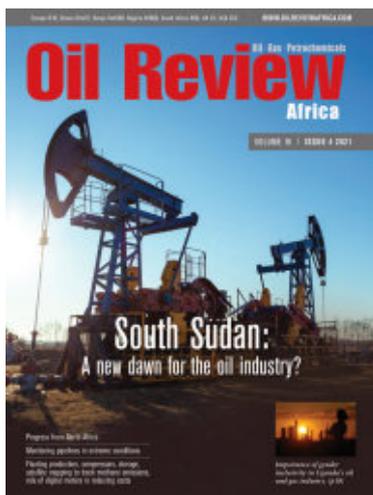


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The latest developments from the markets of South Sudan. (Image credit: Adobe Stock)

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## EDITOR'S NOTE

WHEREAS THE MORE established African oil and gas markets attract the spotlight, it is equally important to pay attention to the emerging markets across the continent – take South Sudan for example – the ‘oil-prolific’ country can easily become tomorrow’s major player with the right investment and geological advantage. We analyse South Sudan’s oil future, where there are challenges, opportunities and plenty of reasons for optimism (p10).

In this issue, we speak with Guillermo Salarich, business development manager, ABB Energy Industries for India, Middle East and Africa region (p18), who explains the importance of gender inclusivity in Uganda’s oil and gas industry. Do look out for our next issue, where we will discuss the benefits of local content in sub-Saharan Africa and how a clear local content strategy can support sustainability goals.

Elsewhere in this issue, besides plenty of market and technology updates, we take a deep dive into the latest developments from Namibia, Angola, Botswana and Tanzania.

**Deblina Roy**

Editor, Oil Review Africa

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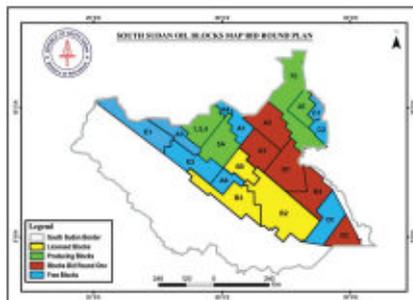
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# Executives Calendar 2021

## SEPTEMBER

- 8-9 DRC Power, Oil & Gas Conference and Exhibition**  
Kinshasa, Democratic Republic of the Congo  
[www.drcoilandgas.com](http://www.drcoilandgas.com)
- 9-10 AOG 2021**  
Luanda, Angola  
<https://energycapitalpower.com/event/angola-oil-gas-2021/>
- 21-23 Nigeria Energy**  
Landmark Centre, Lagos  
[www.nigeria-energy.com/en/home.html](http://www.nigeria-energy.com/en/home.html)
- 21-23 Gastech 2021**  
Singapore  
[www.gastechevent.com](http://www.gastechevent.com)
- 28-30 Mozambique Gas Summit & Exhibition**  
Maputo, Mozambique  
[www.mozambique-gas-summit.com](http://www.mozambique-gas-summit.com)

## OCTOBER

- 7-9 9th Power & Energy Africa**  
Nairobi, Kenya  
[www.expogr.com/kenyaenergy](http://www.expogr.com/kenyaenergy)

## NOVEMBER

- 8-11 Africa Oil Week**  
Dubai, The UAE  
[www.africa-oilweek.com](http://www.africa-oilweek.com)
- 9-12 African Energy Week**  
Cape Town, South Africa  
[www.aew2021.com](http://www.aew2021.com)
- 15-18 ADIPEC 2021**  
Abu Dhabi, The UAE  
[www.adipec.com](http://www.adipec.com)
- 17-19 EAOGS**  
Virtual  
<https://eaogs.com/>

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

## The 27th edition of Africa Oil Week taking place in November

HYVE GROUP PLC, organisers of Africa ~Oil Week (AOW), have announced the CEOs and Ministerial headliners attending the 27th edition, due to take place from 8-11 November in Dubai.

The official Event Brochure, released by the organisers, details the African ministers, government leaders, CEOs and upstream experts due to speak on the CPD-accredited agenda later this year.

Among those listed as main stage headliners is Nicolas Terraz, president of exploration and production and member of the executive committee at TotalEnergies. It will be Nicolas's first speaking engagement in his new role as E&P lead. Lorenzo Fiorillo, head of SSA Upstream at Eni, and CEOs from Fugro, Seplat, Panoro Energy and Wood Mackenzie are all confirmed as 2021 headliners.

Around 45 Ministers and government leaders will also be joining the strategic in-person event, and of which 15 ministers have been selected to host their national energy strategies and investment opportunities. Independents, including CEOs from Africa Oil Corp, Tullow Oil, ReconAfrica, First E&P and Discover Exploration, will too be

*Around 45 Ministers and government leaders will also be joining the strategic in-person event.*



Image Credit: Adobe Stock

presenting their farm out and JV opportunities in the revived Africa Independents Forum.

Paul Sinclair, vice-president of energy and director of government relations at Africa Oil Week, explained, "The agenda, as always, is focused on strategic business intelligence and deal-making opportunities. The past two years

have seen an accelerated transition towards clean energy solutions. At this year's AOW, our curated programme will run under the theme 'Succeeding in a Changed Market' where we, and our impressive line-up of industry experts, will explore opportunities created by the energy transition for the African Upstream."

## Sirius Petroleum joins forces with Baker Hughes for OML 65 development in Nigeria

SIRIUS PETROLEUM, AFRICA-FOCUSED oil and gas production and development company, has signed a MoU with Baker Hughes, for Phase 1 of the approved work programme of the OML 65 Licence, a large onshore block in the western Niger Delta, Nigeria.

Baker Hughes will provide drilling and related services under a mutually agreed pricing structure to deliver the initial nine well programmes.

Toks Azeez, sales and commercial executive of Baker Hughes, said, "This project represents an important step towards delivering our world-class Integrated Well Services solutions on one of the more prolific fields within the Niger Delta. Baker Hughes' technology efficiencies and excellence in execution will support Sirius in enhancing their cost effectiveness and competitiveness in the energy market."



Image Credit: Alamy Stock

*The project will focus on delivering Integrated Well Services solutions within the Niger Delta.*

## Angola wins back stake in Portuguese oil and gas firm

AS A RESULT of the International Arbitration Court's decision, Sonangol will be reinstated as sole shareholder (100%) of Esperaza Holdings BV, the Netherlands-based offshore company.

The litigation concerned the 40% stake held by Exem allegedly transferred by Sonangol EP in Esperaza Holdings BV, the vehicle through which the national oil company made, in 2006, a large and successful investment in the Portuguese oil and gas company Galp SA.

After analysing the documentary evidence and conducting a seven-day probatory hearing, the Arbitral Tribunal concluded

that the transaction by which Exem Energy BV intended to acquire its stake in Esperaza Holdings BV was contaminated by illegality, allowing its owners to influence the direct control of the national oil company, to reap extraordinary financial advantages in its favor to the detriment of the former and, consequently, of the Angolan State.

The 40% of the disputed shares of Esperaza Holdings BV have a current market value of around US\$700mn.

Exem Energy BV was also ordered to bear the total costs incurred by Sonangol in the course of the arbitration process.

## The largest gathering of African energy Ministers under one roof

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## NNPC seeks US\$1 bn fill-in funding for AKK pipeline project

THE NIGERIAN NATIONAL Petroleum Corporation (NNPC), through the federal government, is seeking US\$1bn with an aim to continue work on the US\$2.8bn Ajaokuta-Kaduna-Kano (AKK) gas pipeline project, after Chinese lenders, which had pledged to provide the majority of the funds, failed to disburse cash as timely as expected.

As reported in Reuters, a spokesman for NNPC said that it was still negotiate with the Chinese lenders – Bank of China and Sinosure – to cover US\$1.8bn of the project cost.

However, the three sources privy to the matter told Reuters that NNPC had started to approach others, including export-import institutions, with an aim to continue work on the pipeline. The goal is to run



Image Credit: Adobe Stock

NNPC, which was funding 15% of the project, said last year it had used its own funds to start construction.

through the middle of the West African country to its northern economic hub, Kano.

Chinese lenders had originally expressed interest to fund the bulk of the estimated US\$2.5bn to US\$2.8bn cost of the project, which is central to President

Muhammadu Buhari's plan to develop gas resources and boost development in northern Nigeria, according to the source.

NNPC, which was funding 15% of the project, said last year it had used its own funds to start construction.

## Golar LNG partners with Perenco Cameroon and SNH

GOLAR LNG LIMITED has partnered with Perenco Cameroon and Société Nationale des Hydrocarbures (SNH) to increase utilisation of the FLNG Hilli Episeyo (Hilli).

Commencing 2022 the capacity utilisation of Hilli will

increase by 200,000 tons of LNG, bringing total utilisation in 2022 to 1.4 million tons. The tolling fee for the 2022 incremental capacity is linked to European gas prices at the Dutch Title Transfer Facility (TTF). At current average 2022 TTF gas prices the increased

capacity utilisation represents an expected US\$26.1m in incremental Adjusted EBITDA.

In addition to the 2022 capacity increase, Perenco and SNH intend to drill and appraise two to three incremental natural gas wells during 2021, and subsequently upgrade upstream facilities in 2022 to support further sustained increases in production from 2023 onward.

Under the Agreement, Perenco and SNH are granted an option to increase capacity utilisation of Hilli by up to 400,000 tons of LNG per year from January 2023 through to the end of the current contract term in 2026. This has the potential to increase total annual LNG production from Hilli to 1.6 million tons from January 2023 onwards.



Image Credit: Adobe Stock

Perenco and SNH intend to drill and appraise two to three incremental natural gas wells during 2021.

## Eni announces significant oil discovery in Block 4, offshore Ghana

ENI HAS ANNOUNCED a major oil discovery on the Eban exploration prospect in CTP Block 4, offshore Ghana.

The Eban - 1X well is located approximately 50 km off the coast and about eight km northwest of Sankofa Hub, where the John Agyekum Kufuor FPSO is located. It was drilled by the Saipem 10000 drilling ship in a water depth of 545 metres and reached a total depth of 4179 metres (measured depth).

The discovery has been assessed following comprehensive analysis of extensive 3D seismic datasets and well data acquisition including pressure measurements, fluid sampling and intelligent formation testing with state-of-the-art technology. The acquired pressure and fluid data (oil density and gas-to-oil ratio) and reservoir properties are consistent with the previous discovery of Akoma and nearby Sankofa field.

The estimated hydrocarbon in place between the Sankofa field and the Eban-Akoma complex is now in excess of 1.1 Bboe and further oil in place upside could be confirmed with an additional appraisal well.

Due to its proximity to existing infrastructures, the new discovery can be fast-tracked to production with a subsea tie-in to the John Agyekum Kufuor FPSO, with the aim to extend its production plateau and increase production.

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## Excitement builds as OWI WA registration opens

PARTICIPANTS AND ATTENDEES are looking forward to the return of the Offshore Well Intervention West Africa conference which will be running virtually from 12-15 October.

West Africa's leading well intervention conference will provide stakeholders with a platform to network, share industry best practices and listen to valuable insights to optimise future well intervention campaigns.

Key topics that will be focused on in the conference include the logistical challenges posed by the region and how these can be overcome; the latest technology and equipment available in this space; what role light well intervention could and should have in the region in the future;



Image Credit: Adobe Stock

OWI WA will be running virtually from 12-15 October.

and much more.

Attendees will have the ability to listen to and engage with industry experts from companies such as Shell, Ghana National Petroleum Corporation, Sonangol, Tullow Oil, Schlumberger, Helix Energy Solutions, Baker Hughes,

Silverwell, and more.

Previous events have attracted more than 300 senior well intervention decision makers and registration is now open.

Participants can sign up here: <https://offsnet.com/owi-wa/register>

## GNPC seeks approval for US\$1.65bn loan for oil exploration

THE GHANA NATIONAL Petroleum Corporation (GNPC) is seeking parliamentary approval for a US\$1.65bn loan to buy a 70% stake in the South Deep Water Tano (SDWT) and a 37% stake in the Deep Water

Tano/Cape Three Points (DWT/CTP).

GNPC, through GNPC Explorco, is participating in the upstream sector.

The SDWT is operated by AGM Petroleum Ghana Limited

and the DWT/CTP is operated by Aker Energy Ghana Limited.

As reported in Modern Ghana, the company is expected to form a joint operating company and acquire the stated stakes at different agreed prices.

Quoting GNPC, the source has further reported that this partnership would be critical because prevailing situations like the exiting of oil biggies from the West African nation needed that it develops its capacity and takes up a large part of the exploration activities before Ghana's oil sees a terminal decline.

The partnership is expected to help Ghana in producing an additional 200,000 barrels of crude oil in next four to five years, the source further reported



Image Credit: Adobe Stock

The partnership is expected to help Ghana in producing an additional 200,000 barrels of crude oil in next four to five years, the source further reported.

## Uganda's oil and gas a key focus at African Energy Week

UGANDA'S SIZEABLE RESERVES, enabling regulation and proactive national oil company is positioning the country as a regional hydrocarbon leader, and African Energy Week in Cape Town is set to promote it from 9-12 November 2021.

In a recent working visit to Uganda, the African Energy Chamber (AEC) emphasised the role that AEW 2021 will play in showcasing the country's energy progress, placing Uganda as a top priority at Africa's premier energy event in order to drive associated dealmaking.

Despite representing a relatively new hydrocarbon sector, Uganda – with its 6.5 billion barrels of proven crude oil reserves and 0.5 trillion cu/f of natural gas – has made significant progress in establishing a competitive oil and gas industry.

Uganda boasts participation by some of the world's leading International Oil Companies (IOC). Since 2004, Tullow Oil has played a pivotal role in developing Uganda's oil and gas sector, with significant discoveries made in the Lake Albert Rift Basin in 2006 and 2009. Similarly, Heritage Oil Plc has been a major contributor of Uganda's industry success through discoveries such as the 600-million-barrel drilling campaign in the Albert Basin and the Kingfisher Well in 2008.

The companies have been instrumental in opening up several basins in the country, accelerating associated developments and establishing a competitive sector.

## Europa Oil & Gas farming out Inezgane Licence, North Africa

EUROPA OIL & GAS HAS announced the formal launch of the farmout initiative of its high-impact exploration opportunity, the Inezgane Offshore Permit, offshore Morocco in the Agadir Basin.

Inezgane represents a high-impact exploration opportunity in a highly underexplored area of the world representing an excellent farm in opportunity for interested companies and complements Europa's existing strategy of seeking to develop a balanced portfolio of assets.



Image Credit: Adobe Stock

*The licence is located on the same geological trend which has led to major oil and gas discoveries.*

## SafeSTS develops green technology for ship-to-ship cargo transfers

SAFESTS HAS DEVELOPED and patented a new ship-to-ship cargo transfer system for the Dynamic Positioning (DP) shuttle tankers sector.

The innovation provides increased flexibility and efficiency for the export of oil from offshore fields in the world's most challenging offshore environments.

Traditionally, these shuttle tankers are used in DP mode to load from floating production, storage and offloading platforms, with subsequent transfer to export tankers taking place in side-by-side ship-to-ship transfer operations.

However, the SafeSTS Transfer via Buoy Terminal (TVB) is designed to enable export tankers to load or discharge at a single point mooring (SPM) type terminal, with the DP shuttle tankers discharging in DP mode whilst keeping at a pre-determined distance of circa 150 metres from the export tanker.

In the event of squalls or other environmental events, system stability is provided by the export tanker hold-back tug, while the DP shuttle tanker independently holds station in relation to the export tanker.

The TVB Terminal has no subsea structure apart from anchors and chains, and with the dual-carass floating hoses containing the oil always visible on the surface, regular maintenance and inspection is easily conducted without the use of specialist underwater personnel and equipment.

The TVB Terminal can be located close to the production fields to provide both exceptional operational availability and increased commercial and environmental capability. With its capacity to handle 20 operations per month, VLCC tankers will need to moor once to the TVB Terminal, to then be loaded by multiple consecutive DP shuttle tankers with various sized cargo volumes.

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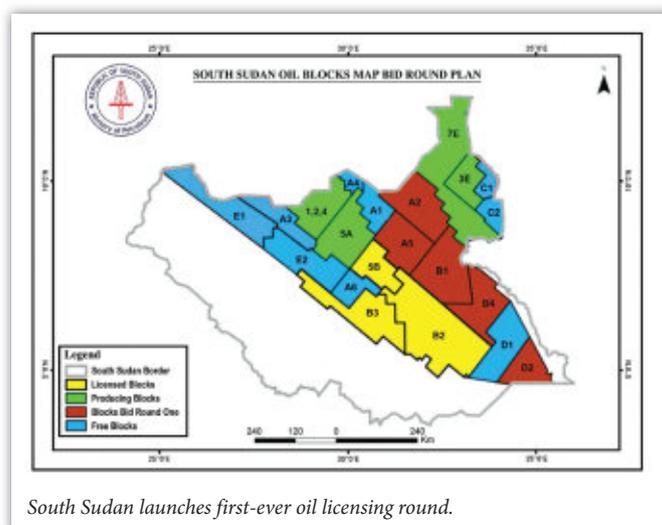
# CAN SOUTH SUDAN'S FLEDGLING OIL INDUSTRY FINALLY BEGIN TO RECOVER?

South Sudan is an 'oil-prolific' country, whose territory includes a large chunk of Cretaceous rift basin system that has proved petroliferous (i.e., rock formation) containing petroleum in Chad, Niger and Sudan. It is viewed as one of Africa's last unexplored frontiers – the holder of sub-Saharan Africa's third largest proved oil reserves (3.5bn barrels of low-sulphur crude).

**I**N SOUTH SUDAN, first oil was discovered in late 1970s when U.S. Chevron made major finds in Western Upper Nile in what is now Block 1, near Bentiu, and developed the Muglad Basin where they found two huge oilfields, Unity and Heglig, both in the South.

The hydrocarbons-rich areas are Bentiu, Greater Upper Nile, Jonglei, Melut, Muglad and Warrap. South Sudan produces two main crude blends: Dar and Nile (which are exported to Asian markets). The latter blend (33.9° API gravity, 0.06% sulphur) is most attractive to refiners because of its high fuel and gasoil yields. API, i.e., American Petroleum Institute gravity, an inverse measure to determine the weight of petroleum liquids in comparison to water. If a liquid has API gravity (above 10) it is considered a lightoil that floats on water. Conversely, API gravity (below 10) falls into the heavy oil category.

South Sudan – currently producing an estimated 150,000-170,000 bpd (from about 700 wells) – aims to boost output to 250,000-bpd by late 2021 when more of shuttered oilfields reopen and investments are directed



South Sudan launches first-ever oil licensing round.

towards exploration of existing and potential new blocks.

Probable natural gas (natgas) reserves are estimated at 30 trillion cubic feet (tcf) – proved figure is 3 tcf. Natgas associated with oilfields is mostly flared or reinjected. Capturing flare gas in oilfields will help increase natgas production – currently almost negligible.

Petroleum geologists are confident of finding more oil-gas reserves in South Sudan basins. The state-owned Nilepet plans to undertake a survey of both mineral resources and oil in a bid to showcase the country's

untapped potentials. Only 10% of oil-bearing basins have been explored to date. Chol Deng Thon Abel, managing director Nilepet, said, "So you still have 90% of the country not surveyed. But we still believe that we have huge reserves which is why we say South Sudan is an oil-rich country." National Petroleum and Gas Commission also echoed two-thirds of the landscape has potential for hydrocarbons, but

only a quarter of South Sudan had been explored."

## Rising water cuts

Exploration faces geological challenges as many ageing oilfields yield more water than oil.

Outdated wells prevent South Sudan from achieving pre-2011 capacity of 350,000-bpd. A Petroleum ministry official cautioned, "If we expect any increase, it will not be more than 5-10% maximum. It is not easy for us to go back to the previous 300,000 bpd because of the geological challenges. We understand there is a natural decline and oil reserve is limited." South Sudan needs approximately US\$1.5bn over the next five years to invest in updated equipment to extract more oil and map unexplored areas (official estimate).

A resumption of oil production in oilfields previously shutdown due to conflict had raised hopes for an oil-led recovery. The economy had picked up strongly before the

Image Credit: Ministry of Petroleum (MoP) of the Republic of South Sudan

## Crude production (000,000 barrels per day)

2014	2015	2016	2017	2018	2019	2020
155	148	137	147	144	172	170

Source: British Petroleum (2021)

## Major oilfields and operators

Location (Block)	Fields	Blend	Operator
1.2.4.	Unity, Toma, Munga, Hegleig, Bamboo, Diffra, Neem.	Nile	GPOC
3.7.	Polach, Adar-Yale.	Dar	DPOC
5A.	Mala, Thar Jath.	Nile	SPOC

Source: Rystad Energy

COVID-19 downturn, with gross domestic product (GDP) real growth reaching 9.5% in FY2019/20. The oil sector continued to be driving force, with estimated oil production of 62.1mn barrels in FY2019/20, one-quarter increase on the 49.1mn barrels reported in FY2018/19 (World Bank data).

GPOC= Greater Petroleum Operating Co.; DPOC= Dar Petroleum Operating Co.; SPOC= Sudd Petroleum Operating Co. DPOC & GPOC consortia produce bulk of the country's oil. Nile Petroleum Corp; Nilepet (national oil co.) holds minority stakes in production-sharing contracts with foreign operators due to low technical expertise and financial resources.

Asian majors dominate the oil industry, whilst western-based international oil companies (IOCs) have yet to invest in South Sudan. China National Petroleum Corp; (CNPC), China Petroleum & Chemical Corp; (Sinopec), Petronas (Malaysia), India's Oil and Natural Gas Corp; (ONGC), Strategic Fuel Fund (South Africa), Kuwaiti-based Tri-Ocean Energy and KUFPEC and Oranto Petroleum (Nigeria) are prominent exploration and production firms.

### Lacking midstream infrastructure

Landlocked South Sudan exports oil from Hegleig and Paloch fields via the 250,000-bpd Greater Nile Oil Pipeline (operated by CNPC) to Khartoum and then to Port Sudan. Hence, oil revenues are shared equally with its northern neighbour. Despite improved bilateral relations after secession in 2011, total reliant on Sudan's oil infrastructure remains a risk. Therefore, South Sudan is seeking new export routes, for example, via proposed pipelines in Kenya, Uganda and Tanzania to the Indian Ocean, but financing remains a key obstacle.

South Sudan has joined a



*Hon. Puot Kang Chol, minister of petroleum of South Sudan, said on 23 June 2021 that oil licensing is a proof of stability and progress in South Sudan.*

mega regional development scheme – spearheaded by Kenya to create a transport corridor for oil and other commodities – the Lamu Port (Kenya) –South Sudan-Ethiopia Transport Corridor project (LAPSSET) that includes ports, highways, railways, oil pipeline and airports. An estimated cost of pipeline (alone) is US\$4bn. South Sudan's director-general of Road Transport and Safety, Lado Tombe, said, "Project would connect landlocked South Sudan to other areas within the region."

In January 2020, LAPSSET received support from African Development Bank, United Nations Economic Commission for Africa and the African Union's New Partnership for Africa's Development. They are keen to promote its implementation, however, no firm target date is given for its construction.

Like any oil-producing countries, South Sudan offers opportunities in midstream and downstream sectors: the construction of oil pipelines, refineries, thermal power plants, fuel depot and waste treatment

and disposal facilities, and field services provision. The country aims to attract more foreign direct investment while building its local capabilities.

### Economic lifeblood

Despite the many challenges, South Sudan hopes to build a competitive oil sector. Only a fraction of the landscape (647,095 sq.km) has been geologically surveyed. "We have around 14 oil blocks other than the areas that we are producing. We are working every day to collect data and then do the mapping, which will help us to open the licensing rounds. The licensing round is to invite new bidders, new players in South Sudan so that we can explore oil in other areas. There is a very big potential to discover more oil in other areas across South Sudan," according to National Petroleum and Gas Corporation (NPGC). But due to Covid-19 induced downturn, first Licensing Round (2020) was delayed.

Juba has made a significant move towards peace, culminating in the formation of a national

unity government in February 2020. The main priorities are nation-building, economic stabilisation and attracting long-term investments into hydrocarbons, basic infrastructure and power generation, among other sectors.

South Sudan is known for its light crude but also reputed to possess significant mineral resources such as gold, copper, diamonds, limestone, iron ore, lead, manganese and zinc. Large dolomite, marble, and uranium deposits are recently identified. The government is keen to promote mining investment. Sustained political/regulatory certainty is catalyst for global investors to bring the required know-how and development capital.

Unlocking the potential of one of Africa's fastest-growing frontier markets requires an enabling environment for international players. South Sudan is the world's most oil dependent economy – oil constitutes 99% of exports. ♦

*Moin Siddiqi, economist*

# NORTH AFRICA: PROGRESS AND EMERGING TRENDS

As the need for energy transformation gathers pace at a global level, North African countries are also starting to make moves. Deblina Roy reports.

**H**OME TO HIGHLY lucrative oil and gas exploration hotbeds, North Africa has become an increasingly important base of operations for oil and gas companies.

This is rightly echoed by Mohamed Boussaïd, Tunisia's minister of industry, energy and mines: "We are determined to accelerate our energy transition over the next decade to achieve energy security through a diversified energy mix and to improve our economic competitiveness."

North Africa has seen a recent influx of activities in its oil and gas sector. Several global players have been active in North Africa's oil and gas space, even during the Covid-19 pandemic.

## Egypt, Morocco and Tunisia

In June 2021, Eni signed an agreement with the Arab Republic of Egypt, the Egyptian General Petroleum Corporation (EGPC) and Lukoil for the merger of the concessions of Meleiha and Meleiha Deep, in Egypt's Western Desert, and their extension to 2036, with the possibility of reaching further to 2041.

Jersey-based oil and gas company Predator Oil & Gas has announced completion of the drilling of MOU-1 in Morocco. Predator (75%) operates Guercif in joint venture with the Office National des Hydrocarbures et



Image Credit: Adobe Stock

Many North African countries are expected to benefit from the IEA programme.

des Mines (ONHYM) acting on behalf of the state (25%).

Based on the positive results, the company will be proposing to its partner to drill the previously defined MOU-4 location later this year to the northeast of MOU-1, and to commission an Environmental Impact Assessment

(EIA) over the prospective area around the MOU-4 location which will also incorporate information from the existing EIA.

AIM-listed SDX Energy, the MENA-focused energy company, has announced the successful completion of the initial three well phase of its 2021 drilling

campaign in Morocco, which will comprise up to a total of five wells over the year.

The first well, OYF-3, which spud on 30 April 2021, reached its TD at 1,183 metres MD on 11 May 2021. The second well, KSR-17, was spud on 13 May 2021 and reached its TD at 1,848 metres MD on 27 May 2021. Finally, the third well of the campaign, KSR-18, was spud on 30 May 2021 and reached its TD of 1,905 metres MD on 14 June 2021.

Compagnie Du Desert (CDD), Zenith Energy's fully-owned subsidiary, has completed the acquisition of a 100% interest

**“Decarbonisation is instrumental for North African countries to achieve their climate and economic development ambitions.”**

in the fully-owned subsidiary of Candax Energy in Barbados, Ecumed Petroleum Tunisia (EPT), which holds a 100% interest in the El Bibane and Robbana concessions in Tunisia.

Nostra Terra, the oil and gas exploration and production company, has announced progress with the planned strategic expansion of its portfolio into Tunisia. Exclusive negotiations and preparations have taken place for a large block with existing discoveries, offering both exploration and appraisal activity, and new entities have been organised in anticipation of such expansion.

In Algeria, Equinor and Sonatrach have signed a memorandum of understanding (MoU) to examine cooperation

within oil and gas exploration and production in Algeria and internationally. The MoU includes cooperation within greenhouse gas emissions and carbon management, industrial safety management, implementation of technology to increase hydrocarbon recovery and development of a model for driving high-performance oil operations.

**Decarbonisation**

Decarbonisation is instrumental for North African countries to achieve their climate and economic development ambitions. Change will not be easy though, as North Africa relies on energy exports to drive its economy, meaning that any substantial shift will require investment from more developed countries.

“The only way to move along... is a dramatic surge in clean energy investment,” stated Tim Gould, co-lead author of the report ‘Clean Energy Transition in North Africa’ and head of the International Energy Agency (IEA) division for energy supply outlooks and investment.

“Countries are not starting this journey from the same point. Emerging countries in particular need the financing and knowledge to build their energy systems sustainably.”

**IEA programme**

The IEA is expanding its engagement with African regional partners through a programme to support sustainable and accelerated development through a varied mix of technologies, help achieve the United Nations’

Sustainable Development Goal (SDG 7), promote increased energy security and affordability, and accelerate the development of clean energy systems across Africa.

Many North African countries are expected to benefit.

Putting in place a mechanism to ensure effective and transparent hydrocarbon revenue management is the essential first step. Maintaining upstream investment to ensure adequate production, especially for gas, also remains vital to provide economic stability.

However, this needs to be accompanied by greater efforts to reduce the environmental footprint of oil and gas operations, given that the emissions intensities of oil and gas production in North Africa are among the highest in the world. ♦

## TUBULAR CENTRIFUGE (HIGH SPEED SOLID BOWL)



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# CRITICAL CONTROL VALVE: IS IT INCREASING PERFORMANCE?

Valves are undergoing change to suit the growing requirements of end-users for data analytics. Whether it is an oil and gas upstream facility or a refinery, valves play a key role in multiple processes and operations.

**A**MONG MANY CRITICAL factors within the oil and gas industry, performance and reliability are some of the key considerations.

Oil and gas valves are critical to control the flow of fluid in the pipeline, change the fluid direction and adjust the pressure of fluids in the flow process.

This is no wonder that these multipurpose roles of industrial valves in the oil and gas industry are leading a significant growth for the global industrial valves market in the oil and gas industry. The market size is estimated to grow at a CAGR of more than 6% from 2021-2023, according

to the international market research company Industry Research Biz.

This trend is seen from the recent product launches from major oil and gas players as well. Gardner Denver High Pressure Solutions (GD), one of the leading total solutions providers for the drilling, well servicing and frac pumps market, has unveiled its new V3 valve that significantly increases performance hours in high pressure hydraulic fracturing operations.

During field trials in the Eagle Ford, Permian and Marcellus shale plays, increased performance

**“ The dramatic increase in performance hours for the V3 compared to its competitors underlines Gardner Denver’s ongoing commitment to applying innovation and improvements to all of our American-made products.”**

of up to 46% over the leading competitor was observed. In the Permian basin, performance of the V2 and V3 could be compared, with an increase in performance of 81% witnessed.

Emerson is also a major

player in the industrial valve market. The company’s ASCO Series 043 Gas Shutoff Valves, ASCO Series 044 Solenoid Valves, ASCO SV401 Series Oil Shutoff Valves, ASCO 266-S Series Fuel Oil Valves, ASCO HOV1B Series Hydramotor Valves, ASCO Liquid Petroleum Gas Shutoff Valves and others are ideal for high-pressure applications.

Another significant player in the market, the Oliver Valves ½” Bore Topside Manual Gate Valve has provided the client and end user with a solution for use in an industry-first high-pressure development in the Gulf of Mexico. Oliver Valves will be supplying multiple ½” Manual Gate Valve DBB’s to a Gulf of Mexico Project. In this project application, the ½” Gate Valve DBB will be used to drain the 20,000 psi rated pipework surrounding the large boarding valves on a semi-submersible floating production unit. The first oil is anticipated in 2024. ♦



*The V3 valve is suitable for use with any standard fluid end utilising P-4 and P-5 valve configuration.*

# SEEKING UK EDUCATION FOR CHILDREN? PANOBA HELPS AFRICAN FAMILIES

With more than 500 boarding schools and just over 150 universities to choose from in the UK, the task of narrowing down choices to one can be a daunting one for international parents.

**A SURVEY BY** StudyTravel Network for the 2019-20 academic year shows that within the boarding school sector, 67% of international student recruitment came through educational consultants or agents, outweighing all other avenues such as fairs, advertising or word or mouth recommendations.

Working with an educational consultant has clear advantages for both international families and for UK schools. For busy families, much of the time-consuming groundwork and research can be reduced through a knowledgeable consultant and one who has visited schools in person and therefore able to describe to families the small idiosyncrasies that make one school differ from another. There are many facets to finding the right school and with the help of an expert consultant, families can be sure that no stone is left unturned. No two children are the same and ensuring that a school has the required academic courses, co-curricular activities, boarding facilities, location and pastoral care, is just a part of the in-depth scrutiny needed for a successful school placement.

For UK boarding schools, welcoming international students from around the globe is particularly important. Schools pride themselves on preparing students for global careers and to be 'world ready' and this can't be achieved without diversity being reflected within their student body. Schools rely on agents to help them to attract students to create a balanced international intake across many nationalities. For school admissions staff, working with a reputable agent means much of the initial communication and administration is taken care of by the agent, as well as qualifying students in terms of their suitability for the school.

Panoba is an educational consultancy set



*Panoba Directors Nicky Sakpoba and Debbie Gispan.*

up in 2014 to service discerning African families seeking UK education for their children. With offices in Abuja and London, Panoba's Directors Debbie Gispan and Nicky Sakpoba are well versed in working closely with families and advising on the best that UK educational establishments have to offer, including GCSE, A Level, International Baccalaureate curricula, summer programmes, foundation programmes and

**“ During the pandemic, UK boarding schools have very effectively supported their international students, many of whom were unable to return home during the school holidays.”**

university entry. Whether a student is an aspiring footballer or polo player, has a burning desire to play drums or undertake the Duke of Edinburgh Gold award, Panoba will find the perfect environment for them. There is growing demand for UK boarding schools offering specialist education for Specific Learning Difficulties and Panoba also offer expert advice to families seeking this support.

During the pandemic, UK boarding schools have very effectively supported their international students, many of whom were unable to return home during the school holidays. There has been unprecedented demand for September 2021 places from international families needing a safe environment where their children can enjoy uninterrupted learning and all the best that a boarding education can bring. ♦

[www.panoba.co.uk](http://www.panoba.co.uk)

# COMMISSIONING OIL AND GAS STORAGE FACILITIES IN AFRICA

Fuel storage is a vital part of a country's energy network. Many African countries are building crucial oil and gas storage facilities, which is key for national development as well as keeping reserves portfolios strong. Deblina Roy reports.

**T**WO YEARS BACK, Equatorial Guinea paved the way for the construction of West Africa's first LNG storage and regasification plant. Built by American manufacturer Corban Energy Group and located at the Port of Akonikien, the plant will enable the transportation and storage of LNG from the Punta Europa LNG Terminal to Akonikien on the southern border of the mainland.

Among the recent projects in the continent, the long-awaited Tshele Hills storage facility by Botswana Oil Limited is set to be completed before 2023. The 186 million litre storage facility is expected to accelerate southern African country's strategic oil reserves from the current 18 days to 60.

South Africa is also gearing up for a key oil storage project. The oldest 120,000 bpd crude oil refinery, operated by Engen (Enref), will be converted into a storage facility as the refinery is no longer sustainable in the long term, stated the company.

Located on the eastern coast in Durban, the refinery has been closed since a fire in December damaged the plant. Engen's CEO Yusa Hassan said that the company is aiming to commission the new import and storage terminal in the second half of 2023, although he did not give any cost estimates for converting the crude refinery.

In Tanzania, African



Image Credit: Adobe Stock

*Tanzania's storage facility aims to transform Zambia's fuel supply.*

**“ Among the recent projects in the continent, the long-awaited Tshele Hills storage facility by Botswana Oil Limited is set to be completed before 2023.”**

petroleum supply company Dalbit International and EPC company Belgravia Infrastructure (BSL) will build a new fuel depot in Dar es Salaam for Tanzania's Tazama Pipelines, the official groundbreaking ceremony for which took place on 23 June 2021.

The storage facility aims to transform Zambia's fuel supply. Currently, petroleum products imported via Tanzania are stored in multiple facilities across Dar es Salaam. No single facility has enough capacity to meet demand. Oil marketers, therefore, have to pay multiple companies for

storing fuel, increasing costs.

The new facility in the Kigamboni district of Dar es Salaam will solve these critical issues. The site can hold 80,000 cu/m of diesel and 40,000 cu/m of petrol, meaning it will be able to store all petroleum products headed for Zambia and drastically improve time and cost efficiencies for oil marketers. Crucially, increasing storage capacity will boost the supply of fuel, helping to alleviate fuel shortages, which is vital for the sustainable development of Zambia. ♦

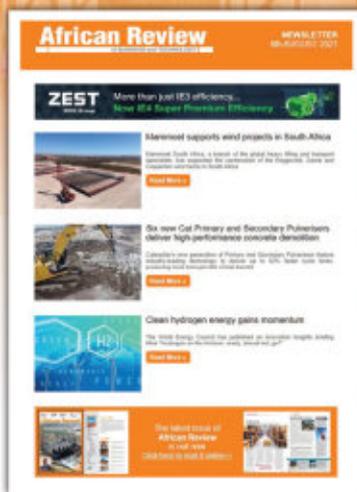
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# THE IMPORTANCE OF GENDER INCLUSIVITY IN UGANDA'S OIL AND GAS INDUSTRY

Oil and gas exploration has the potential to transform Uganda's economy and society, and women have a vital role to play. ABB is helping to promote gender diversity, as Guillermo Salarich, business development manager, ABB Energy Industries for India, Middle East and Africa region, explains.

**U**GANDA'S NASCENT OIL and gas sector has been a major beneficiary of foreign direct investment into the East African country in recent years. Planned oil and gas projects in Uganda represent a total investment of US\$12bn and sector revenues are forecast to reach around US\$4bn a year by 2030.

Despite recent efforts to encourage more women to enter the oil and gas industry in Uganda, they remain largely under-represented. This is reflective of the situation in Africa at large, where only 8% of the oil and gas workforce is female, compared with the global average of 15%.

Recognising this imbalance, the Petroleum Authority of Uganda (PAU) has called for greater gender inclusivity in the sector as a way to encourage economic and social development within the country.

ABB, which has a base in Uganda, and whose local workforce is 40% female, is committed to helping the PAU and the government of Uganda develop a roadmap that encourages and nurtures females from an early age into engineering, technology and energy roles, localises the market, upskills and trains the local workforce, creates jobs, and fosters the next generation of leaders and engineers.



Image Credit: Adobe Stock

*Uganda is encouraging integration of women into all levels of the oil and gas industry.*

## Untapped talent

The key to inclusivity is access to equal opportunities. The PAU has already made a strong statement through gender-sensitive initiatives, supporting full female participation at all decision-making levels and increasing job opportunities for women and female representation in management positions.

This aligns with Uganda's

Agenda 2030 for Sustainable Development and the National Development Plan and is an important function of wider efforts to encourage economic and social development.

Incentivising more women to join what is traditionally a male-dominated industry will help the oil and gas sector to meet demand for skilled labour, encourage the next generation of girls in Uganda to aspire to

leadership roles, as well as boost profitability, performance and innovation. By encouraging gender diversity, Uganda will incentivise more skilled resources and untapped talents.

## A roadmap for change

The efforts of the PAU and the Ugandan government are already reaping rewards. Today, women are being integrated into all levels of the oil and gas industry, from

management positions to R&D, sales, technology and finance. This is supported by various initiatives. Uganda is party to several international and regional protocols promoting female participation in leadership and governance.

The country also recently joined the Extractive Industry Transparency Initiative (EITI), which requires all member countries to consider gender inclusivity when forming Multi-Stakeholder Groups (MSGs).

Statistics from international oil companies indicate Uganda is in a much better position than many of its contemporaries when it comes to gender inclusivity. CNOOC Uganda Limited leads the way with women representing 51% of the workforce. Total E&P Uganda has 39%, Tullow Oil

Uganda had 35% at the time of farm out, Armour Energy Limited stands at 25% and Oranto Petroleum Limited at 13%.

Education is also a vital tool to promote gender diversity. The education system in Uganda has made major advancements in recent years in encouraging more young women to continue into higher education, particularly STEM subjects, and equip themselves with the skills to enter the workforce.

**ABB diversity initiatives**

In September 2020, ABB launched its global diversity and inclusion strategy with the target of doubling the number of women in senior management roles. Diversity isn't just restricted to gender, of course, and ABB is also committed to attracting



Image Credit: ABB

Guillermo Salarich is the business development manager at ABB Energy Industries for India, Middle East and Africa region.

people of different ethnicities, ages and abilities.

The benefits of gender

diversity are well documented. Research shows that greater representation of women's voices is vital for advancing sustainable development for any given community. Gender equity and inclusivity in the labour force can drive productivity and innovation, enhance engagement with local communities and ultimately drive profitability for public and private sector organisations.

ABB is leading by example in Uganda, nurturing and developing a diverse range of talent, providing technologies that drive energy efficiency and low carbon operations, and promoting in-country economic growth. A key part of this is supporting the development of diversity and inclusion initiatives in the country. ♦



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# WHAT'S NEW IN EFFICIENT MULTI-PHASE PUMPING?

Maintaining gas pressure required to transport gas with pipelines is a crucial task. From improving efficiency to reducing the uncertainty of the well, the role of hydro compression technologies cannot be understated.

**F**ROM NATURAL GAS extraction to pipeline transmission, compressors perform important roles in many applications and are key to transforming the refining and distribution process.

Major gas compressor companies are now launching hydro compression technologies to bring the benefits of high-pressure equipment to new field explorations.

To this end, German screw pump specialist Leistriz has launched a new generation of multiphase pumps, combining the advantages of screw pumps and screw compressors.

The Leistriz development is set to bring the next evolutionary step in multiphase pump (MPP) applications and a new way of increasing operational efficiency when exploiting oil and gas from fields with high gas volume fractions (GVF). According to Roland Maurischat, vice-president engineering solutions at Leistriz, the result is an increase in system efficiency of up to 25% (at GVF of 95% and more), providing significant reductions in both OPEX and CAPEX.

Maurischat said, "By developing hydro compression technology, we provide oil producers maximum benefits: improving efficiency and reducing the uncertainty of the well itself. What we did was to combine the large operating window of a screw

*The new technology combines the benefits of the Leistriz multiphase pump and of the screw compressor technology.*

pump in multiphase applications, e.g. against varying flow regimes, with the higher efficiency of a screw compressor."

Adding to this list, Sullair, global portable and stationary rotary screw air compressors manufacturer, has introduced its Tier 3 OFD1550 oil free portable air compressor which delivers ISO 8573.1 Class 0 oil free air wherever users need it – plantside, refinery-side or at the jobsite.

The Tier 3 OFD1550 portable air compressor represents the latest solution in the expanding Sullair oil free portfolio. As more users seek options for sensitive compressed air needs – including pharmaceuticals, refineries/ petrochemical, food and beverage, electronics, pipelines, power

plants and more, products are needed for dedicated oil free plant air and back-up oil free air.

Not only that, H&S Valve, Ignition Systems and Controls (ISC), Global Compressor and Potemkin have combined to form a new organisation, Global Compression Services, a solutions provider and one-stop shop for natural gas compressor equipment parts and services for operations across the globe.

Anthony Speer, president, Global Compression Services, said, "Our goal is to raise the industry standard of value by offering full manufacturing

capabilities that are unrivaled in the after-market compressor parts industry."

In addition to these, global provider of mission critical air and gas handling products Howden Group's acquisition of Fancraft (Pty) Ltd, South Africa's independent aftermarket services company focused on the maintenance, repair and installation of air and gas handling equipment and turbomachinery, aims to help the regional customers increase the efficiency and effectiveness of their air and gas handling processes, enabling them to make sustainable improvements in their environmental impact. ♦

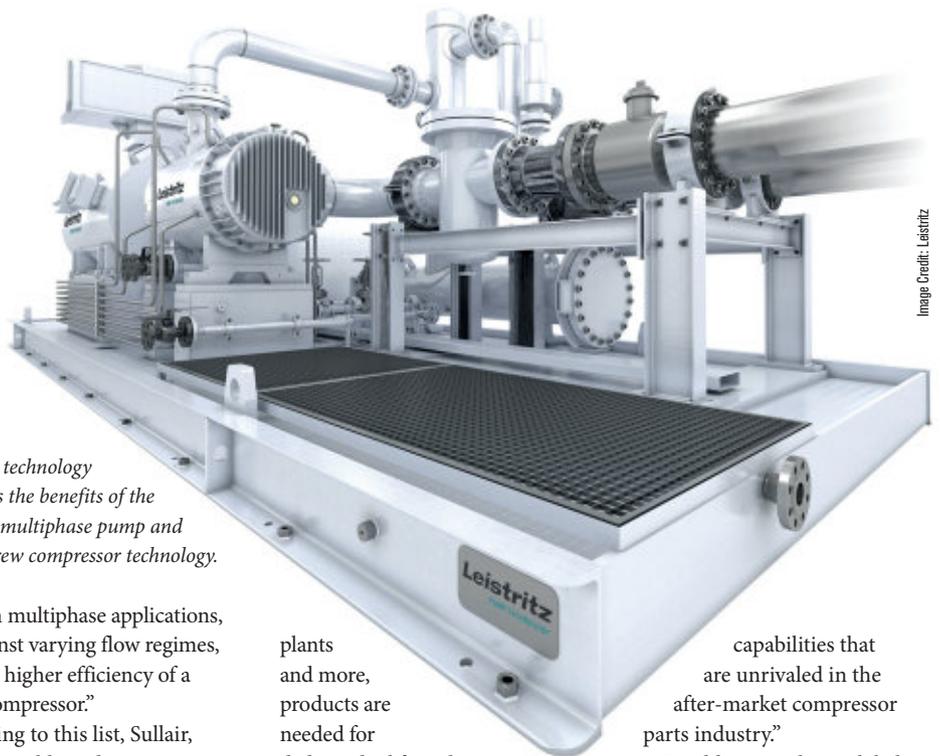


Image Credit: Leistriz

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# FLOATING PRODUCTION

## KEY TO AFRICA OIL OUTPUT

Floating production is used in the offshore oil and gas industry for the hydrocarbon production and processing and storage of oil. It is powering Africa's oil and gas industry forward, with new fields and projects coming through all the time. Martin Clark reports.

**A**FRICA'S OFFSHORE SECTOR continues to thrive, with demand for floating production services intact despite a challenging business and economic climate over the past year.

In May, Total launched first production from its Zinia Phase 2 short-cycle project, which is connected to existing Pazflor's FPSO (floating production, storage and offloading) unit.

It is one in a string of fields now in production in Total's Block 17, dubbed the 'golden block'.

The Zinia Phase 2 project, which includes the drilling of nine wells, will produce 40,000 bpd by the middle of next year.

Located in water depths of up to 1,200 metres, and around 150 kilometres from the shoreline, the field's resources are estimated at 65 mmbbl.

"Zinia Phase 2 is a key project for Angola that comes at the right time to sustain the production of the country," said Paulino Jerónimo, chief executive of the National Oil, Gas and Biofuels Agency (Agência Nacional de Petróleo, Gás e Biocombustíveis, or ANPG).

Block 17 is operated by Total, alongside a clutch of other major oil giants, and operates four FPSOs in the main production areas of the block – Girassol, Dalia, Pazflor and CLOW.

The start-up is a shot in the arm for Angola's offshore sector too.



Image Credit: Adobe Stock

*Safety is a crucial component and, for the most part, floating production operations, sometimes located many miles offshore, continue without incident.*

A frontrunner in the emergence of Africa's offshore industry in the 1990s, the country has been courting fresh interest and investment in the wake of a drop in output, with problems exacerbated by declining oil prices and revenues.

Elsewhere, newer producers are turning to established

expertise for floating production help.

In Mauritania and Senegal, services group Petrofac will help operator BP to develop operational procedures for its Greater Tortue Ahmeyim (GTA) liquefied natural gas (LNG) project, which straddles the offshore border.

Centred on minimising risk and harm to personnel, plants and the environment, the procedures will encompass all offshore operations, from floating production and storage to subsea work.

The Tortue Ahmeyim gas field contains estimated resources of 15 trillion cubic feet of gas and is one of the largest batch of upstream projects underway in Africa today.

Such expertise is essential given the incredible complexity of floating production operations the world over.

This was tragically highlighted earlier this year after an accident on the FPSO Espoir Ivoirien, which resulted in two fatalities whilst work was being performed in a cargo tank.

The FPSO, which is operating on the Espoir field offshore the Ivory Coast, shut down production in the wake of the incident.

Like all areas of the oil and gas industry, safety is the top priority and, for the most part, floating production operations, sometimes located many miles offshore, continue without incident.

BW Offshore, for instance, has since signed an extension agreement for the Abo FPSO in Nigeria with Nigerian Agip Exploration Ltd, a subsidiary of ENI S.p.A., until the end of the fourth quarter 2021, with further options until the second quarter of 2023. ♦

**“ The Tortue Ahmeyim gas field contains estimated resources of 15 trillion cubic feet of gas and is one of the largest batch of upstream projects underway in Africa today.”**

# IMPROVING METHANE DATA: FOCUS ON THE ROLE OF SATELLITES

The IEA's Methane Tracker relies on data processing and converts readings of concentrations to identify large sources of emissions from oil and gas operations, and continues to improve global understanding of methane emission levels and the opportunities to reduce them.

**C**HANGES IN THE atmospheric concentration of methane can be used to estimate the rate of emissions from a source that would have caused such a change. International Energy Agency (IEA) has incorporated emissions detected by satellites for the first time in the 2021 update to the Methane Tracker.

This relies on data processing by Kayrros, an earth observation firm, to convert readings of concentrations to identify large sources of emissions from oil and gas operations.

Large emissions from oil and gas operations that were detected by satellites in 2020 are included in the Methane Tracker for onshore areas in Algeria, Kazakhstan, Iraq, Kuwait, Russian Federation and Turkmenistan. Globally, around 5.5 mt of methane emissions were detected by satellites in 2020.

In all countries, emissions are assigned either to upstream or downstream operations based on the geographic location of

**“Emissions in oil and gas are assigned either to upstream or downstream operations.”**



Image Credit: IEA

directly-observed emissions events. These readings are also used to inform estimates of emissions that may be occurring in countries that cannot currently be observed directly by satellites.

The increasing amount of data and information from satellites will continue to improve global understanding of methane emissions levels and the opportunities to reduce them. However, satellites do have some limitations:

- Existing satellites do not provide measurements over equatorial regions, northern areas or for offshore operations. This means that there are a large number of major production areas (e.g. in areas that are often covered with snow) where emissions cannot be directly detected by

satellites. The 5.5 mt of emissions detected by satellites that are included in the Methane Tracker come from areas that provide around one quarter of global oil and gas production in 2020.

- Existing satellites should be able to provide methane readings globally on a daily basis, but this is not always possible because of cloud cover and other weather conditions. Sentinel 5P readings for 2020 were also affected by a data outage that reduced the number of direct observations that are currently available (these should be available at a later date). The 5.5 Mt of emissions included in the Methane Tracker is the estimate after an upward revision of directly observed

leaks in 2020 to account for the lack of perfect coverage.

- Satellites provide data for large emitting sources. They may fail to capture small-scale emissions sources such as faulty components, which could add up to a large overall amount of emissions.
- The process of using changes in the atmospheric concentration of methane to estimate emissions from a particular source can rely on a large level of auxiliary data and be subject to a high degree of uncertainty.

This is from IEA's report on methane tracker. To read the full report, click here <https://www.iea.org/reports/methane-tracker-2021/improving-methane-data-focus-on-the-role-of-satellites>

# REDUCING TIME TO FIRST OIL

Stewart Maxwell, technical director at Aquaterra Energy, speaks with Deblina Roy about exploring less conventional pathways to increase production. He also says that companies increasingly need to factor reducing emissions into their strategy.

**Recently there was news that Nigeria is planning to allocate around 57 marginal fields later this year. Keeping that in mind, how can Aquaterra Energy help the successful field winners reach first oil quickly?**

Aquaterra Energy is offering Sea Swift conductor-supported offshore platforms, one of which has already been successfully installed in Nigeria. We're also working on a Sea Swift platform offshore Angola, where the fabrication and engineering works are going on, and we are hoping to roll into future platforms there.

The conductor-supported modular platform takes care of another crucial segment – accelerated production with reduced time. The platform uses less steel in a lot of the shallower water depths (it can have up to 30% less steel than a traditional jacketing structure) that benefits the operator with less fabrication – so the operator can do it faster.

It has a decreased carbon footprint. You're using less steel. Therefore, you're using less raw material. Therefore, your carbon footprint of the development overall has reduced. Also, because it's a modular structure, you can use smaller fabrication yards. You can use smaller vessels – you're not relying on a crane barge or a heavy lift vessel to install because you can use your

jack-up. The Sea Swift offshore platform is a modular system that combines an offshore platform with the rig-run benefits of a subsea development. This offers operators a flexible option to reduce their build and installation costs, and importantly, reduce time to first oil in shallow water applications.

**As a global offshore equipment and solution provider, what challenges exist around the technical capabilities in the oil and gas sector, specifically in Nigeria?**

Nigeria has a well-developed fabrication base. However, one of the challenges in Africa is, although it has been involved in oil and gas for many years, indigenous creation of some of the components or indigenous fabrication of some of the smaller elements doesn't take place. If you fabricate something in Nigeria, all of the steel is imported. There is no local steel or local pipe fabrication. On the other hand, if you fabricate in



Image Credit: Aquaterra Energy

*Stewart Maxwell is the technical director at Aquaterra Energy.*

Asia, for instance, the steel is typically from Asia. If you fabricate in America, the steel comes from America. Same goes for the Middle East. So, while Nigeria is planning to allocate around 57 marginal fields later this year, regional dependence on imports can be challenging.

**“ The oil and gas industry has a fairly large focus on decarbonisation. It is incumbent upon all of us who are involved in the oil and gas industry to look at that push towards zero carbon or carbon reduction.”**

**In regards to the local content development, what is Aquaterra Energy doing about Environmental, Social, and Governance (ESG)?**

There are similar drivers behind the issue of local content, which is also a key component in ESG initiatives. In 2020, the delivery of one of our projects in West Africa created more than 300,000 hours of paid employment in-country. As a company, we are committed to generating and increasing the number of local projects. While working with our clients we have a tailored approach and aim to meet regulatory obligations to track performance and identify areas

*Aquaterra Energy is offering Sea Swift conductor-supported offshore platforms, one of which has already been successfully installed in Nigeria.*



Image Credit: Adobe Stock

where it can be increased.

Also, we're supporting the installation of a smaller shallow-water platform that is fully powered by renewable sources – eliminating diesel consumption offshore and the required trips for regular fuel supply. With Nigeria targeting a 20% reduction in greenhouse gas emissions by 2030, operators can benefit from this solution and better position themselves to support the country's ambitions, as well as those of their business and the industry.

Also, Aquaterra Energy's platform takes care of the safety side too, making the whole development inherently safer, removing the need for unnecessary offshore trips. Rather, the operator can monitor the status of the platform via

sensors which allow the operator to monitor the structure, the top sites and equipment. This all helps to reduce the required visits offshore, benefiting both the staff and operator.

#### **What are the possible ways to deliver decarbonisation objectives?**

The oil and gas industry has a fairly large focus on decarbonisation. It is incumbent upon all of us who are involved in the oil and gas industry to look at that push towards zero carbon or carbon reduction. There are a few ways to do this. Reducing raw materials during the engineering stage of a platform is one way to reduce the carbon footprint. Decreasing the number of vessels that are required for maintenance or installation can also provide

carbon benefits. Also, it's important to take note of region-specific solutions while addressing decarbonisation aspects. For example, you cannot apply any rigid European strategy in Africa as that may have a detriment to the local community and the local development. The approach has to be one that is tailored to each region, providing

**“ In 2020, the delivery of one of our projects in West Africa created more than 300,000 hours of paid employment in-country.”**

local content and a local community benefit.

#### **What are Aquaterra Energy's medium-to-long term plans in Nigeria?**

In the next three to five years, we want to expand our growth in the region and welcome working with new customers in Nigeria. In the medium- to long-term, we want to have a stronger presence in West Africa and emerge as a first choice for the offshore engineering-led products and services that safely deliver operational excellence. The licensing rounds that are taking place at the moment in Nigeria are going to create great opportunity for a range of companies, and we hope to provide our engineering excellence where possible. ♦

# DRILLING FOR GAS: WHERE IS THE INDUSTRY UP TO?

Gas exploration & production (E&P) continues to drive Africa's energy sector amid rising interest in clean and alternative fuels. Martin Clark reports.

**A**FRICA'S GAS SECTOR could play a pivotal role in any long-term energy transition to cleaner fuels.

For now, at least, despite mounting interest in fossil fuel alternatives, the industry is still growing, with huge and untapped potential right across the continent, from Nigeria to Namibia.

In one of Africa's newer oil producers, Ghana, the nation is enjoying the benefits of rising gas volumes associated with crude oil production.

Gas off-take to the Ghanaian government of around 110 million standard cubic feet per day in the first quarter of 2021 was almost double the levels seen in 2019, American E&P firm Kosmos Energy said in a 10 May update.

It is one of the companies behind Mauritania and Senegal's Greater Tortue Ahmeyim liquefied natural gas (LNG) scheme — one of Africa's largest current crop of gas projects.

Phase one is now around 58% complete, which is expected to rise to 80% by the end of 2021, Kosmos reported recently.

Global demand for LNG, which can be transported by ship, has been rising and is expected to nearly double from current levels by 2040.

One question could be whether new projects are able to attract the level of financing



Image Credit: Adobe Stock

*Ghana is enjoying the benefits of rising gas volumes associated with crude oil production.*

needed in the new green climate era, but thus far, that has not been a stumbling block.

That does not mean there are no other challenges: several other world-scale LNG projects, in Mozambique and Tanzania, have run into obstacles for different reasons, including a rise in hostile militancy disrupting operations.

But new gas possibilities keep opening up, notably in South Africa, in the wake of Total's Brulpadda discovery and follow-up Luiperd find, which has triggered a rush to secure acreage offshore.

It means drilling is sure to

come in a bid to supply what is Africa's most developed industrial economy.

The discovery of frontier basins is not limited to the offshore either, with neighbouring Namibia's onshore acreage now being targeted — the country has long been known to hold large offshore gas deposits, with the still undeveloped Kudu gas field, first discovered in the 1970s.

Canadian independent Recon Africa is now drilling the second well in the Kavango Basin in the Kalahari Desert in north east Namibia.

It says its work so far provides

clear evidence of a working conventional petroleum system.

"Mud gas results indicate a high BTU gas with the presence of light oil in numerous cutting samples," said Dan Jarvie, a member of ReconAfrica's advisory board.

"Based on these initial results, the components and processes for a working petroleum system are all present."

For import-dependent nations, like Namibia and South Africa, these may be energy lifelines, regardless of any longer-term shift to non fossil fuel alternatives. ♦

# RELIABLE MONITORING IN EXTREME CONDITIONS

Whether in upstream, midstream or downstream operations, pipelines play a significant role in the oil and gas industry. Matthew Hawkrigde, chief technology officer, Ovarro, explains how Remote Telemetry Units can be used to optimise the performance and maintenance of oil and gas pipelines.

**W**HILE OIL AND gas pipelines are essential to the industry, they are not fail-safe.

Structural failures including corrosion, cracks and leaks are common issues, which companies must resolve quickly and effectively, in order to minimise downtime and interruptions and increase efficiency.

As well as costly product loss, pipeline leakages can significantly damage wildlife and the natural environment and pose a threat to workers and the population.

There is, therefore, a need to constantly monitor the environmental impact of any operations and above all else, ensure the safety of staff and the general public. The most valuable tool in meeting this new range of key performance indicators (KPIs) is information; and the most appropriate device to collect and process this information is the Remote Telemetry Units (RTUs).

For decades now, RTUs have been a key component in the data chain from the I/O to the CEO. These devices have a longstanding track record of sitting on remote pipelines, wellheads and offshore platforms, collecting, storing and acting upon data, regardless of the surrounding environment.

To date, most RTUs have been used to collect and log operational data and perform



*Pipelines are one of the safest and most effective ways to transport oil and gas.*

local control. This very same device is also the ideal solution to collect and act upon the new wave of information that is needed for a modern, efficient and profitable organisation.

The RTU is a field mount computer. It collects data locally, acts upon it immediately, reports data to the central supervisory control and data acquisition (SCADA) control room and maintains a local historical store as an additional backup.

In remote locations, communications may be slow, intermittent or unreliable. The RTU is the device at the edge, sitting between the control room and the field instruments, that provides a low latency response to changing site conditions as well as performing data filtering.

The RTU ensures that only critical information is passed via the narrow communications links, minimising data throughput but maximising information throughput. Within the downstream sector, refineries operate 24/7, which means firms need RTU systems that are robust, secure, reliable and flexible enough to be able to manage and monitor extensive pipeline networks. RTUs are integrated with sensors across these sites and provide data to the SCADA system.

Working the other way, RTUs can receive commands from the supervisory system and transmit them to the end devices as well as retaining an ability to act autonomously. RTUs can do this over large and remote pipeline

networks, handling the data acquisition portion of SCADA, providing early warning of impending issues – such as a rise in temperature of a holding tank or decreased pressure in a pipe – avoiding asset failure and potential environmental incidents.

Pipelines are one of the safest and most effective ways to transport oil and gas. But, with thousands of miles to cover across some of the world's harshest environments, monitoring performance and condition can be challenging, to say the least. RTUs offer one solution to this challenge – collecting, reporting and acting on critical data even in extreme and remote conditions. ♦

[www.ovarro.com](http://www.ovarro.com)

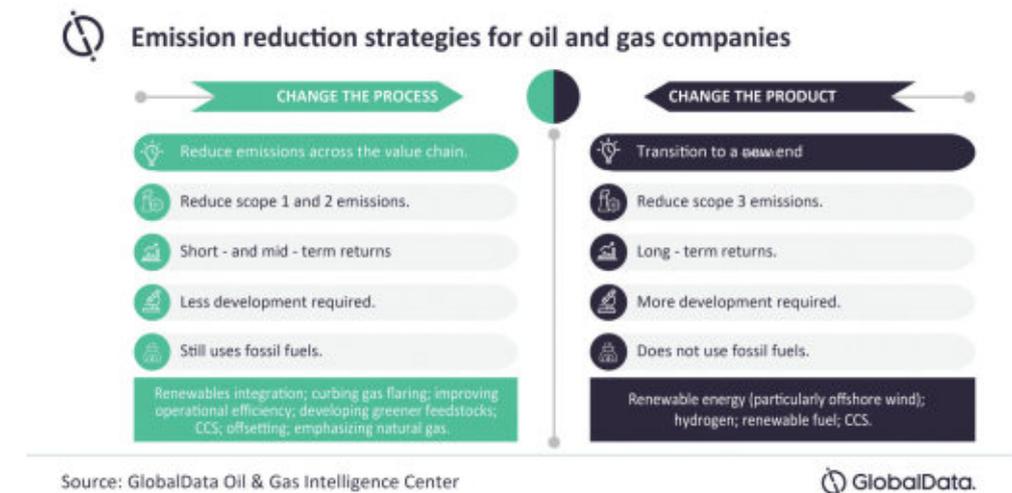
# EMISSION REDUCTION: STRATEGIES FOR COMPANIES

Hydrocarbon demand is set to fall in the coming decades due to the measures the Paris Agreement signee governments will take to discourage emissions and ensure the success of net-zero goals. This agreement will render conventional oil and gas activity less and less viable, says GlobalData.

**I**N ORDER TO reduce emissions and minimise losses, oil and gas companies should adopt measures such as carbon pricing by altering processes across the value chain, according to GlobalData's report ESG (Environmental, Social, and Governance) in Oil and Gas – Thematic Research.

The report has further revealed that technological innovation and increased consumer mindfulness will make sustainable alternatives to hydrocarbon-intensive products more and more attractive. For example, in transport, historically the largest hydrocarbon-demanding sector, conventional cars will be displaced almost entirely by electric vehicles (EVs).

This is reflected by George Monaghan, oil and gas analyst at GlobalData. He commented, "Though some demand will remain, survival for most current oil and gas companies will mean transitioning to a new product. While there are many options for products, with renewable energy being the most popular, companies will only succeed if they invest while demand is there to capitalise on already strong cashflows by the time demand falls. Companies that wait until hydrocarbon revenues dry up will have insufficient cash to fund a transition." Oil and gas companies will need effective governance to steer themselves



*Oil and gas companies will need effective governance to steer themselves through the existential disruption that the next three or four decades will bring.*

through the existential disruption that the next three or four decades will bring. A balancing act will be necessary: meeting net-zero objectives while retaining scale demands deft leadership. For example, companies must sustain sufficient cashflows to handle demand volatility, overhaul their asset portfolios, make astute investments, and satisfy sustainability-minded stakeholders.

Monaghan continued, "As millennials come to dominate the consumer base and workforce and begin to assert their preferences, companies that fail to maintain good social practices (toward workers and affected local communities) will struggle

to attract and retain customers and employees."

The emission reduction strategies available to oil and gas companies can be divided into two broad approaches: change the process and change the product. It is easy but unwise to underestimate the effectiveness of the 'change the process' approach. It involves multiple small and unglamorous changes but can deliver significant emission reductions. At the same time, meeting 2040 or 2050 net-zero goals and dealing with the increasing unavailability of hydrocarbon reserves will require companies to change the product.

Monaghan added, "Scope 1 and 2 emissions represent the majority of emissions for which

the oil and gas industry is responsible. These emissions can be reduced by altering value chain practices. Since the end product is unchanged, this 'change the process' approach requires less R&D and infrastructural investment. It promises short- and mid-term returns.

"However, other emissions are inextricable from oil and gas, particularly those produced by end-user combustion of the hydrocarbons (termed scope 3). Technological innovations may reduce the carbon content of the end-product, but practically, so long as the end-product is oil and gas, the company producing it will be responsible for significant scope emissions." ♦

# INTEGRATING YOUR ASSETS

At this uncertain time, asset-centric solutions are grabbing the attention of O&G companies to maximise remote assets' performance with minimum human intervention. Companies are adopting a holistic plan for ongoing maintenance activity based on new operational conditions, optimising productivity and profit by reducing unscheduled downtime. Deblina Roy reports.

## IN THE CURRENT

environment, asset performance management (APM) is a critical component, and therefore, oil and gas producers are making significant investments in APM solutions to capture that value.

This is according to Andrew Meyers, research director, IDC Energy Insights, which is also echoed by Gaurav Verma, research manager, IDC Energy Insights. Verma said, "At this unprecedented time, asset-centric solutions such as APM and digital twin have been grabbing the attention of O&G companies for maximising remote assets' performance with minimum human intervention."

Among the many innovative solutions to ensure asset integrity management, some of the most recent have been announced by Halliburton and AVEVA. Halliburton has introduced the Ovidius isolation system, a packer that transforms from an engineered metal alloy into a rock-like material when it reacts with downhole fluids, creating a long-lasting seal for improved well integrity.

Operators can deploy Ovidius in wellbore isolation applications, where it will provide the traditional benefits of expanding elastomers with new capabilities to withstand differential pressures and extreme temperatures found

in the most challenging high-pressure/high-temperature environments while providing unparalleled anchoring forces.

AVEVA, the industrial software company, is simplifying business processes, while reducing value leaks and sustaining productivity. AVEVA Unified Supply Chain solution aims to provide easy data management to deliver a single source of crude oil information that is easily shared across different teams and locations. This intuitive software will eliminate the requirement for specific coding, drastically reducing the learning curve delivering high-performance computing and advanced data processing. Recently, PETRONAS, Malaysia's fully integrated oil and gas multinational, has selected AVEVA's Unified Cloud Solution to drive productivity and redefine processes.

Speaking about this, Harpreet Gulati, senior vice-president, planning and operations, AVEVA, said, "Our solutions are helping organisations to change the way they work and operate. We are

delivering the digital transformation of PETRONAS' supply chain, by empowering its workforce to make better, more agile decisions with next-generation software that is enhancing the user experience as well as providing built-in collaboration, interactivity and advanced analytics."

In fact, the industry is encouraging more cutting-edge solutions to manage asset integrity solutions. In April 2020, Cambridge-headquartered sensing technology company CorrosionRADAR won the Materials Performance (MP) / Association for Materials Protection and Performance (formerly NACE) Corrosion Innovation of the Year Award for its Predictive Corrosion Under Insulation (CUI) Monitoring System. The solution combines real-time field data and predictive analytics generated via wireless sensing waveguides embedded under the asset insulation, with quality, integrity and risk-based inspection methodologies to drive repair or rehabilitation schedules.

Strategic partnerships are

being made for better asset performance and risk management solutions too. Lloyd's Register (LR), a professional services company specialising in engineering and technology solutions, has partnered with the innovation leader in Operational AI, Falkonry, to combine its predictive digital twins with asset performance for heavy industry, including chemicals and oil and gas.

The technology partnership is expected to harness Falkonry's Operational AI Digital Twin solution, called Clue, to identify equipment conditions, providing instantaneous alerts on suspect and undesirable behaviour. LR's AllAssets will enhance the actionability of these alerts through its risk analysis and extensive library of 10,000 recommendations.

With more than US\$1 trillion per year lost on unplanned downtime, owner operators seeking to improve uptime and reduce costs have much to gain from improved operations and maintenance strategies.

This resulting digital twin solution will then help to generate a holistic plan for ongoing maintenance activity based on new operational conditions, optimising productivity and profit by reducing unscheduled downtime. 🔥

**“ Oil and gas industry is encouraging more cutting-edge solutions to manage asset integrity solutions, combining real-time field data and predictive analytics.”**

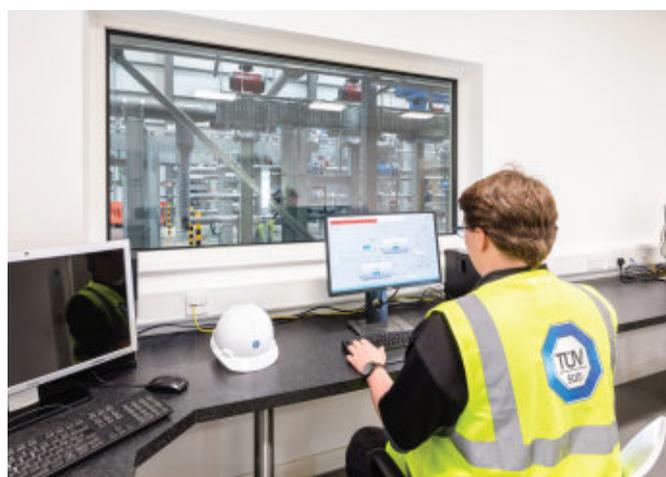
# AFRICAN RIG COUNT

COUNTRY	May 2020	June 2020	May 2021	June 2021
ALGERIA	27	29	28	25
ANGOLA	0	0	4	4
CAMEROON	0	0	1	1
CHAD	6	3	3	3
CONGO	0	0	0	0
CÔTE D'IVOIRE	0	0	0	1
EQUATORIAL GUINEA	0	0	0	0
GHANA	0	0	2	2
KENYA	4	3	3	4
LIBYA	11	12	12	12
MAURITANIA	0	0	0	0
MOROCCO	0	0	0	0
MOZAMBIQUE	0	0	1	1
NIGERIA	8	9	6	5

Source: Baker Hughes

## TÜV SÜD launches real-time subsea meter calibration tool

TÜV SÜD NATIONAL Engineering Laboratory (NEL) has launched NEL-SURE, a real-time software tool for the verification of subsea multiphase flow meters (MPFM), with an aim to help operators optimise reservoir management and revenues.



The software can also accommodate a virtual meter to provide a secondary measurement for verification of the MPFM's output.

As the oil and gas industry exploits deeper fields, routine calibration is unviable due to the excessive cost of removing subsea MPFMs for laboratory-based validation. While MPFMs are calibrated before installation, laboratory-based flow regimes differ greatly to actual subsea conditions.

NEL-SURE provides in-situ, continuous calibration of MPFMs and uses a traffic light system to alert operators to a meter's health. The software can also accommodate a virtual meter to provide a secondary measurement for verification of the MPFM's output. This will help to improve process and control decision making, increase productivity and safety and reduce environmental impacts through the early identification of potential system failures.

Marc Laing, head of software and modelling at TÜV SÜD National Engineering Laboratory, said, "The challenge is to take the calibration process from the laboratory and move it to the 'in situ' location. This will ensure that flow meter verification accounts for the different effects of pressure, temperature and fluids at each individual well, allowing operators to have ongoing confidence in the measurements.

"NEL-SURE meets this challenge by reducing financial exposure and delivering operators increased confidence in the deployment and use of MPFMs. These intelligent meter health checks will save industry millions of pounds per year from unnecessary calibrations, maintenance and shutdowns," concluded Laing.

## Saipem launches SUIISO for offshore oil and gas facilities

SAIPEM HAS ANNOUNCED the launch of SUIISO, a technological solution for the production of green hydrogen thus confirming its commitment to support its clients in the energy transition.

The trademark has been registered with the European Union Intellectual Property Office (EUIPO).

SUIISO combines various renewable energy sources such as floating wind, floating solar and marine energy in a single system. The aim is to power, together or individually, electrolyses installed on existing offshore platforms for the production of green hydrogen.

The technology responds to the growing demand for green hydrogen production and, at the same time, it allows the conversion of oil and gas offshore facilities which have now reached the end of their life cycle. The oxygen resulting from this process can be used in various areas such as aquaculture or seaweed production.

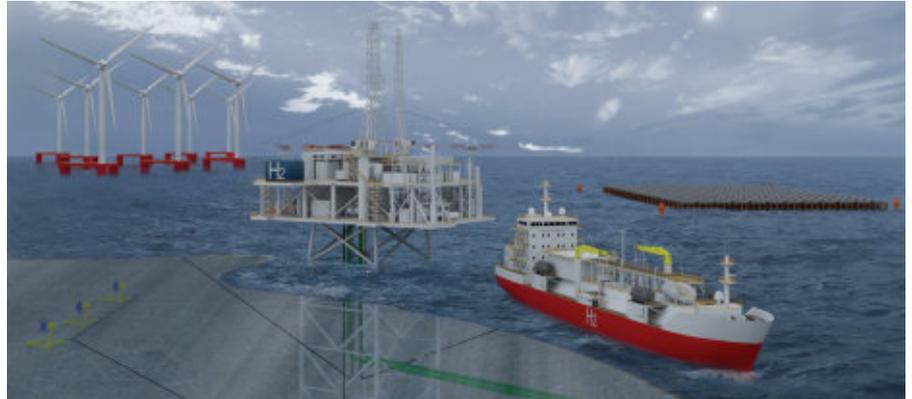


Image Credit: Saipem

*SUIISO combines various renewable energy sources such as floating wind, floating solar and marine energy in a single system.*

Thanks to these features, SUIISO will find its first application in the AGNES project, the offshore energy hub that Saipem, in partnership with QINT'X, intends to build off the Adriatic coast of Ravenna.

Francesco Caio, CEO of Saipem,

commented, "The know-how gained in the design and execution of infrastructures and technologically advanced plants allows Saipem to cover the green hydrogen production value chain and to be a strategic partner in the path towards a net zero economy."

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## Gardner Denver launches GD 800HDD pump for horizontal directional drilling market

GARDNER DENVER HIGH Pressure Solutions (GD), has expanded its suite of pump offerings for the horizontal directional drilling (HDD) market, with its new GD 800HDD pump.

The American-made pump, built with quality and efficiency in mind, features an extremely high flow rate of more than 1000 gpm, which makes it suitable for the most demanding HDD projects. Its light weight eases transportation between work sites, and its extremely high rod load rating of 53,000 lbs, ensures the pump is tough and long lasting.

The pump is designed to operate at a slow run speed, delivering the same output, flow, and pressure as faster pumps, with less violent actions, wear



Image Credit: Gardner Denver

*GD pumps can be used as maxi rig pumps and provide a suite of options to the HDD industry.*

and friction. The delivering of fewer strokes, extends the consumable life of the pump. GD pumps are qualified as maxi rig pumps and provide a suite of options to the HDD industry, when tunneling under rivers and roads, and laying sewerage systems, water pipes, fibre optic lines and pipelines.

Adam Avey, engineering supervisor, GD, said, "As an extremely powerful but lightweight 800 breaking horsepower (BHP) pump, the GD 800HDD is an ideal fit for the HDD market, which has traditionally been reliant on heavy, less mobile oil and gas drilling pumps."

## Corrosion Resistant Alloys collaborates with PipeSearch to drive digital transformation

CORROSION RESISTANT ALLOYS, LP (CRA), and PipeSearch, have collaborated to launch the PipeSearch platform, which connects oil country tubular goods (OCTG) demand to supply.

PipeSearch offers a suite of services for both buyers and sellers, with a focus on confirmed quality inventory solutions for buyers, and increased asset recovery value for sellers. It is centred on intelligent data

collection and offers customers options to fulfill urgent needs and recover asset value.

These efforts are supported by CRA's experienced commercial, and technical services team, just-in-time (JIT) manufacturing global infrastructure, and quality credentials in the corrosion resistant alloys OCTG field.

Cole Patchell, president, PipeSearch and vice president, CRA, said, "It is the responsibility of our industry to reduce its carbon footprint by repurposing existing inventories instead of always buying new. This exciting collaboration is driving a shift to digital value-added services in the industry and building the future of the tubular industry through global digital transformation."



Image Credit: Adobe Stock

*The collaboration will bring in the future of the tubular industry.*

## Yokogawa launches OpreX Data Model Broker

YOKOGAWA ELECTRIC CORPORATION has launched the OpreX Data Model Broker, a plant data transformation platform in the OpreX Connected Intelligence line-up, that promotes the utilisation of data throughout the plant life cycle.

OpreX Data Model Broker automatically verifies the consistency of data in different plant designs and instrumentation systems, and enables their inter-utilisation through the application of ontology, an AI technique in database operation and management.

Design Data Validation, the first component to be released by Yokogawa for this platform, assists in the complicated and time-consuming task of systematically identifying and confirming inconsistencies between piping and instrument diagrams (P&ID) and 3D piping diagrams.

By identifying inconsistencies in massive volumes of data, this component enhances work efficiency, and reduces the number of man-hours required for such work.

With the increase in plant sizes and sophistication over the years, the facilities installed in these plants have grown even more complex. When a plant is built or expanded, the departments responsible for each area of work use different design tools.

The same is true with systems, for which there are not just designs and specification documents, but also diagrams, from device and equipment vendors, and engineering data from different system suites.

# Salunda unveils Crew Hawk Analytics for offshore oil and gas sector

SALUNDA LIMITED HAS launched Crew Hawk Analytics with an aim to provide faster and more accurate decision-making capabilities in the offshore oil and gas sector, delivering enhanced levels of safety protection and management of people and assets in the drilling Red Zone.

Salunda Analytics is part of the advanced Crew Hawk location tracking system, which integrates multiple technologies into an effective zone management network. This tracks the locations of people and moving equipment on the drill floor in real time, providing position tracking performance to avert incidents,

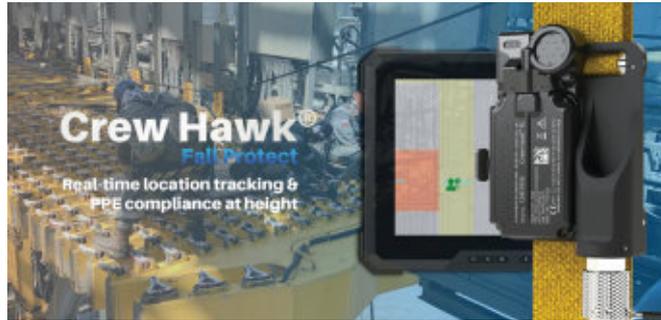


Image Credit: Salunda Limited

Crew Hawk Analytics from Salunda Limited provides faster, easier and more accurate decision-making capabilities in the offshore oil and gas sector.

and reduce the risk of workplace injuries and accidents.

Salunda Analytics aims to offer real time operational performance data to track

individual and machinery warning patterns against actual alarm activations. This can provide the operator with indicative system behaviour

capabilities, which for example, will trigger an automatic shutdown to prevent a drill floor incident before it happens and stop unplanned interaction between people and machinery, raising further the levels of all-round rig Crew Hawk Analytics and protection.

After action reports provided by the system are also available in the form of recorded data that can be used to quickly analyse and assess the number of alarms/warnings per job role/function, type of operation, unit rig time or cumulative rig time among myriad critical functions.

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# DIGITAL FLOW METERS: MUSCLING INTO OIL AND GAS

Gordon Lindsay, technical lead at TÜV SÜD National Engineering Laboratory, speaks with Deblina Roy about the evolution from analog to digital flow meters, and how these digital meters are helping oil and gas operators reduce costs and increasing output.

**T**HE FORMAT OF information produced by analog and digital devices is different. However, it's ultimately referring to the same measurement value, in this case, flow. For the mechanical meter, it is a simple case of mechanical motion, where the flow turns a turbine. When a turbine blade passes an electromagnetic pickup on the meter body, a pulse is generated, the number of pulses over a given time interval is used to calculate a flow rate.

If there is high-voltage equipment near the analog meter, electrical noise may interfere with the signal, which in turn can give false signal amplitudes and pulse counts which ultimately increases the uncertainty of measurement in the flow measurement reading. This was the main disadvantage of the analog devices.

"One of the key advantages of digital devices is that the data can also be streamed to more than one place. With an analog device, generally, a cable is hardwired from say a turbine meter to a pulse counter, or to somewhere in a control cabinet. We then make that information available to a local PC or data logging software. With a digital device, if it's networked using a digital Fieldbus such as, Profibus, Modbus, Foundation Fieldbus, the data can effectively be streamed to multiple data servers allowing control, data acquisition and machine learning systems to access the data which essentially means that the data interrogation and assessment is more dynamic," Lindsay explained.

"Digital flow meters have potentially hundreds of different variables, but even an experienced operator doesn't necessarily understand what these variables are, or even if the operator does understand them, they may not understand how they behave depending on different operating scenarios. So, the best



*Gordon Lindsay is the technical lead at TÜV SÜD National Engineering Laboratory.*

way to improve confidence is to use emerging data science techniques to develop condition-based monitoring (CBM) software. CBM software takes these variables and determines hidden relationships between them as well as patterns that can point to error or failure states. With enough data, these systems can be used to not only flag live errors but also predict future errors based on the data trends and patterns present within its historical databases. It's increased user confidence and these systems aim to provide. For example,

software that displays credible information which is now meaningful and understandable for the end-users."

## Data is the key

"Data will take different forms depending on the source and application. That's a challenge that a lot of companies face and it's going to be up for companies to make it as easy as possible for the customers to hand over data, understand it and then generate these models as quickly and as efficiently as possible.

To give a more specific example: a condition-based calibration (CBC) can be a key next step, which builds upon the concept of condition-based monitoring (CBM). Every quality critical metrology device that an oil and gas company uses will require calibration. For example, a flow meter requires calibration regularly. Once or twice a year (depending on site-specific requirements), a customer will remove the meter from the pipeline, send it to a calibration lab and then reinstall the device – which is a very costly process. This is typically referred to as a time-based calibration (TBC). However, in some instances, the device may not have even required calibration. The device might have been performing perfectly fine and there was no drift from the baseline calibration.

By using a CBC system, the operator can therefore streamline this process and make calibrations and operations, in general, more dynamic. By using data-driven modelling the operator can also monitor a system based on its available historical data to determine if a device requires calibration. If the device doesn't require calibration, there's no need to stop the process. Thus, the operator understands the system better and this data-driven modelling system has reduced operating costs." ♦



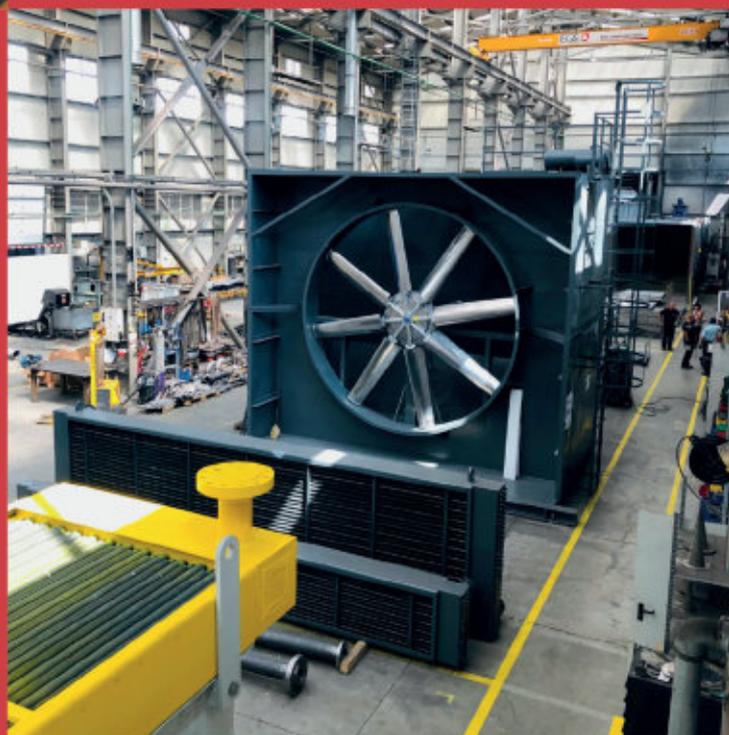
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