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Yousef Ahmad - Artist

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Shell recently announced the launch of the first resident mobile robot that has been certified to work in hostile environments. The Sensabot – developed by leading robotic experts from across the world – will work in remote or unmanned oil and gas facilities, following final tests at Shell’s Pernis complex in the Netherlands. The first robot will be deployed at the Kashagan oilfield in Kazakhstan’s zone of the Caspian Sea, before the system is rolled out across other facilities in harsh environments, as well as in refineries and LNG terminals.

The semi-autonomous robot is remotely controlled by operators working in a safe location. It is equipped with an array of sensors and video cameras that allow it to act as the ‘eyes and ears’ of operators, enabling them to check equipment and respond to alerts quickly, while gathering real-time data. The robot, which is designed to work for six months without requiring maintenance, is able to drive through rough terrain including gravel, mud and snow, as well as climb vertical surfaces using rails on the outside of process modules. In Shell’s own words, the robot “can go anywhere humans can, but without needing additional protection.”

Aside from its obvious safety benefits, the Sensabot offers economic advantages and helps to improve productivity. The robot has initially been equipped for surveillance of oil and gas facilities, but has a number of different manipulator arms that can be adapted for use by emergency services or for maintenance purposes. Shell is also seeking commercial partners to help expand the technology.

Robotics is an example of an innovative digital technology that is helping to transform the oil and gas industry, alongside advanced analytics, cloud computing, simulation and unmanned aerial systems (aka drones), etc. Recent research from McKinsey & Co. suggests that the effective use of digital technologies in the oil and gas sector has the potential to cut CAPEX by up to 20%, while also reducing operating costs. The global management consulting firm predicts that the latest technological advancements will trigger a second digital age that could also significantly increase productivity and performance: “The visibility and clarity delivered by digital technologies and advanced analytics can give executives unprecedented, granular views into operations, increase agility, and support better strategic decision making. Digital enablers, from process digitisation to robotics and automation, can also help realise this potential by supporting processes in dynamic ways.”

This issue of LNG Industry includes a number of articles that outline the benefits of embracing digital technologies. Intergraph Process, Power & Marine (p. 34) discusses the numerous ways that engineering software can help LNG operators, pointing to its work on several projects including Santos’ GLNG facility in Queensland, Australia. Quorum Business Solutions (p. 39) explains how commercial software is capable of automating operations at bi-directional LNG facilities, and Lanner (p. 43) looks at predictive simulation as a strategy for helping to manage market uncertainty.

On the topic of digital advancements, LNG Industry is pleased to announce the launch of our new-look website. Please visit www.lngindustry.com to take a look at some of the exclusive new features on offer to members and subscribers. And, if you haven’t already, download our free App to read the latest issues of LNG Industry on your mobile or tablet device (simply search for ‘LNG Industry’ in the App Store or Google Play).

**Finland**

**World’s first LNG-powered icebreaker delivered**

Arctech Helsinki Shipyard has announced that it has delivered the world’s first LNG-powered icebreaker to the Finnish Transport Agency. The vessel – *Polaris* – was then handed over to Arctia Icebreaking Oy. It will serve in icebreaking, oil recovery and sea rescue operations for a period of at least 50 years.

*Polaris* is capable of running on either LNG or low sulfur diesel oil, and complies with the International Maritime Organization’s (IMO’s) Tier III emission standards and special requirement for sulfur emissions in the Baltic sea. It features three Azipod propulsion units that can rotate 360°, enabling first-rate manouevring. The vessel also has an icebreaking capacity of 1.8 m at a speed of 3.5 kt. It is 110 m long and has a breadth of 24.4 m.

**Canada**

**PNW LNG granted conditional approval**

The government of Canada has granted conditional approval for the proposed Pacific NorthWest LNG (PNW LNG) project on Lelu Island within the District of Port Edward, British Columbia (B.C.), following a rigorous federal environmental assessment.

In a statement, the government described the project as a major opportunity to grow the country’s economy. During construction, the PNW LNG project will create an estimated 4500 jobs and an additional 630 direct and indirect jobs during the operation of the facility. As well as benefiting from job creation throughout the region, local First Nations communities will also benefit significantly through agreements reached with the proponent.

The project is subject to over 190 legally binding conditions, determined through extensive scientific study. For example, Pacific NorthWest LNG Ltd will be required to comply with mitigation measures that will minimise adverse effects on fish, fish habitat, marine mammals, wetlands, migratory birds, and human health.

Jim Carr, Minister of Natural Resources, said: "The Pacific NorthWest LNG Project will deliver thousands of good middle-class jobs and will help pay for schools and roads and social programmes that enrich people’s lives [...] This is an exciting day for British Columbia, for Canada and for the natural gas industry in this country."

Petronas confirmed that it will now study the conditions imposed by the Canadian authorities and conduct a total review of the proposed project prior to deciding on the next steps forward.

**USA**

**Chart issued patent for liquefaction technology**

Chart Energy & Chemicals Inc., a Chart Industries Company, has announced that it has been awarded a patent for its IPSMR® cryogenic liquefaction process technology by the United States Patent and Trademark Office.

The IPSMR cryogenic liquefaction process technology has been developed by an in-house engineering team comprising Douglas Ducote, Vice President – Process Plant Technology; Timothy Gushanas, Process Consultant; and James Podolski, Process Engineer.

The technology, initially intended for use in the making of LNG, uses a mixture of light hydrocarbons and nitrogen to provide refrigeration. Process optimisation is achieved through an improved refrigeration cycle using Chart’s proprietary brazed aluminium heat exchangers (BAHXs). Chart said that the IPSMR process allows clients to achieve maximum operating efficiency, economy and performance by 6 – 10% over other industry recognised single mixed refrigerant processes.

Andrew Moriarty, President of Chart Energy & Chemicals, said: “The IPSMR process technology and our modular plant solutions are at the centre of many of the proposed investments, at various stages of regulatory approval, that will enable the export of North American shale gas through liquefaction.”

Chart is also actively developing IPSMR to improve the efficiency of other liquefaction processes, such as ethane, ethylene and energy storage projects.

In addition to the US, IPSMR process technology has been patented in other major countries, including China and Japan, and it is patent pending in many others.
Singapore

ExxonMobil and Pavilion collaborate to develop LNG bunkering solutions

ExxonMobil has announced that it is collaborating with Pavilion Energy Pte Ltd to develop solutions for LNG bunkering and other downstream developments in Singapore.

ExxonMobil claims that it will help Pavilion to establish LNG bunkering procedures, starting with truck-to-ship deliveries. It will also help develop safety and operational standards for LNG bunkering in Singapore. This cooperation supports the LNG bunkering initiative of the Maritime Port Authority of Singapore.

Nancy Carlson, the Vice President of Aviation and Marine at ExxonMobil Fuels and Lubricants, said: “The collaboration with Pavilion Energy combines both companies’ expertise, and is one of the steps we are taking toward establishing ExxonMobil’s global LNG bunkering offer.

“Our 40-year heritage in LNG and marine insights, alongside Pavilion Energy’s dedicated approach, can help us to meet our vessel operators’ growing demand for integrated marine fuel solutions. ExxonMobil is committed to ensuring that we continue to meet our customers’ requirements.”

Australia

Amec Foster Wheeler awarded consultancy contract for Ichthys LNG

Amec Foster Wheeler has announced that it has been awarded a consultancy contract by INPEX for the Ichthys LNG project, offshore Western Australia.

Under the contract, the company will provide a team of production and maintenance assessors to carry out competency assessments of the Ichthys operations and maintenance teams across all project assets. This includes the central processing facility, the floating production storage and offtake vessel, and the Bladin Point LNG onshore processing facility. The company claims that the assessments will be aligned with Australian national competency standards for the process industry.

The Amec Foster Wheeler Group President for Asia, Middle East, Africa & Southern Europe, Roberto Penno, said: “This is the latest example of Amec Foster Wheeler’s market leading capability being used to benefit a world class LNG project. We are proud to be involved in the Ichthys LNG project and will utilise our significant global O&M expertise to deliver this important role.”

The contract will run until April 2017, with the assessments to be carried out at the production yards in South Korea, offshore Western Australia and the onshore LNG facility in Darwin.

News Highlights

- Mott MacDonald awarded Panama contract
- First LNG loaded at Gate’s third jetty
- Teekay enters 15-year time-charter contract with Yamal LNG

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**China**

**FLNG performance test completed**

Wilson Offshore & Marine has announced that a floating LNG (FLNG) unit, for which the company provided turnkey services for Exmar, has successfully completed its performance test at the Wilson yard in Nantong, China.

This marks the first time that LNG has been produced onboard a floating facility.

The 72-hour performance test was carried out in the presence of classification societies, Exmar and other relevant parties.

The FLNG project is being delivered by Wilson under an engineering, procurement, construction, installation and commissioning (EPCIC) contract with Exmar.

All of the systems on the FLNG unit have been commissioned and tested without leaving the shipyard by using LNG to supply gas without connection to a pipeline. Conducting gas trials and performance testing in the shipyard shortened the time required for project completion.

Wei Huaining, Project Manager for the FLNG project and Deputy General Manager of Wilson (Nantong) Heavy Industry, said: “The successful completion of [the] performance test verified Wilson’s comprehensive project management capabilities from engineering design, supplier management to fabrication, demonstrating our integrated EPCIC project delivery capability in complicated and challenging projects. The project has also cemented Wilson’s position in floating LNG turnkey projects around the world.”

---

**Norway**

**DNV GL grants AIP for new LNG bunker vessel design**

DNV GL has granted Vard Engineering Brevik AS Approval in Principle (AIP) for its new 6500 m³ LNG bunker vessel design.

The design has been evaluated for compliance with the DNV GL Gas Bunker rules, the applicable Gas Carrier rules, as well as the IGC Code’s 2016 edition.

Øystein Kristoffersen Sæther, Managing Director for Vard Engineering Brevik, said: "The excellent cooperation between DNV GL and Vard resulted in a development enabling flexibility and quality assurance of our design. We are proud of our joint efforts and strongly believe that the cooperation between DNV GL and Vard results in first class designs for ship owners and operators.”

The AIP is a continuation of the successful General Approval of Ship Application (GASA) of Vard and Brevik Technology’s new IMO Type-B LNG cargo containment system, which was granted by DNV GL at the end of last year.

Johan Petter Tutturen, Business Director for Gas Carriers at DNV GL, said: “With the continuing rise in interest in LNG as a ship fuel, both from an environmental and economic perspective, it is essential that we continue to develop the infrastructure which will allow this technology to thrive [...] We are very pleased to have been able to build on this excellent cooperation with Vard and support their interest and dedication in developing this new concept.”
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USA
AGDC and ConocoPhillips sign MoU

The State of Alaska, through the Alaska Gasline Development Corp. (AGDC), and ConocoPhillips Alaska Inc. have executed a Memorandum of Understanding (MoU) regarding negotiations to form a joint venture (JV) company. The JV could facilitate marketing LNG from the Alaska LNG project to global LNG markets and acquire North Slope gas, with the goal of bringing LNG buyers and North Slope wellhead sellers together.

AGDC and ConocoPhillips confirmed that they intend to pursue the support of the other major North Slope producers in the formation of the JV.

AGDC said that the MoU forms part of its broader plan to position the Alaska LNG project for a front end engineering design (FEED) decision.

The MoU focuses on leveraging the strengths of the parties to advance the goal of economic commercialisation of the North Slope natural gas resources. It also anticipates raising market awareness of the Alaska North Slope gas resource and the Alaska LNG project. Active sales and negotiation activities with global buyers could begin once the JV has been successfully formed.

Once established, the JV is expected to initially focus on gathering LNG market information in support of the JV’s pursuit of gas and LNG sales agreements as the project moves forward.

The JV would also seek to establish terms for a sufficient and reliable supply of gas to the project, resolving project gas supply assurance issues. The MoU anticipates that other producers or third parties could join the JV, make gas available via wellhead sales, or commit to tolling arrangements with the Alaska LNG project.

China
Engie to supply LNG to Beijing Gas Group

Engie has announced that it has been awarded a contract to supply approximately 900 million m³ of LNG to meet the downstream requirements of Beijing Gas Group (BGG). The contract award follows a tender process launched by BGG to secure its winter gas needs for Beijing, China.

Engie will deliver 10 cargoes of LNG to BGG over the period November 2016 through February 2017. BGG shall receive the LNG volumes into the Caofeidian terminal, in Northern China, where it will be stored, regasified and transported into Beijing’s gas network. LNG deliveries will notably involve floating storage in order to manage the winter peak shaving and flexibility needs of BGG.

Philip Olivier, CEO of Engie Global LNG Business Unit, said: “This new agreement between Engie and BGG shows the fruitfulness of the relationship that both companies have built over the last years. We are confident that our cooperation will contribute to cover China’s growing energy needs.”

Europe
Shell to fuel Carnival Corp.’s LNG-powered cruise ships

Carnival Corp. & plc has announced that it has signed a framework agreement with Shell Western LNG B.V., under which Shell will supply LNG for Carnival Corp.’s LNG-powered cruise ships. Initially, Shell will supply fuel for two new LNG-powered ships belonging to Carnival Corp.’s AIDA Cruises and Costa Cruises brands.

Under the agreement, the vessels will use Shell’s infrastructure in cruise ports to refuel. Both ships are expected to launch in 2019, and will visit popular Northwest European and Mediterranean ports.

As part of the framework agreement, both parties have the opportunity to work together on supplying LNG as a marine fuel to future LNG-powered vessels or additional itineraries. The overarching agreement allows each of Carnival Corp.’s brands to negotiate its own LNG supply contracts with Shell as new LNG-powered cruise ships launch in the coming years.

Both vessels will be built with Carnival’s next generation ‘green cruising’ ship design, will be equipped with dual-fuel engines, and will be powered by LNG both in port and at sea.

The Senior Vice President of Maritime Affairs for Carnival Corp., Tom Strang, said: “We are proud to be on the forefront of advancing LNG as a fuel source for the cruise industry and creating an entirely new model for powering next-generation cruise ships. We look forward to a productive partnership with Shell, which has the experience and shared commitment to quality, safety and operational efficiency needed to help us bring this innovative LNG initiative to life with the first fully LNG-powered ships in the global cruise industry.”
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Outlook for the Middle East

Mark Adeosun, Douglas-Westwood, UK, explains why the Middle East is set to lose its market share in spite of increased export capacity.
Since the commissioning of Trains 1 and 2 at the Das Island 1 LNG terminal (the UAE) in 1977, the construction of liquefaction terminals in the Middle East has been mainly focused in Qatar, starting with the construction of Train 1 at Qatargas 1 in Ras Laffan. Following the first cargo shipment from this facility in December 1996, Qatar has gradually increased its LNG export capacity from 2 million tpy to its current output capacity of 77 million tpy – making Qatar the world’s largest exporter of LNG. Other countries, such as Yemen and Oman, also contribute to the region’s export capacity. However, with the former having declared force majeure on its Total-operated Yemen LNG facility a number of times in the last couple of years, this has restricted its ability to operate to its full potential.
Over the same period, when the construction of export facilities thrived within the region, import facilities have been practically restricted to floating units, with the exception of the Marmara Ereğlisi (1994) and Izmir Aliaga (2006) land-based import terminals in Turkey. Israel, Jordan, Kuwait and the UAE have all deployed floating import units over the past eight years in order to meet increasing domestic demand for natural gas. The use of LNG for power generation in the region has been rising over the past decade. This trend is forecast to continue, with Bahrain and Lebanon expected to commission their first floating import unit over the 2017 – 2021 period.

Middle East in focus
The Middle East is currently the largest LNG exporting region in the world, with six operational facilities that run on 25 trains. However, the majority of these facilities came onstream prior to 2011 and export levels are expected to remain at current levels for the foreseeable future as Qatar’s North Field production moratorium remains in place. No liquefaction terminals are expected onstream in Qatar within the forecast period. Consequently, Australia is expected to overtake Qatar as the world’s largest exporter by the end of 2017, and the US soon after the forecast period.

A major influence on expenditure in the region over the 2017 – 2021 period will be developments in Iran. With the lifting of US, UN and EU nuclear-related sanctions, investment is expected to gradually stream back into the country – potentially restarting Iranian LNG plans.

The majority of Iran’s planned LNG projects have been stalled or suspended due to the impact of economic sanctions. The Iran LNG project is currently the only project under construction, comprising two LNG trains, each with a capacity of 10.5 million tpy. The facility, which is reported to be over 60% complete, is expected to be operational by 2019. Other liquefaction expenditure is associated with the prospective completion of other LNG projects in Iran that were stalled due to the international sanctions. The revival of these stalled projects (Pars LNG and Persian LNG) should guarantee that the Middle East remains the world’s largest exporter of LNG for the foreseeable future. However, the financing structure of these abandoned projects is currently unclear. The only other expenditure on export facilities in the region over the forecast is expected to be the replacement of the Das Island 1 facility.

Export capacity in the Middle East over the 2012 – 2016 period remained at 100.1 million tpy. However, this is expected to increase to 110.6 million tpy by 2021, driven by the construction of the Iran LNG terminal. However, due to large increases in capacity in Australia and the US, the Middle East’s market share of just over 28% in 2016 will fall to 23% by 2021.

Despite the region being a major exporter of LNG, a couple of import terminals are expected to be built – with Turkey accounting for the majority of expenditure on import facilities. Another potential import project within the region is the Kuwait National Petroleum Corp. (KNPC) LNG facility in Kuwait, which is expected to come onstream by 2020.

Figure 1. CAPEX on LNG facilities in the Middle East 2012 – 2021 (source: Douglas-Westwood, ‘World LNG Market Forecast 2017 – 2021’).

Figure 2. Middle East expenditure 2012 – 2021 (source: Douglas-Westwood, ‘World LNG Market Forecast 2017 – 2021’).
Market overview

A combination of sustained low oil prices and lower than expected economic growth profiles of many Asian countries (particularly China) has led to oversupply in the market, causing LNG spot prices to fall substantially. Asia will continue to be a key region of demand growth, yet prices have struggled. In August 2016, Japan’s LNG spot price averaged US$5.40/million Btu – a 50% decline compared to the same period 12 months prior. The low oil price remains a concern for the LNG market, as most long-term LNG contracts are linked to oil price, with the flexibility to vary according to market conditions greatly reduced. With long-term contracts in place, LNG suppliers’ ability to swap cargoes to the highest-priced bidder, or to adjust their LNG trading to where they can gain the most profit, is restricted.

Douglas-Westwood (DW) forecasts that CAPEX on LNG facilities between 2017 and 2021 will total US$284 billion – an increase of 50% compared to the previous five years. Over the forecast period, the Middle East will experience a 30% compound annual growth rate (CAGR) and, overall, the region will account for 3% of global expenditure.

While the Middle East has historically been a net exporting region, in recent years there has been a clear rise in domestic gas consumption, with two cargoes of LNG from the Sabine Pass LNG plant delivered to Kuwait and the UAE in 2Q16. However, import projects will remain in the minority over the forecast period, accounting for only 7% of regional expenditure.

Conclusion

In recent years, oversupply within the market has increased due to weaker demand from Asia. This is likely to remain the case in the short-term due to additional export capacity from Australasia and North America. However, seasonal gas demand will remain a key driver, particularly in Western Europe and Latin America, as LNG demand in these regions is often driven by prolonged winter seasons, while declining local gas production will also play a part. Global LNG CAPEX will experience a 14% CAGR over the next five years, and the use of natural gas will continue to play an increasingly important role in meeting global energy demand.

Qatar retained its position as the world’s largest exporter of LNG in 2016. However, DW expects to see a shift in the market, with Australia forecast to become the biggest supplier by the end of 2017. With many countries in the Middle East having large gas reserves, ongoing political tensions and proxy warfare are a big stumbling point for the development of these capital-intensive projects, hence curtailing further investments over the near-term. LNG
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