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Australian operational focus leads to successful GLNG performance

GLNG Operations, ConocoPhillips and Bechtel report on Queensland project

GLNG is a joint venture between Santos of Australia, PETRONAS of Malaysia, Total of France and KOGAS of South Korea. The joint venture extracts gas from coal seams in the Surat and Bowen basins of Queensland which is transported by high pressure pipeline to Curtis Island, off the coast from Gladstone, for conversion to LNG.

The Curtis Island facility comprises a two-train LNG plant - each train with nameplate capacity of 3.9 million tonnes per annum, two 140,000 cubic metres capacity LNG storage tanks and a product loading jetty.

GLNG awarded Bechtel the front-end engineering and design contract for the Curtis Island facility way back in December 2008, followed by the engineering, procurement and construction contract in January 2011.

A proven lump-sum, turn-key (LSTK) contractual approach was implemented, where the contractor maintained responsibility for commissioning and start-up (CSU) and operations until the performance test and other turnover criteria were met.

Strategy

This strategy integrates owner and licensor personnel into the contractor's CSU team and enables a smooth transition from contractor to owner at the turnover of an operational plant that meets production targets.

GLNG resourced the project with a strong owner's project team and from the earliest stages of design, incorporated key members of the operations team to maintain a focus on start-up and operations throughout all project stages.

A fully integrated CSU team from GLNG, Bechtel and ConocoPhillips was formed in the earlier stages of the project. This team worked together throughout



Figure 1: GLNG's two-Train LNG facility located on Curtis Island in Gladstone Harbour, in the eastern state of Queensland (courtesy of GLNG)

the different phases of CSU and through operation of the LNG plant.

Bechtel and ConocoPhillips also developed an intensive operations training program, which was provided prior to CSU and supplemented with "on the job" training throughout the CSU process. This ensured that at plant handover the GLNG team was fully proficient in the operation of the facility.

As with any large project, a few issues occurred during start-up and the first year of operation, which required resolution.

Nevertheless, the facility's performance and relatively limited occurrence of serious operational problems are positive testament to the liquefaction technology selected and the collaborative operations team's focus throughout all project phases.

Once installed, the technology is simple and easy to operate. Additionally, it allows for faster commissioning and startup, since commissioning can progress in some sections of the plant

while construction continues in the remaining sections.

First LNG production from GLNG's Trains 1 and 2 was achieved in September 2015 and May 2016, respectively. Train 1 achieved sustainable nameplate production capacity 135 days from introduction of feed gas, and Train 2 achieved the same in only 80 days.

In addition, the production from both trains exceeds nameplate capacity as confirmed through formal performance tests. These were impressive accomplishments and this article will share insights into how they were achieved.

GLNG's vision

GLNG's vision was to build and operate an efficient LNG production facility well suited to the unique characteristics of gas produced from coal seams.

Some of the key characteristics of coal seam gas (CSG) include a gradual ramp up to full production and a sensitivity to the wells being fully shut-in (in some

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cases CSG wells can require work-over after being shut-in to recover production).

Good facility turn-down, high plant availability and minimization of full LNG train outages are important requirements to achieve when operating a plant to convert CSG to LNG.

After a thorough review, GLNG selected the Optimized Cascade® Process as the technology, together with the Global LNG Collaboration between ConocoPhillips and Bechtel to design, construct and commission the two train, 7.8 MTPA LNG facility.

The technology delivers high availability and thermal efficiency throughout a wide range of feed gas compositions without the need to adjust refrigerant compositions.

Approach

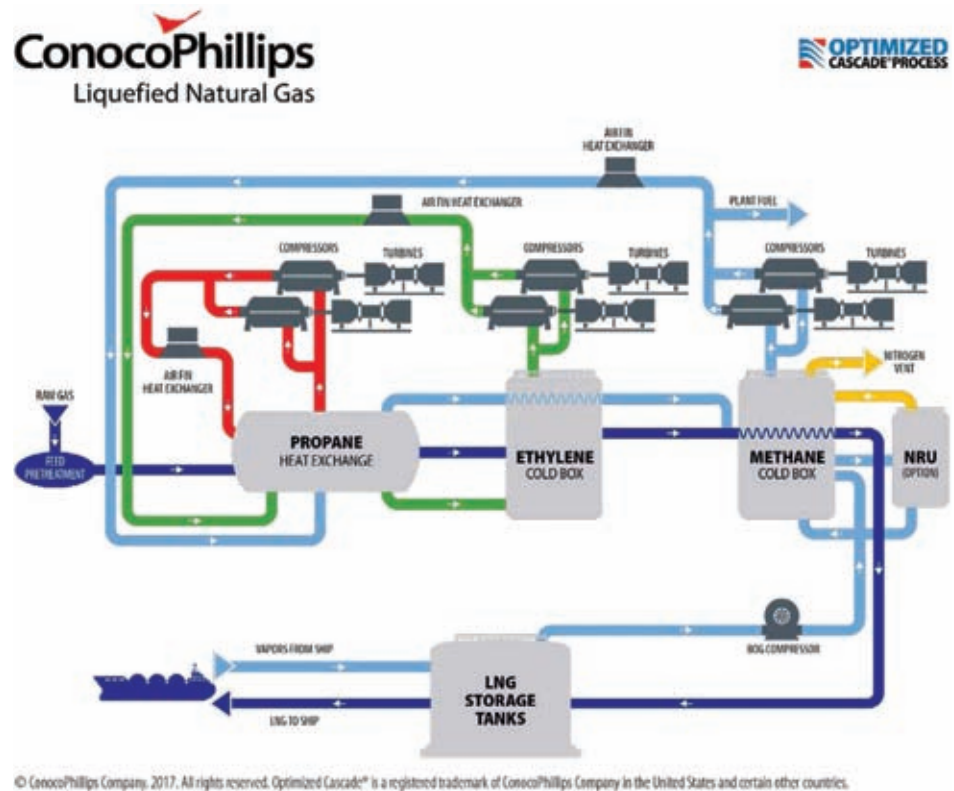
The two-trains-in-one approach, where one train of highly reliable heat exchangers and other process equipment is served by two parallel refrigeration turbine/compressor sets, prevents total train downtime in the event of any single turbine/compressor string trip.

In such an event, the design allows operators to quickly and easily rebalance refrigerant loads and maintain production in excess of 60 percent. Another highly desirable feature of the Optimized Cascade® Process is the ability to re-start a tripped turbine/compressor with little or no flaring.

However, even in the event of a total plant trip, liquefaction process temperatures, pressures, and liquid levels, due to the design of the liquefaction unit facilities, are maintained for prolonged periods, enabling a rapid restart of the plant.

The infrequency of plant trips, combined with the ability to restart quickly when a total plant trip does occur, help maximize the overall facility availability and production efficiency, which are key elements in meeting GLNG's stringent requirements. The technology also provides for stable operation at low throughput, supporting a ramp up to full production while minimizing the risk of well shut in.

The schematic below provides a simplified depiction of the Optimized Cascade® Process. The raw gas is first treated to remove carbon dioxide (CO₂), hydrogen sulfide (H₂S) and other sulfur compounds, water (H₂O), organometallic mercury compounds, particulates, and



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Figure 2: ConocoPhillips Optimized Cascade® Process Technology with NRU Option (courtesy of ConocoPhillips)

other contaminants before routing to the liquefaction section of the plant.

Heat exchangers

The treated gas is then chilled and condensed in successively colder heat exchangers, using pure propane, ethylene, and methane refrigerants until LNG is produced.

The design for GLNG includes an integrated nitrogen rejection unit (NRU) configured to achieve optimal LNG plant performance and maximize the net present value of the facility.

The LNG product is then pumped into insulated storage tanks in preparation for shipment. Boil off gas and ship return vapors are captured and recycled through the Optimized Cascade® Process for efficient re-liquefaction and maximum output.

Santos' experience as an equity partner in the Darwin LNG project provided confidence in the Optimized Cascade® Process and the ConocoPhillips and Bechtel LNG Collaboration. Another important consideration was the ability to capture synergies associated with Bechtel simultaneously constructing two neighboring LNG facilities on Curtis Island.^[1]

The long history and the many projects utilizing the LNG Collaboration evidences the ability to reduce the overall project schedule in several ways.

Engineering

For example, some detailed engineering activities can begin during the early phases of FEED since the plant layout,

vessel sizing criteria, and other critical considerations are already well known. Schedule reducing synergies exist throughout all phases of the project, from pre-FEED through commissioning and startup.

Key to success: fully integrated commissioning and start-up team: With the chosen contracting strategy (EPC-LSTK), both ConocoPhillips and Bechtel were incentivized to complete the project with fully operational trains meeting production and efficiency targets, as demonstrated through formal 72-hr performance tests.

This structure was beneficial to GLNG because at turnover of care custody, and control (TCCC) of the plant, GLNG did not have to pursue the contractor for assistance with work items during the commissioning and start-up phases, as such items remained within the contractor's area of responsibility.

Bechtel also benefitted from this structure because at the time of TCCC they would have resolved the majority of "punch list" items, thereby allowing a definitive schedule for demobilization of their personnel and equipment.

There can be no question that operations excellence begins in design.^[2] One of the advantages of the ConocoPhillips and Bechtel LNG collaboration is that each bring complimentary perspectives. ConocoPhillips' focus on technology, engineering, and operations complements Bechtel's focus on engineering, procurement, construction, and overall project management capabilities.



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One key to achieving GLNG's vision was their strategic decision to embed and involve experienced operations personnel into the project from the earliest project phases through TCCC and during subsequent operations, as well.

Collaboration

The ConocoPhillips and Bechtel collaborative relationship also brought operational expertise and lessons learned from a large installed base of licensed Optimized Cascade® facilities.

Due to the significant industrial base in Australia, a good selection of experienced operations candidates with applicable LNG experience was available.

GLNG recruited personnel early in the process to front end load the project with appropriate operations resources. Operators assisted throughout the Pre-FEED, FEED and EPC phases.

They were an integral part of the team for HAZID, HAZOP, SIL Studies, FATS and SATs and Module Yard activities.

Since Bechtel was responsible for starting up the plant and the initial operations until plant TCCC, the GLNG operations workforce was incorporated into the Bechtel CSU team, which ensured a seamless transfer from the Bechtel controlled CSU phase to stable operations.

ConocoPhillips operations specialists were incorporated into the CSU team as well, such that all three parties worked together as an integrated team.

Training

The plant operations staff supplied by GLNG sufficiently early in the project to receive training prior to commissioning and start-up activities. This allowed training of the operators in hydrocarbon fundamentals and on the ConocoPhillips Optimized Cascade® Process early enough to allow them to assist on various CSU work.

Bechtel and ConocoPhillips were responsible for providing classroom training that consisted of equipment theory, plant functions and layout, the Optimized Cascade® Process, mechanical design, safety matters, plant start-up and operation, and facility troubleshooting. Personnel with operating and engineering experience from ConocoPhillips provided training based on first-hand experience and knowledge. Critical equipment vendors provided additional operations training.

Once the classroom training was completed, GLNG operations staff were

incorporated into Bechtel's CSU team. This arrangement provided Bechtel with additional staff for commissioning and start-up activities and provided GLNG with staff trained in the operation of the LNG facility. This fully integrated team continued throughout commissioning, start-up, and operation of the LNG plant.

Bechtel, ConocoPhillips and the GLNG operations team worked together to build, test and commission a high fidelity Operations Training Simulator (OTS). The utilization of the OTS allowed the GLNG operations team to write/validate procedures, familiarize themselves with plant and equipment start-ups and shutdowns, and understand "all of LNG Train" dynamics, optimization techniques, troubleshooting and tuning of control loops prior to start-up.

ConocoPhillips completed higher fidelity dynamic simulations during the design phase, complete with hydraulics and much more detailed equipment modeling and integration, to select the proper valve trim as well as to develop and test many of the control algorithms.

This effort proved greatly beneficial in validating and testing the OTS, which ultimately matched plant performance very well. After start-up the OTS was As-Built by Bechtel, leading to a simulator that provides a good match to plant performance.

Milestones

With the EPC contract being awarded in January 2011, early work began at the facility in May, 2011. Most of Train 1's utilities were commissioned by early July 2015 to support pressuring up the inlet pretreatment area with hydrocarbons on 7 August 2015 (initial Start-up).

For Train 2, initial start-up of the power generators used fuel gas from Train 1 until Train 2 fuel systems were up and running. Train 2's initial start-up took place on 17 April 2016.

The Optimized Cascade® Process is designed for rapid chill down and ramp up to full production. The combination of closed loop refrigerant circuits and ability to route the feed sequentially through each refrigerant stage allows for rapid chill down without undue concern over thermal rate of change limitations.

It is also possible to operate and control the plant at very low rates, since no difficult refrigerant phase transitions occur within any of the equipment. Also, with controllable LNG production at very low rates, there is no need to chill the

LNG Tanks with an external source, such as an LNG cargo.

Barring the time to cool down the LNG Tanks, which takes approximately three days per tank, chill-down and ramp up to full production can often proceed within a day and GLNG achieved first drop of LNG within 33 hours of the start of cooldown of either Train 1 or Train 2.

Ramp up to full production was slowed by residual debris on the propane system as well as by ongoing commissioning activities such as gas turbine performance mapping

Nevertheless, Train 1 completed its performance test within 65 days of producing its first LNG cargo and Train 2 completed its performance test within 33 days of producing its first LNG cargo.

The nature of the CSU collaboration allowed lessons learned from Train 1 to be applied to Train 2 as follows:

- QA focus areas for construction
- Optimization of construction as well as CSU sequence
- Application of Train 1 tuning parameters to Train 2

Commissioning Tests (process and utility): Commissioning tests were required for all systems, all package units, various special items such as metering skids, firewater pumps, utility systems and of course, all control systems, alarm systems and shutdown systems.

The purpose of the commissioning tests was to demonstrate that individual systems within the facility performed to design specifications provided for in the EPC contract. There were 36 individual tests each with a procedure and a report documenting the results and individually signed off by Bechtel and signed off and witnessed by the owner.

Performance Test: Once all of the equipment and system acceptance tests were completed, formal 72-hr performance tests were completed for each train to demonstrate that production and thermal efficiency targets met or exceeded the guarantee rates.

The production result achieved for Train 1 was 15.5 percent above guarantee.

The production result for Train 2

improved, with a demonstrated production 18.1 percent above guarantee.

By successfully completing the formal 72-hour performance tests, sustainable production capacity at design production or above was achieved in 135 days from initial start-up for Train 1 and 80 days for Train 2.

Efficiency targets were also met in a similar fashion for each train.

Conclusions

By engaging the ConocoPhillips and Bechtel LNG collaboration, and applying its preferred contracting strategy, GLNG selected an LNG liquefaction technology suitable for operating a plant that can convert CSG to LNG and a contractor motivated to deliver a completed, tested and operating LNG plant.

Key to the successful start-up of the operation were:

- Having an LNG liquefaction plant that can be rapidly chilled down and ramped up to full production, and quickly adjusted to changing conditions;
- Integration of experienced operations staff in the earliest phases of design and construction throughout the project stages and with owner's project team focused on plant operability;
- Structured training of operations personnel through classroom, vendor and simulator training; and
- Integration of operations personnel into the Bechtel CSU team to provide hands on training and the opportunity for experienced operations personnel to optimize the commissioning and start-up of the facility. ■

This article was written by GLNG Operations Pty Ltd - Downstream Operations: Richard L. McLaughlin, PhD, Production Planning and Optimisation Manager; Mark Goldup, Operations Excellence Manager; and ConocoPhillips Company's Greg Thomas, Director, LNG Technology and Licensing, and Wesley R. Qualls, Engineering Fellow, and Bechtel Oil, Gas & Chemicals' David Messersmith, Manager, LNG Technology and Services Group.

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As number of import facilities expand LNG will be used more to fill the energy gaps

Royal Dutch Shell keeps up tradition of BG overview often published for Gastech

Over the next two decades, as more countries have existing infrastructure in the form of onshore import terminals or floating storage and regasification units (FSRUs), liquefied natural gas will increasingly be used when there are shortages in domestic energy supply.

That is the view of Royal Dutch Shell in its LNG Outlook and which forecasts LNG market growth through 2020 of 50 percent, mainly from LNG facilities already under construction or recently completed.

The LNG industry will need to make large investments to supply demand growth after 2020 when use beyond the power sector is expected to continue to increase.

Investment

Shell said global demand in 2016 reached 265 million tonnes as market growth kept pace with supply in Asia and the Middle East, absorbing the increase in supply from Australia.

“Global LNG trade demonstrated its flexibility time and again in 2016, responding to shortfalls in national and regional gas supply and to new emerging demand,” said Maarten Wetselaar, Integrated Gas and New Energies Director at Shell.

“The outlook for LNG demand is set to grow at twice the rate of gas demand, at 4 percent to 5 percent a year between 2015 and 2030,” said Shell in its first annual LNG outlook, a report previously compiled and published by BG Group before its acquisition.

China and India, which are set to continue driving a rise in demand, were two of the fastest growing buyers, increasing their imports by a combined 11.9MT of LNG in 2016.

“This boosted China’s LNG imports in 2016 to 27MT and India’s to 20MT,” Shell stated.

New importers

“Total global LNG demand increased following the addition of six new importing countries since 2015: Colombia, Egypt, Jamaica, Jordan, Pakistan and Poland,” the report said.

“They brought the number of LNG importers to 35, up from around 10 at the start of this century,” it added.

Egypt, Jordan and Pakistan were among the fastest-growing LNG importers. Due to local shortages in gas supplies, they imported a combined 13.9MT of cargoes.

“The bulk of growth in LNG exports in 2016 came from Australia, where exports increased by 15MT to a total of 44.3MT.

“It was also a significant year for the USA, after 2.9MT of LNG was delivered from the Sabine Pass terminal in Louisiana,” Shell noted.

The Anglo-Dutch company said LNG prices are expected to continue to be determined by multiple factors, including oil prices, global LNG supply and demand dynamics and the costs of new LNG facilities.

Trading

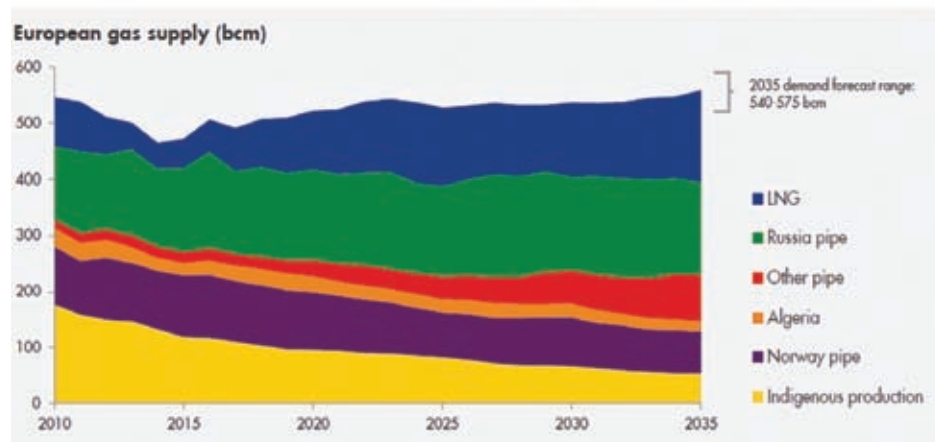
In addition, the growth of LNG trade has evolved into helping meet demand when domestic gas markets face supply shortages.

“LNG trade also is changing to meet the needs of buyers, including shorter-term and lower-volume contracts with greater degrees of flexibility.

“Some emerging LNG buyers have more challenging credit ratings than traditional buyers,” the company added.

“In China, a government target has been set for gas to

LNG to take larger share of European gas demand



Competition in Europe between pipeline and LNG (Graphic: Shell)

make up 15 percent of the country’s energy mix by 2030, up from 5 percent in 2015.

“Meanwhile, Southeast Asia is projected to become a net importer of LNG by 2035, a significant transformation for a region which includes Malaysia and Indonesia, currently among the major LNG exporters in the world,” the report added.

LNG will also see market expansion as a transport fuel in countries such as China, where in 2016 there were more than 200,000 LNG-powered vehicles.

“Over the next decade, LNG use in the heavy-duty and marine transport sectors is expected to grow in the Middle East, Europe, Southeast Asia and the USA,” said the Shell report.

“Growth is expected in marine as well as in road transport, with LNG as a lower emissions alternative to diesel and heavy fuel oil. Tighter emissions regulations have also played a role,” it noted.

“The International Maritime Organization agreed to a global 0.5 percent sulphur cap on marine fuel that will take effect from 2020.

“LNG as a fuel contains virtually zero sulphur versus 3.5 percent specification for global marine fuel today,” Shell added.

In the natural gas and LNG markets, the US is expected to continue to consume more gas than any other country. Russia is set to stay second, with 2016 gas demand estimated to be 440 billion cubic metres.

China’s gas demand is expected to increase significantly, reaching 450 Bcm by 2030, up from around 200 Bcm in 2016.

“This will be met by a mix of conventional and unconventional domestic production as well as pipeline and LNG imports,” said Shell.

“An additional 100 MTPA of LNG demand from China would be equal to an increase of more than 20 percent in total global LNG demand in 2030,” the Anglo-Dutch company said.

Europe

The future outlook of LNG demand in Europe remains uncertain due to environmental policies, domestic gas production and pipeline gas imports.

“Gas demand increased by around 5 percent in 2016, driven mainly by the power sector,” said Shell.

“This was the result of more coal-to-gas switching in the power sector, nuclear outages in France, and a colder than usual winter in Northern Europe, particularly in the UK and Ireland,” it added.

As for Southeast Asia, countries such as Malaysia and Indonesia are among the major LNG exporters in the world.

“However, by 2035, the region is set to become a net importer. The rise in demand is driven by economic growth coupled with declining domestic gas supplies in countries such as Thailand,” the report said.

As for the countries supplying LNG, growth in 2016 was dominated by Australia, though exports increased by 3.8MT from Qatar, Indonesia and Angola.

“Production in other Atlantic basin projects fell by 3.5 MT, driven by

“Southeast Asia is projected to become a net importer of LNG by 2035...”



Who developed the world's first LNG tanker?

Who opened up the Asia-Pacific market by exporting LNG from Alaska to Japan?

Whose Optimized Cascade® Process technology was selected for four of the last seven LNG projects in Australia?

Whose technology is expected to produce 25% of the world's LNG by 2020?

Answer: **ConocoPhillips**

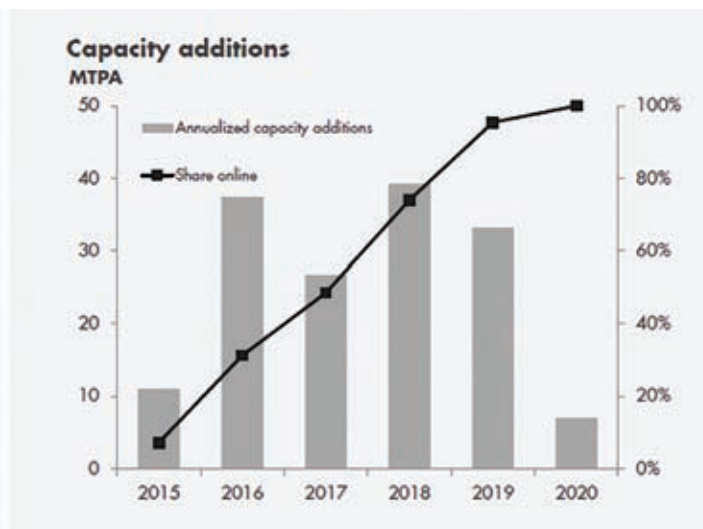
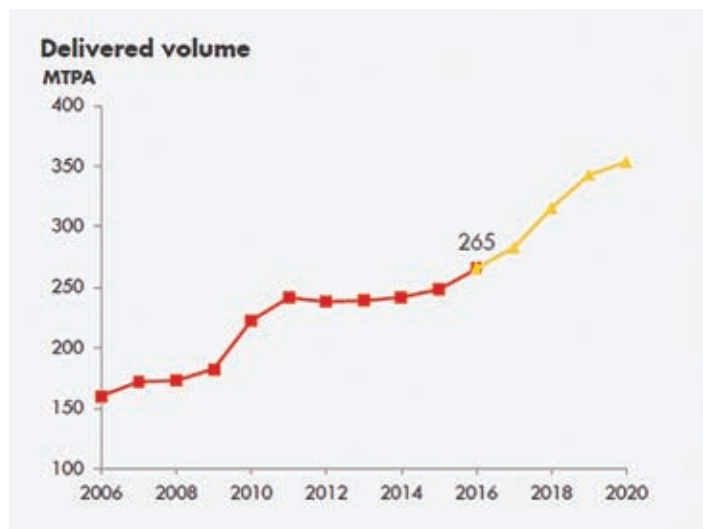
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Shipments and volume capacities are on the rise (Graphic: Shell)

operational issues in Trinidad and Tobago, Nigeria and Algeria,” Shell said.

Spot prices

“LNG spot prices - the amount paid for short-term supplies - as a proportion of oil prices in 2016 were very similar to 2015, suggesting that spot LNG maintained its relative competitive position within the energy mix,” the report added.

“Looking ahead, future LNG prices are expected to continue to be determined by everything from oil prices to prices of

renewable sources of energy to the costs of new LNG projects.

“Future LNG prices will continue to compete with regional piped gas prices,” it said.

The Shell outlook explained that governments are increasingly recognising the benefits of gas and its role in delivering the key policy objectives of secure and affordable supplies of energy, to reduce the impact on climate change and manage air quality.

“For example, the 13th Five Year Plan

in China, adopted in March 2016, identified 45 Bcm of additional gas demand - more than total gas demand in The Netherlands - to improve air quality in cities,” Shell said.

“In China in January 2017, the National Energy Administration announced the cancellation or suspension of more than 100 coal-fired power plants that were in planning or under construction.

“If they had gone ahead, these projects would have a combined capacity of more than 100 gigawatts - more than double

Germany’s installed coal and lignite capacity,” the report explained.

Flexible

While the global industry has been flexible in developing new demand, there has been a decrease in final investment decisions for new supply.

Shell said it believed further investments would need to be made by the industry to meet growing demand, most of which is set to come from Asia, after 2020.

“Many new buyers face uncertainties in their own gas markets related to, for example, the global economy, domestic gas exploration, and the liberalisation of electricity and gas markets.

“This means they increasingly favour shorter-term contracts, around five years, as opposed to traditional long-term contracts which typically run for two decades.

“Companies that sell LNG will increasingly need a large enough portfolio and sufficient flexibility to supply a growing number of countries, including more developing economies,” stated Shell. ■



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For the Record

ARGENTINA believes it is still on track to cease liquefied natural gas imports by 2022 as shale-gas supplies from its estimated 802 trillion cubic feet of technically recoverable resources begin to flow. “Argentina’s dry natural gas production declined each year from 2006 to 2014, and the country has shifted from a net exporter of natural gas to a net importer,” according to a new report from the US Energy Information Administration. In 2015, natural gas production increased for the first time since 2006, as ongoing efforts to increase production from key shale-gas areas in Argentina aimed to reduce its imports of natural gas by pipeline and in the form of LNG. Once one of the largest natural gas exporters in South America, Argentina was a net importer of natural gas by 2008. Imports, which accounted for 23 percent of Argentina’s natural gas consumption in 2015, came by pipeline from countries such as Bolivia and, to a lesser extent, as LNG from sources such as Trinidad and Tobago in the Caribbean. “The Argentinian government hopes to stop

importing LNG by 2022,” the EIA report said, while pointing out various obstacles that have to be removed if this were to happen. Argentina is the third country in the world, after the US and Canada, to commercially develop tight oil and shale gas. Argentina’s Vaca Muerta (Dead Cow) formation within the Neuquen Basin has an estimated 308 Tcf of technically recoverable shale-gas resources. “Vaca Muerta’s geologic properties have been compared with the Eagle Ford play near the Gulf of Mexico in Texas in terms of its depth, thickness, pressure, and mineral composition,” the EIA noted. The report said more than 588 vertical and horizontal shale wells have been drilled and completed in the Vaca Muerta shale play since 2010. According to the Argentine Ministry of Energy and Mines, shale-gas production reached 64.6 billion cubic feet (Bcf) at the end of 2015. Argentina’s national oil company, Yacimientos Petroliferos Fiscales (YPF), the most active operator in the Vaca Muerta shale play, has initiated joint venture pilot project agreements with partners such as US companies Chevron Corp. and Dow Chemical, as well as Petronas of Malaysia to further develop the play. However, the US said that although Vaca Muerta may have similar geologic properties to the Texas shale play, the production history of the Eagle Ford may be difficult to replicate in

Argentina. “While drilling costs in Argentina have declined, they are still higher than YPF’s target costs.” The EIA said. “The average drilling and completion cost of a horizontal well in Vaca Muerta was estimated to be \$11.2 million as of 2015, compared to \$6.5M to \$7.8M in the Eagle Ford,” the EIA said. “Ultimately, the economic competitiveness of Argentina’s indigenous shale gas resources will depend on the costs of domestic drilling and completion and the productivity of newly drilled wells. Although Argentina has an established energy industry, the current oil and gas sector is relatively small. The highest active rig count in Argentina in recent years was 110 for its nonshale oil and gas production, compared to more than 230 dedicated shale rigs in the Eagle Ford alone in 2013. Argentina has relatively high labor and imported equipment costs, shortages of specialized shale rigs, and limited proppant capacity - factors likely to hinder efforts to quickly increase production,” the EIA added.

AUSTRALIA is building its LNG bunkering capability. The first LNG fuel operation has taken place at Fremantle Port in Western Australia as the country develops its maritime fuel market on its way to becoming the largest global producer of LNG ahead of Qatar. The truck-to-ship bunkering took place at

Fremantle on February 19 involving fuel distribution company Evol LNG, part of the Wesfarmers Chemicals, Energy & Fertilisers group. The Fremantle operation followed the first ever Australian LNG bunkering completed on 23 January by Evol for Woodside Petroleum, operator for the North West Shelf and Pluto LNG export plants. That truck-to-ship refueling was under an agreement between Woodside and Evol and involved the bunkering of the platform supply vessel, “Siem Thiima” at King Bay Supply Base near the port of Dampier. The Fremantle refueling at the weekend was for the same Norwegian-flagged vessel, the “Siem Thiima”. Fremantle Port Authority approved a bunkering licence for Evol in July 2016. Evol later secured its second major Australian port bunkering licence from the Pilbara Ports Authority, including Dampier. Evol’s Kwinana LNG production plant provides fuel for truck-to-ship bunkering for LNG-powered vessels visiting Fremantle and those in the Pilbara Ports area. The Kwinana plant is just 20 kilometres from Fremantle but is 1,320km from the LNG export terminal and port at Dampier. The liquefaction facility uses Linde’s process technology with a closed single-mixed refrigerant cycle and can produce 175 tonnes per day of LNG. It also has 4,000 cubic metres capacity of storage. Feed-gas

to make the LNG is delivered to the Kwinana plant from the North West offshore gas fields via the Dampier-to-Bunbury natural gas pipeline. Evol said it was able to supply customers at Fremantle and other Western Australian ports with LNG at a competitive price compared with low-sulphur marine diesel and would be able to refuel ships at up to 45 tonnes per hour, which is comparable to traditional bunker fuels. Western Australia is leading the nation in providing access to a cleaner shipping fuel, while Australia itself will become the largest LNG exporter after 2019, surpassing Qatar’s annual LNG shipments of 77 million tonnes per annum. “Our decision to enter the LNG bunkering market is



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part of a long-term strategy that recognizes environmental and economic sustainability of LNG as a transport fuel,” said Evol Business Manager Nick Rea. “It also recognizes that the LNG marine fuel market is still in development so the fact Evol has over 15 years’ experience in distributing LNG means we saw an opportunity to provide a suite of services that perhaps others can’t,” added Rea. “With growing demand for lower emission fuels over the past decade, we’ve seen the number of LNG-fueled ships in operation worldwide increase steadily from a handful to more than 75, with an additional 80 expected to be built in the next three years,” he said. “If interest is there, Evol will obtain licences from other major Australian and regional WA ports to conduct LNG bunkering operations, and look at investing in infrastructure to meet the market’s needs,” he added. Rea pointed out that LNG fuel growth will be helped by the International Maritime Organization (IMO) regulations for a cleaner shipping industry and the introduction of emission control areas in Europe and North America. In addition, China has introduced emission control areas around its three major ports. “Interest in LNG as a marine fuel is growing, especially since the IMO announced that it would introduce a global marine fuel sulphur limit of 0.5 per cent from 2020,” he said. “It’s certainly an offering we’d like to expand, particularly as truck-to-ship LNG bunkering can be achieved relatively inexpensively with existing logistics and assets,” added Rea.

BC FERRIES, the Canadian shipping

company serving towns and communities around Vancouver Island in British Columbia, says the second of three new dual-fuel vessels with LNG capability is

on its way to Vancouver from the shipyard in Gdansk in Poland. The “Salish Eagle” will join the “Salish Orca” as the second vessel in its fleet with gas propulsion as

well being able to run on diesel. BC Ferries said the “Salish Eagle” is 10 days into a 10,440 nautical mile journey across the Atlantic and then into the Pacific from

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Poland to BC, via the Panama Canal. "The journey includes stops for refuelling in Santa Cruz, Canary Islands, and Panama City, Panama, and sailing up the west

coast of North America to British Columbia," the company said. BC Ferries is one of the largest ferry operators in the world, providing year-round vehicle and

passenger services on 24 routes with a fleet of 34 vessels. Its ships are mostly under contract with the provincial government to provide essential

transportation links for coastal communities. The French-speaking province of Quebec also uses LNG-fueled ferries for outlying islands, making

Canada one of the world leaders in ferry transportation using LNG. The "Salish Eagle", which is designed to travel at up to 15 knots, is scheduled to start service with the first of its two sister ships in the Southern Gulf Islands routes around Vancouver. The fleet of three LNG-powered ferries each have three engines and can switch from natural gas to diesel if needed, though BC Ferries said the preferred fuel is LNG because of cost savings and its smaller environmental footprint. "We are looking forward to introducing all three new Salish-Class vessels into service this year, which will serve British Columbians for decades to come," said Mike Corrigan, the President and Chief Executive of BC Ferries. "We plan to operate these ships on natural gas, which will improve our environmental footprint and reduce our operating costs," he stated. The artwork created to adorn the "Salish Eagle" is designed by John Marston, a member of the native North American Stz'uminus First Nation, and will be applied when the ship arrives in BC. The Polish Remontowa Shipbuilding yard is responsible for delivering the ship to BC and has contracted a professional international ship-delivery specialist for the job.

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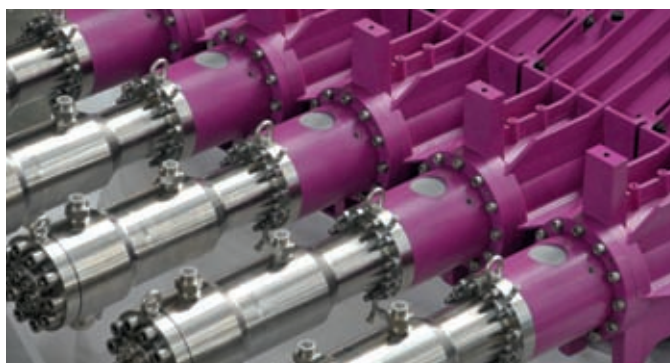
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BOMIN LINDE LNG, the German company based in Hamburg, is building up its bunkering expertise after successfully conducting the first re-fueling operation using LNG for a chemical tanker in a German port. This

involved delivering fuel to the vessel “Fure West” in Rostock, the German port on the Baltic Coast. A total of four LNG trucks were unloaded onto the vessel operated by Swedish shipping company Furetank AB at what is Germany’s largest Baltic port. “The truck-to-ship bunkering process went smoothly thanks to the seamless coordination between the ship’s crew and our Bomin Linde experts onshore,” said Sonja Nesshoever, Director of the LNG portfolio at Bomin Linde. “I am glad that we were able to bring the partnership agreement between our two companies to life just weeks after it was signed,” added Nesshoever. The German company pointed out that “Fure West” became one of the first tankers to run on LNG when it was retrofitted by its Swedish owners. “Since then, the Gothenburg-based frontrunner in the utilization of LNG as shipping fuel has gained significant experience with the environmentally friendly fuel and plans to extend its fleet of LNG-powered tankers,” Bomin Linde added. “Together, Furetank and its partners in the Gothia Tanker Alliance have ordered a total of

six LNG-fuelled newbuilds,” it said. Lars Höglund, Managing Director of Furetank, said his company was happy to be able to bunker LNG in an increasing number of ports, including Rostock. “Jointly developing the LNG market is the basis for successfully establishing LNG as ship fuel,” said Höglund. “We are glad to have Bomin Linde LNG as our partner, with whom we will not only extend our truck-to-ship supply but also ship-to-ship bunkering,” he added.

BRITISH COLUMBIA Premier Christy Clark said benefit deals linked to LNG projects signed with two native North American First Nations were a milestone for the natural gas future of the Canadian province. The provincial government said the Lax Kw’alaams and Metlakatla First Nations had reached multiple agreements “to ensure benefits accrue” as a result of the construction and operation of an LNG export industry in the Prince Rupert port area. “Building this new industry is an unprecedented opportunity to create jobs and economic prospects for British Columbians and

these agreements ensure members will directly benefit from the industry’s growth,” said Premier Clark. The BC government said there were three key components: an LNG benefits agreement, a coastal fund benefits agreement and a pipeline benefits agreement. “The LNG benefits agreement provides financial benefits including a trust fund and capital for road improvements and infrastructure,” BC said. “Upon Pacific NorthWest LNG’s final investment decision, a predetermined amount of funds will be released from the trust, with the remaining balance available once facility construction begins,” the province added in reference to a joint venture led by Malaysian energy company Petronas. “A total of 1,942 hectares of Crown land will also be transferred to the Lax Kw’alaams as part of the benefits detailed in the agreement,” it added. The coastal fund agreement defines ongoing benefits during export operations, including those linked to PNW LNG and any additional LNG export facilities that may be built in the Prince Rupert area. “After many meetings and negotiation sessions, I feel

pleased we are at this stage,” said Mayor John Helin, representing the Lax Kw’alaams. “We have the first of its kind environmental agreement and have a benefits package that will allow us to go a long way to address the needs of our members, should this project proceed,” he said.

CHIYODA Corp. of Japan, one of the world’s leading LNG engineering and construction companies, posted a 39.85 billion yen net loss (\$355M) in the fiscal third-quarter because of woes in the subsea market and the “prolonged tumble in oil prices” delaying projects. The performance prompted by its Emas Chiyoda subsea business compared with a 2.45 billion yen (\$22 million) net profit in the same quarter of 2015 after “delayed investments by clients” and amid a deterioration in project prices and “fierce competition” in the market. Because of its energy market troubles Chiyoda shares have plunged 23 percent from a high of 930 yen per share in October 2016 to 716 yen on February 9, 2017. Net sales in the third quarter to the end of December 2016

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still held up at 435.11 billion yen (\$3.87 billion). Chiyoda, based in Yokohama, said that during the first nine months of the fiscal year, the business environment surrounding the Group remained challenging. “The balance of supply and demand for liquefied natural gas remained considerably loose as a result of the completion of new plants in Australia and the United States, while the final decision on investments in large LNG projects that the Group expected was slightly delayed,” said Chiyoda. “Moreover, the Japanese economy saw that companies remained cautious about capital investments despite the growing expectations for the government’s economic stimulus measures,” it stated in its earnings. Chiyoda is one of the world’s leading LNG engineering companies, working on projects in Australia, Mozambique, Russia and the US. In general terms, it was anticipated that the price of crude oil had bottomed out as a result of the conclusion of an agreement with the Organization of the Petroleum Exporting Countries on production cutbacks. “However, lingering uncertainty

persisted, mainly due to concerns over the repeated occurrence of terrorist attacks in various parts of the world and the effects of the Presidential election in the United States, whose outcome was unexpected by the majority of people,” Chiyoda said. “In the LNG business, the Group’s core business, it secured a new contract in Indonesia in addition to carrying out other large-scale projects around the world. It aggressively tackled highly feasible expansion projects and other new projects,” the company added. “In this way, it maintained a superior business position. On the other hand, Emas Chiyoda Subsea Ltd., to which the Group had made an equity participation in March 2016, has faced the larger-than-anticipated slowdown of the subsea market,” the company said. Emas Chiyoda Subsea was established less than a year ago as a procurement and construction service provider in the form of a 50-50 joint venture between Singapore-based Ezra Holdings, the offshore contractor, and Chiyoda. Under the deal to launch EMAS Chiyoda Subsea, the Japanese company also

subsequently brought in Japanese shipping and offshore project company Nippon Yusen Kabushiki Kaisha (NYK Line) as an additional shareholder. “Having thoroughly evaluated the value of the stocks in hand and examined the possibility of future recovery of the loan rendered, the Chiyoda group recorded non-operating expense and extraordinary losses,” it explained. Chiyoda said it had a contract backlog of 933.95 billion yen (\$8.31Bln), down 19.8 percent from a year ago. Operating income amounted to 10.41Bln yen (\$92.7M), down 31.8 percent year on year, also due to the hit taken for the Emas Chiyoda subsea business. “The Group sincerely regrets the recorded results that significantly underperformed the results forecasts announced at the beginning of the fiscal year. A company-wide effort has been determined to improve earnings through the thorough implementation of the evaluation of investment projects and the business management of the Group companies so that it will be able to regain the trust of stakeholders,” stated Chiyoda.

CRYO SHIPPING AS, a company based in the Norwegian port of Bergen, said it had developed a new type of small-scale LNG carrier and bunkering ship through converting offshore industry vessels. Cryo Shipping aims to become one of the largest LNG feeder and bunker operators with its fleet of conversions. “The company aims to establish a fleet of flexible and efficient small-scale LNG tankers to be able to secure supply of LNG to consumers regardless of location,” said Nicholai H. Olsen, managing director and partner of Cryo Shipping. “The ships will be able to perform both feeding and ship-to-ship (STS) bunkering operations in all types of waters and ports,” Olsen explained. “We are working on projects to convert platform supply vessels into LNG tankers which should be in operation by the first half of 2018,” said Olsen. “We have designed the LNG system by using known technology, but combined in a new way. We have also developed design for newbuildings with completely new and unique functionality that we aim to contract when our portfolio can meet the investment,” he added. Cryo Shipping

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noted that by 2020 the expected numbers of LNG-powered ships was expected to rise to around 1,000. "Today LNG logistics are predominantly done by road transport - giving costly logistics with high environmental and socioeconomical impact," the company said. "The few small-scale LNG tankers that exist are not designed to meet regular supply requirements in a growing LNG market. Use of LNG storage bunkering facilities will result in congested traffic at storage facilities and harbours and we therefore focus on providing direct STS bunkering both at port, anchor and at sea," said Cryo Shipping. The company believes its solution will provide both the maritime and land-based industry with more efficient operations with less time consumed in connecting to LNG supplies.

DELEK GROUP, the Israeli East Mediterranean company, with plans to supply natural gas to Jordan, Israel, Egypt and the Palestinian Authority has signed an agreement to acquire Canadian company Ithaca Energy for US\$525 million. The purchase is part of Delek's strategy to focus on energy exploration and production and expand its international operations beyond its East Med operations offshore Israel and Cyprus. Delek subsidiaries are stakeholders in the Leviathan gas field with reserves of 22 trillion cubic feet and in the established Tamar field in Israeli waters as well as the Aphrodite field offshore Cyprus. The Israeli company's main partner in the East Med operations is Houston, Texas-based Noble Energy. The East Med and Cyprus gas fields have a range of supply options, including pipeline

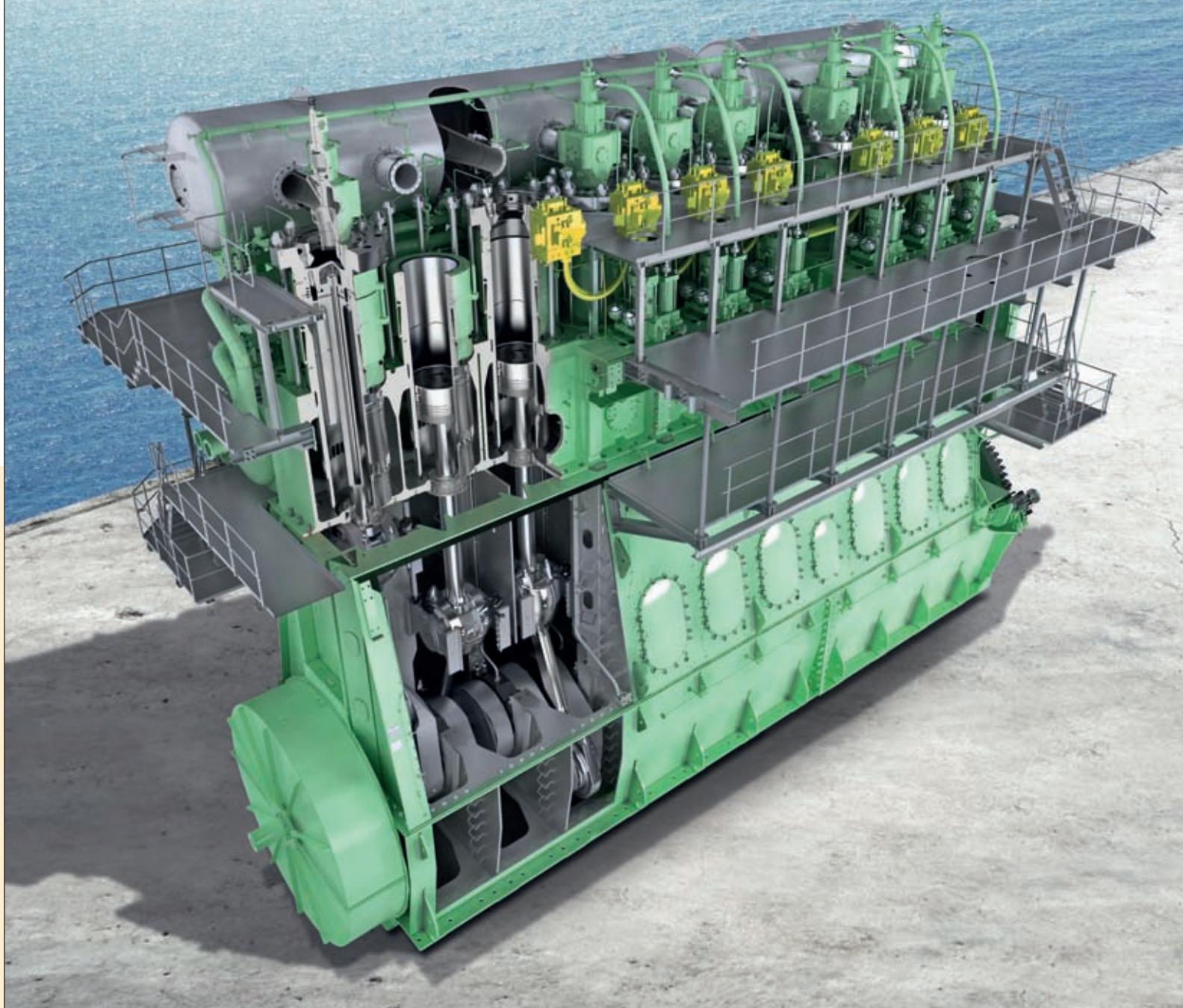
gas for LNG production. Delek said it was financing the acquisition from its own sources and cash reserves and cash flow expected from operations and the sale of

other assets. "This is a major step forward in consolidating Delek Group as an international energy company with the ability to explore, produce and drill for oil

and gas assets," said Delek President and Chief Executive Asaf Bartfeld. "This latest deal will significantly strengthen the operative arm of the group, which will

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represent complementary and synergetic activities to Delek's existing operations and allow us to expand Delek Group's international operations and its range of operational capabilities," added Asaf Bartfeld. "It will contribute to the continued growth of the group and consolidate our position in the international market," he said. Ithaca is engaged in energy exploration and production in the North Sea offshore the UK and has major experience as an oil and gas field operator. Israeli energy company Delek already has a 20 percent stake in Ithaca and is its largest minority shareholder. The shareholders of the remaining 80 percent are being asked to sell their shares to Delek for C\$1.95 per share, a 12 percent premium on the previous closing price. Ithaca Chairman Brad Hurtubise, said: "We are very pleased to announce the offer, which provides an attractive opportunity for all shareholders to secure a premium cash value for their investment following a sustained period of share price growth and at a favourable point in the company's evolution." Ithaca is an

independent whose shares are listed on the Toronto Stock Exchange and the Alternative Investment Market (AIM) in London.

EAGLE LNG Partners, the company with plans to develop liquefaction and export facilities on the banks of the St Johns River in Jacksonville, Florida, has formally filed its application with the US Federal Energy Regulatory Commission. The planned venture will have three small-scale liquefaction Trains and at full build-out and will be capable of producing up to 1.65 million gallons of LNG per day, or about 1 million tonnes per annum.

Eagle LNG aims to transport the fuel to markets in the Caribbean and Latin America for power generation. It will also be delivered to local and regional markets, including marine bunkering and high horsepower applications for domestic consumption. "The dramatic growth of natural gas supply in the United States has created abundant and affordable natural gas reserves that make LNG a competitively priced fuel alternative to diesel and heavy fuel oil. In

addition, natural gas fuel has significant environmental benefits, reducing air pollution and carbon emissions," said Dick Brown, company Chief Executive. "If Eagle LNG receives permission from FERC to begin construction by the first quarter of 2018, we anticipate completion of the Project in 2019," added Brown. The Florida company noted that many Caribbean countries currently rely on petroleum to supply a large portion of their electricity needs. "This project supports their tremendous desire and interest to have a cleaner energy solution that provides a direct and reliable supply of LNG from a liquefaction source at predictable cost. LNG from this project also complements greater penetration of renewables in the region leading to an environmentally sustainable future," said Eagle LNG. "In addition, this project will help the maritime industry meet this major transition to stricter emissions levels by producing high-quality LNG for use in marine bunkering," added the US company. The Marine Environment Protection Committee at the London-based International Maritime

Organization confirmed in 2016 that a global 0.5 percent cap on sulphur content in marine fuel will come into force in 2020.

EGYPT has held a signing ceremony for the chief executives of Italian energy company Eni and UK major BP with the Egyptian government in Cairo to complete the sale of a 10 percent stake to BP for around \$500 million in the "supergiant" Zohr field that will impact regional LNG trading when it comes on stream in late 2017. The ceremony included Eni CEO Claudio Descalzi, his BP counterpart Bob Dudley, Egyptian Prime Minister Sherif Ismail and Minister of Petroleum Tarek El Molla. It involved the signing of a deed giving BP its share in the Zohr field, part of the Shorouk licence concession, following an initial agreement made in November 2016. Eni currently holds a 90 percent stake in the licence, though Russian oil company Rosneft has agreed to acquire 30 percent of Eni's licence shareholding, subject to the Egyptian governmental approval. The Zohr field when it comes on



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stream in late 2017 will affect regional LNG markets, especially for main player Egypt which was once an exporter and now imports LNG cargoes. Egypt has two Floating Storage and Regasification Units deployed at the port of Ain Sokhna in the Gulf of Suez to import cargoes and satisfy natural gas demand. During 2016, Egypt took delivery of almost 100 LNG cargoes from the spot and short-term market and it recently announced the result of a tender to buy a further 45 cargoes in the months ahead. The Zohr field was discovered by Eni in August 2015 and is the largest offshore natural gas field in the East Mediterranean, with minimum resources in place of 30 trillion cubic feet and potentially much more. Eni said it also confirmed to the Egyptian government that the Zohr field would start production before the end of this year. "Claudio Descalzi has been received by President Abdel Fattah el-Sisi. The meeting follows the one held in January during which Eni's CEO confirmed that the development of Zohr is progressing very quickly, having been fast-tracked, and that the start of production is confirmed for 2017, just two year after the discovery was made," Eni said. In Egypt, Eni and BP are also partners in the Nooros field, discovered in July 2015 in the Nile Delta and which is already producing about 25 million standard cubic metres per day. They are also awaiting the coming on stream of the Baltim SW field discovered in Egypt in June 2016. The start-up of Baltim SW is expected in 2019.

EGYPTIAN Petroleum Minister Tarek El-Molla said the country was paying less than the global price for shipments of liquefied

natural gas received in recent months from worldwide suppliers and has been extended better payment terms for future cargoes. The minister made the points

after confirming that the nation had signed a \$1 billion contract with three international companies to import 45 cargoes of LNG. El-Molla said state-

owned Egyptian Natural Gas Holding Co. (Egas) had signed its short-term supply accords with Russian company Rosneft, France's Engie and an affiliate of the



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national energy company of Oman. The cargoes booked vary in range from 138,000 cubic metres capacity and 156,000 cubic metres capacity "Egypt will

also have a grace period of six months to pay for the shipments," the minister said. He explained that in its tender the payment period in which suppliers can

expect to get settled in US dollars was extended from 90 days after the date of delivery to between 120 and 180 days, reflecting Egypt's tight currency reserves.

The cargoes will be delivered to either of the two floating import facilities based at the Egyptian Gulf of Suez port of Ain Sokhna. The Egyptians began importing

LNG in April 2015 to satisfy natural gas consumption demand, which increased by an annual average of 7 percent over the previous 10 years. One of the FSRUs at Ain Sokhna is under a five-year charter from Hoegh LNG of Norway and the other import facility was supplied by Singapore-based BW Gas. While confirming its latest LNG cargo tender numbers and terms, Egypt is also counting on the fast-track development by Italian energy company Eni of the Zohr natural gas field offshore the East Mediterranean coast with confirmed resources in place of 30 trillion cubic feet.

ENAGAS, the Spanish natural gas transmission network operator and LNG terminal owner, posted a small increase in annual net profits as the nation's demand rose for a second consecutive year and more winter LNG cargoes were imported. Enagas said profits for 2016 came in at 417.2 million euros (\$443 million), which represents an increase of 1.1 compared with the previous year. The Madrid-based company has four fully owned LNG regasification terminals in Barcelona, Cartagena, Huelva and Gijon. It also has 50 percent of the Bahía Bizkaia Gas (BBG) plant in Bilbao and 72.5 percent of the Saggas terminal in Sagunto. All of them have the necessary technology for the unloading and reloading of carriers, which allows the company to reinforce the supply structure in Spain. "So far in 2017, national demand for natural gas has grown 20 percent compared



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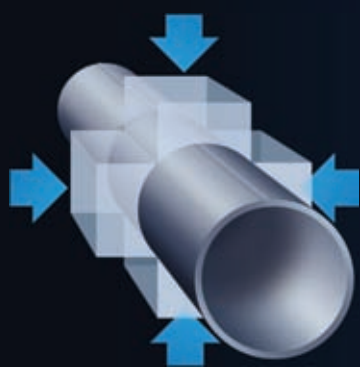
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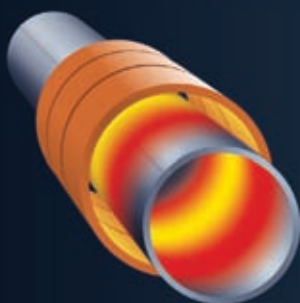
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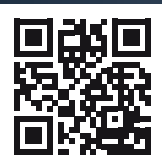
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to the same period in 2016 due to the effect, among others, of the cold wave. On January 19, gas demand reached a record figure last recorded in February 2012, which was exceeded by meeting all demand due to the role of underground storage and regasification plants," said Enagas. The network operator said demand for natural gas for gas-fired electricity generation so far in 2017 is up by 32 percent, which "highlights the fundamental role that natural gas plays" in guaranteeing power supplies. Spanish demand for natural gas in 2016 grew by 2.1 percent compared with 2015, reaching 321,495 gigawatt hours, representing a second successive annual increase. "This growth was mainly driven by industrial demand - the main consumer of natural gas - which rose 3.3 percent, in line with the evolution of the economy, and the growth in domestic demand, which increased by 3.2 percent," Enagas said. Over the next three years, the company forecasts gas demand in Spain growing at around 3.5 percent a year, mainly due to the improvement of the economy and a greater penetration of gas in the energy mix. Spanish LNG imports in December rose by more than 60 percent compared with the same month a year ago to a total of 25 cargoes. The majority of imports came from Nigeria and Peru, followed by volumes from Algeria, Qatar, Angola and Norway. During last year Enagas said it invested 912 million euros (\$969M) in current operating assets. At the end of 2016, Enagas's net financial debt amounted to 5.08 billion euros and financial availability was 2.40Bln euros. More than 80 percent of the Enagas debt was at a fixed rate and the average net cost of debt stood at 2.4 percent compared with 2.7 percent in 2015. Enagas also published an outlook for 2017 to 2020 when it pledged to consolidate its positions in regions where it is already present, reinforcing operational efficiency, maintaining a solid financial position. "Over the next few years, the operating environment is expected to be characterized by the transition, led by Europe, to a low-carbon energy model, in which gas will play a fundamental role as a low-emission fuel," said Enagas. "In this context, Enagas will be able to play an important role for the security of supply in Europe and for the integration of markets, being present in the main developments of gas infrastructure and projects to encourage new uses of natural gas," it added. In other growing markets in which the company is already present,

Enagas said it would continue to promote the development of gas and LNG infrastructure and markets and intended to invest at least 1.45 billion euros during the next three years.

ENGIE, the French energy company has taken delivery of a joint venture bunkering vessel to be based at the Zeebrugge liquefied natural gas import terminal in Belgium to lead the development of the LNG fuel market for shipping. The vessel called "Engie Zeebrugge" is owned by the France-Japan bunkering venture set up in 2016 and which also has the Japanese trading house Mitsubishi Corp. and Japan's NYK Line shipping company as shareholders. The LNG bunkering ship was built at the Hanjin Heavy Industries and Construction Company shipyard in the port of Busan in South Korea. "She will run on LNG for her maiden voyage, after a few days of loading LNG delivered by trucks at the shipyard," the owners said. Engie, Mitsubishi and NYK have set up a marketing company called Gas4Sea to develop the LNG fuel market in northwest Europe and elsewhere. The 5,000 cubic metres capacity "Engie Zeebrugge" will use Zeebrugge in Belgium as its home port and operations will also involve the LNG terminal owner, Fluxys of Belgium. Two LNG-fueled ferries operated by United European Car Carriers will be the first customers of the Zeebrugge bunkering ship. The vessel will take on LNG at the Zeebrugge terminal where carriers deliver shipments from Qatar and elsewhere and where docking is also provided for small-scale tankers supplying the regional market on a break-bulk basis. "Under the Gas4Sea brand, the three partners intend to support the development of LNG as a marine fuel, thus contributing to an environmentally friendly maritime industry," the companies added. "As international regulations on emissions for ships tighten, LNG is expected to become an important alternative fuel," they said. "Currently, the bunker market amounts to approximately 250 million tons of heavy fuel oil per year. The challenge in making LNG grow in the bunker market is to develop sufficient supply infrastructure to support the increasing number of LNG-fueled ships that are expected to come into operation," the companies stated.

EXCELERATE Energy, the US developer of LNG terminals, said it signed

a letter of intent with Daewoo Shipbuilding and Marine Engineering of South Korea for the delivery of up to seven floating storage and regasification units (FSRUs), depending on future market demand. Under the accord, Excelebrate has taken the option to order one FSRU in the second quarter of 2017. "Excelebrate is looking to be able to respond to the market demand for natural gas as its existing fleet of nine FSRUs become committed to long-term projects," a statement said. The initial specifications are for 173,400 cubic metres of capacity for the FSRUs with equivalent baseload send-outs. The US company last helped organize an FSRU for the first import project in Pakistan and has vessels scheduled for deployment in Bangladesh and Puerto Rico. Excelebrate's agreement for the Bangladesh terminal will see it set up infrastructure at Moheshkali Island in the Bay of Bengal. The International Finance Corporation, a lending institution of the World Bank, is taking an equity stake in that venture in return for financing. Excelebrate will deliver the Bangladesh FSRU on a build-own-operate-transfer basis. The vessel will

have storage capacity of 138,000 cubic metres and regasification capacity of 500 million standard cubic feet per day. The Bangladesh FSRU is expected to be ready to enable first imports of LNG in 2018.

FLUOR Corp., the US energy engineering and construction company, said it won a contract for the Canadian Woodfibre LNG export project being developed at Squamish, north of Vancouver. Fluor said it signed the deal with the US affiliate of Japanese LNG engineer JGC Corp. to provide construction-related support to the front-end engineering and design for the venture Planned for the site of a former pulp mill on the shores of Howe Sound in Squamish, Woodfibre is a mid-scale LNG facility with initial capacity of around 2.1 million tonnes per annum. The Woodfibre project is being developed by Indonesian billionaire Sukanto Tanoto and his Pacific Oil and Gas company. The scope of the contract will see Fluor provide construction planning and design services to support the FEED package and the development of the engineering, procurement and construction proposal. JGC and KBR of the US are taking part



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in a FEED package and pricing run-off to secure the full EPC contract. “With our industry-leading modular design and construction approach, Fluor will work closely with JGC to develop a project execution strategy that delivers capital efficiency and schedule certainty to Woodfibre LNG,” said Pierre Bechelany, senior vice president of pipelines and LNG for Fluor, whose headquarters are in Irving, Texas. “Leveraging JGC’s extensive LNG experience and Fluor’s project execution and construction expertise, we look forward to helping Woodfibre LNG advance this project for the community and British Columbia,” added Bechelany. The Woodfibre development in 2016 became the first LNG export project in Canada to receive its full environmental approval from the federal government in Ottawa under the new tougher legislation. It has now also taken a final investment decision to proceed. The liquefaction plant and infrastructure is on the traditional lands of the Squamish First Nation and they have been given some input on environmental issues and the cleanest

technology choices. Canada is still some way off building an LNG industry as most other projects are on hold as Canadian costs and conditions multiply at the same time as the economics of the industry have changed because of lower oil prices.

GASLOG Ltd, the shipping line based in Monaco with a fleet of 27 LNG carriers, said progress had been made with the plan for a liquefied natural gas import hub offshore the northern Greek city of Alexandroupolis to serve customers in both Greece and Bulgaria. The project company is called Gastrade and is Greek owned. It proposes to use a floating storage and regasification unit (FSRU) alongside onshore and offshore infrastructure. GasLog said it had now closed the sale and purchase agreement to acquire a 20 percent shareholding in Gastrade, which has received a licence to develop an independent natural gas system offshore Alexandroupolis, the capital of the Evros area in the northern Greek region of East Macedonia and Thrace. The northern Greek floating LNG and natural gas hub was first announced

as a viable joint venture involving GasLog in December 2016, though Gastrade, a company incorporated in Greece, has been involved in the development of this FSRU project over a number of years. The front-end engineering and design study is expected to be part-funded by a European Union grant, and is scheduled to commence in the first half of 2017. It has been assigned the status of an EU Project of Common Interest (PCI) and designated as a priority EU energy infrastructure project. Gastrade said it was currently in discussions with a number of additional potential investors, including DEPA, the Greek state-owned gas company, and Bulgarian Energy Holding, owned by the Bulgarian Ministry of Energy. “Other large-scale international companies have expressed an intention to participate in the ownership and development of the terminal,” said GasLog. “A number of companies have also expressed interest in supplying LNG to the project,” it added. “This FSRU project would provide a new route and a vital source of gas diversification to a number of countries that are currently highly dependent on pipeline gas in South East and Central Europe,” said GasLog, which is also Greek owned under Chairman Peter Livanos. “As well as enhancing security of supply in the region, it will promote competition and pricing flexibility. The project has the backing of the Greek and the Bulgarian Governments as well as the EU,” added GasLog. Gastrade has said it was hoping to take final investment decision of the Greece-Bulgaria LNG hub by the end of 2017, with the project scheduled to be operational by the end of 2019.

GAS NATURAL Fenosa, the Spanish utility and natural gas and LNG player with multinational interests, said it acquired two new LNG carriers at a cost of \$450 million in the fourth quarter as its overall profits declined and one of its businesses was seized in Colombia in a dispute over debts. “These LNG tankers will improve the competitive position of Gas Natural Fenosa in the LNG international market,” said the company, which now has nine LNG vessels in its fleet. GNF reported a net profit of 1.34 billion euros (\$1.43Bln) in 2016, a 10.3 percent decline on the figure for 2015. The result is in line with company expectations for the multinational businesses it runs, mainly in Europe and South America, and including LNG trading interests as well as liquefaction stakes in Egypt and Oman. GNF is based

in Barcelona and operates in more than 30 countries and has over 23 million utility customers. Earnings from GNF’s infrastructure business, which includes the operation of the Maghreb-Europe gas pipeline, LNG and hydrocarbon production and storage, rose to 298M euros in 2016, up 1.7 percent. This was due largely to the 3 percent increase in the international transport tariff on the Maghreb-Europe pipeline. “Earnings from global gas supply and wholesale marketing activity amounted to 547M euros, a reduction of 30.6 percent, and in line with the energy price adjustment trend,” GNF said. Its fourth-quarter earnings contained details of problems it has been facing in Colombia where that country’s Superintendent of Domestic Public Utilities ordered the seizure of the goods, assets and businesses of Electricaribe, the country’s electricity company controlled by GNF. The Spanish company said that as a result of the seizure it “has no significant control or power of influence over Electricaribe” and it no longer figures on its balance sheet. “Consequently, its assets, liabilities and non-controlling interests have been decommissioned to the net amount of 475M euros,” said GNF. GNF had informed the Colombian authorities earlier in 2016 that it was troubled by the debt accumulations at Electricaribe, where the Spanish company has an 85 percent stake. It said that by September 2016 the debt accumulated by defaulting costumers had amounted to 1.2Bln euros. Electricaribe was acquired by Union Fenosa in 2000 and was later added to the merged GNF in 2009. GNF’s international activities account for 45 percent of earnings and the Spanish business contributes 55 percent. The report showed that gross earnings for the year amounted to 4.97Bln euros, a decrease of 5.6 percent compared with 2015 after its liquefied petroleum gas business in Chile was discontinued. GNF said its performance was affected by “a very demanding macroeconomic and energy climate” in addition to the depreciation of Latin American currencies against the euro. “Despite this difficult scenario, GNF’s results reflect a sound business model,” the company said. Details showed how the main divisions contributed to total sales. The natural gas distribution businesses contributed almost 35 percent to earnings and electricity sales accounted for a further 27 percent. Its electricity generating and marketing units made up almost 20



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percent of sales and natural gas supply and marketing contributed 17 percent. GNF also has interests and capacity in regasification and import terminals such as Sagunto and Reganosa in Spain, Montoir-de-Bretagne in France and the Puerto Rico LNG importer Ecoelectrica. The Barcelona company remains Spain's biggest LNG player, along with the network and LNG terminal operator Enagas.

GAS NATURAL Fenosa has used a jetty-side truck to fuel a ferry with liquefied natural gas at the Port of Barcelona for the first time. The vessel that received the LNG was the “Abel Matutes” for its regular voyage between Barcelona and Palma in Majorca. The “Abel Matutes” is owned by the ferry company Baleària, part of Eurolineas Maritimas, and carries 850 passengers and around 250 vehicles. Gas Natural Fenosa said the LNG fueling operation was part of a contract with Baleària to supply the fuel using the truck-to-ship (TTS) direct transfer method. “This is the first such operation to be carried out in the Port of Barcelona, within the Air Quality Improvement Plan promoted since 2016,” GNF said. GNF said the first fuel load was part of a testing process and the dual-fuel ferry is then expected to start operating with its auxiliary natural gas engine, reducing emissions during port manoeuvres for its daily sailings to and from Majorca. “With this joint project with Baleària, and in close collaboration with the Port of Barcelona, GNF continues to promote the use of natural gas as an alternative fuel for the transport of people and goods, helping to improve air quality and replacing more pollutant fuels,” said Daniel López Jorda, general director of the GNF Retail

Business. GNF is a leading LNG operator in Europe and overseas. It has liquefaction project stakes in Egypt and Oman and import terminal capacity at

several facilities in Spain such as Barcelona, Sagunto and Mugardos. It additionally operates a small fleet of LNG carriers to deliver the fuel and manages

pipeline assets such as the Maghreb-Europe Gas Pipeline. Adolfo Utor, the President of ferry operator Baleària, said the fueling operation was the first

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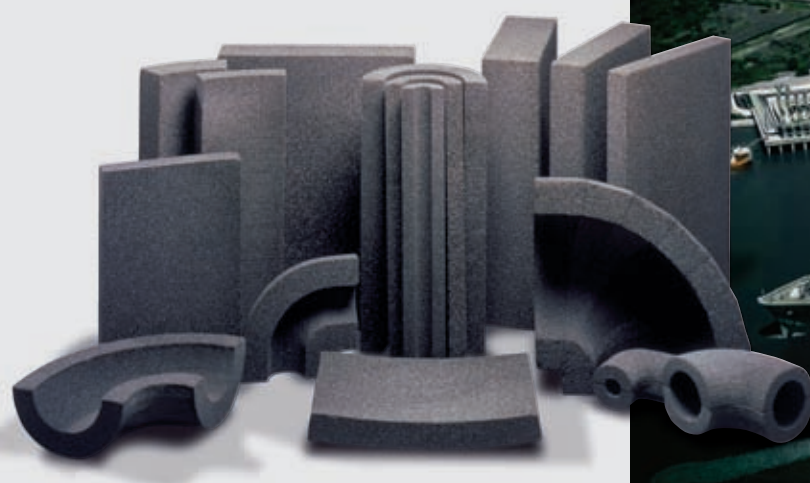
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effective step in showing its commitment to the use of LNG. “This makes Baleària the pioneer shipping company in the use of LNG in Spain,” added Utor. The 29,670-

tonne ship was delivered in 2010 from the Hijos de J Barreras shipyard in Vigo, Spain. It had its Bergen auxiliary engine for LNG fuel use fitted under a contract

with Rolls-Royce signed in 2015. Baleària is Spain's leading ferry company with a fleet of 20 vessels operating between the Iberian peninsula, the Balearic Islands,

the Strait of Gibraltar and the Bahamas, and is committed to developing LNG as a marine fuel because of the requirements for expanding Emission Control Areas.



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GREEN DRAGON Gas Ltd., one of the largest independent companies involved in Chinese production and sale of coal-seam gas, which is used to make LNG in Australia, is listed on the London Stock Exchange and is now considering listing its shares in China itself. Green Dragon made the statement as it issued its annual results showing that CSG sales increased by 5.6 percent to 3.41 billion cubic feet compared with 3.23 Bcf in 2015. Randeep S. Grewal, Chairman and founder of Green Dragon, said that 2016 had been a year of significant operational progress. The Chairman said that Green Dragon had taken “huge comfort” from the Chinese government’s 13th Five-Year plan that “specifically identified our joint projects” with China Nation Petroleum Corp, China National Offshore Oil Corp. and PetroChina respectively as priority CSG projects. The long-term potential of CSG was demonstrated in the state of Queensland when three CSG-to-LNG plants were built on Curtis Island to export LNG to Asia, including China. Higher CSG production in China would provide regional competition to LNG sales volumes and imports. Green Dragon said that this “explicit support” was invaluable and makes possible Chinese yuan debt financing with financial institutions in China seeking opportunities aligned with longer term government policy. “With this increased domestic interest, the Board has



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decided to evaluate the merits of a Dual Listing to potentially access the Chinese financial markets where the prospects in Chinese CSG energy investment have broader appeal and understanding,” the company said. The company said it was in discussions with a range of Chinese financial institutions with regard to both re-financing its US debt with Chinese debt and on raising additional growth funding. “The Board will come to a decision on the merits of a dual listing in the first half of 2017,” it said in regard to a possible listing in Shanghai or Hong Kong. “While we do not expect to issue any new shares, we hope this will help narrow the discount to our asset value and deliver increased value to all shareholders,” it added. “The compression enhancements made to the gathering system infrastructure have borne fruit during the year in terms of increased sales volumes from existing wells,” said Green Dragon. The LSE-listed company, whose ticker is GDG, said its operational targets in 2017 included executing agreements with CNOOC and in the second half of the year to commence

initial gas sales from one of its blocks in the southwest Chinese province of Guizhou.

GTT, the French maritime storage tank technology company, said it received an order with three options from Samsung Heavy Industries of South Korea to equip a floating storage and regasification unit being built for Norwegian shipping line Hoegh LNG. GTT said this new order from SHI and Hoegh is for the Mark III membrane containment system. Each vessel, which could eventually number a total of four, will have a storage capacity of 170,000 cubic metres and a regasification capacity of 750 million standard cubic feet per day of send-out. Delivery of the first vessel from the South Korean shipyard is scheduled for May 2019. “We are very satisfied that our systems have become the standard in this offshore gas industry segment. GTT benefits from a renowned expertise in this market and the company is quite confident in its capability to meet new challenges,” stated Philippe Berterottiere, Chairman and Chief Executive of GTT.

The company said that competitive advantages offered by GTT technologies were included in capital expenditure and operating expenses. GTT added that the optimization of LNG storage capacity has allowed GTT to gain a strong position on this offshore LNG FSRU segment. “Currently, six regasification vessels, built by SHI and equipped with the GTT technologies, are in service and two are on order,” said the French company. GTT recently received an order from another South Korean yard, Hyundai Heavy Industries, to equip an additional Hoegh FSRU newbuild with the same Mark III LNG tank containment system. That Hoegh FSRU will be built at Hyundai's shipyard in Ulsan with 170,000 cubic metres of capacity and a delivery date in 2018. GTT regards the Mark III as a proven solution for new projects that require greater resistance to liquid motion, particularly for multigas applications or partially filled tanks in vessels such as FSRUs.

HOEGH LNG said it was working with four major energy companies,

including Qatar Petroleum and ExxonMobil, for a floating import project planned for Pakistan in collaboration with Pakistani company Global Energy Infrastructure Ltd. The consortium, which also includes France's Total and Mitsubishi Corp. of Japan, are developing a project that includes a floating storage and regasification unit, a jetty and a pipeline to shore. “The FSRU will have a minimum regasification capacity of 750 million cubic feet per day by 2018,” said Hoegh. Saad Sherida Al-Kaabi, President and Chief Executive of Qatar Petroleum, said the consortium brings together partners with a “proven track record” of performance. “Forming this consortium with Total, Mitsubishi, ExxonMobil and Hoegh LNG represents a significant milestone that complements Pakistan's successful effort to meet the growing demand for clean-burning natural gas in this important market,” said Al-Kaabi. “Qatar Petroleum is proud to partner with these distinguished companies to help meet Pakistan's energy needs,” he added. Pakistan has a large demand for natural gas and a well-established gas



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market and distribution system. It already has one LNG import facility in operation at Port Qasim, east of Karachi and at least one other being planned. “This project has the potential to deliver substantial, reliable natural gas supplies to the public and private sectors in Pakistan. The FSRU has been committed with Hoegh and the consortium is promptly advancing through the necessary technical and commercial milestones,” the companies said. The GEIL company, registered in Pakistan, in December 2016 signed a firm 20-year charter agreement with Hoegh for the FSRU.

INPEX Corp., the Japanese developer of the US\$37 billion Ichthys LNG project in the Northern Territory of Australia, posted a plunge in earnings as it sought to keep the Australian joint venture on schedule to begin LNG production before the end of 2017. Inpex said net income for the first nine months of the fiscal year was 47.9 billion yen (\$421.7M) compared with 67.4Bln yen in the corresponding period of 2015, a drop of almost 29 percent. Net sales of natural gas, oil and other products were down by almost 23 percent in the nine months to 623.4 billion yen (\$5.48Bln) versus 809Bln yen in the 2015 period. Inpex’s sales values for natural gas in the period plunged more than 30 percent to 164Bln yen from 238Bln yen in the 2015 period, though volumes were little changed. The Japanese company stated that the Ichthys LNG project still remained on track despite the problems related to a contract cancellation. Australian contractor Cimic, previously called Leighton Holdings, in January 2017 pulled a newly acquired company out of finishing work on a power station next to

the Ichthys LNG plant. Inpex is developing the Ichthys joint venture with French energy company Total as its main partner. Cimic recently completed a hostile takeover of the UGL construction company and one of its first steps was the cancellation of the Ichthys power contract for its new subsidiary. JKC, a consortium of Japanese engineering groups JGC and Chiyoda and US engineering group KBR, estimates work on the power plant is 89 percent complete. JKC previously said it was still assessing the situation and considering options to complete the power plant but wouldn’t comment on how the collapse of the sub-contract would affect other work at the Bladin Point site near Darwin where the liquefaction plant is also being constructed. Inpex reiterated it was still aiming for the September quarter to begin LNG production at Bladin Point, where liquefaction and LNG export facilities were estimated to be more than 95 percent complete. The Japanese company previously re-scheduled the start-up to between July and September 2017 instead of the previously scheduled date of December 2016. It also increased LNG production capacity by 6 percent to 8.9 million tonnes per annum from the original 8.4 MTPA. Ichthys has long-term contracts to supply LNG shipments to the Japanese utilities Tokyo Gas, Osaka Gas, Kansai Electric Power, Toho Gas and Jera Co. Inc., the joint procurement venture between Tokyo Electric Power and Chubu Electric.

JAPANESE energy companies are now focusing on the total of 60 million tonnes of LNG volumes becoming available on the Gulf Coast and Atlantic Coast of the US from 2020, with many of the cargoes pointing at Japan. “American LNG will

contribute to diversification of procurement LNG pricings,” according to a new report from Tetsuo Morikawa, a senior economist at the Institute for Energy Economics in Japan. “The first shipments of US LNG from the Lower 48 arrived in Japan in January,” the report noted. “The spot LNG price, which jumped to the mid-\$9 range per million British thermal units in mid-January, came down to around \$8 in the latter half of the month,” the report said. “This was due to the passing of peak winter spot procurement and the restart of Gorgon LNG Train 1. As there is still an oversupply of LNG, the spot price could tumble in the coming months,” said Morikawa, while looking at the oil market to which long-term LNG contracts are linked. “Since the start of 2017, the oil market is focusing on how well OPEC and non-OPEC countries observe the production cut agreed last year,” he said. “The compliance rate with the agreement is estimated at 80 percent so far, which is relatively high. Accordingly, Saudi Energy Minister Khalid al-Falih projected that supply and demand will rebalance by the time of the OPEC meeting in May,” he added. “Another focus is the growth in American oil output as a result of the rise in oil prices,” the report said. “US output was 8.81 million barrels per day in November 2016, up 230,000 barrels/day month-on-month. The number of operating rigs has been rising since May 2016, and shale oil productivity continues to improve. The oil futures market is seeing an increase in short position by commercial traders, which could indicate a rise in price hedging by producers for a production increase. Though there are not yet signs of a rapid output recovery, American oil output has surely bottomed out,” he said. “This year, oil prices are

likely to be affected not only by the supply-demand fundamentals including the OPEC and non-OPEC production cut and the increase in American oil output, but also significantly by non-fundamentals including US interest rate hikes, sustainability of the ‘rump market’, the French presidential election, the German general election and geopolitical risks in the Middle East,” Morikawa stated.

JORDAN COVE LNG, the Canadian-run export project for the US northwest state of Oregon, has been given permission by the US Federal Energy Regulatory Commission to file a new application with an amended design that is expected to improve its chances of being approved. The new filing with the FERC followed project design changes by the developer, Veresen Inc., based in Calgary, Alberta, to improve the overall plans. “Through feedback from stakeholders and extensive engineering work, we have designed a more efficient facility that does not require a power plant, and will reduce overall environmental impacts,” Veresen said. Jordan Cove has now formally removed its proposal to construct a 420-megawatt power plant adjacent to the facility planned for Coos Bay. Veresen said that removing the power plant from the plan results in a facility that can be more efficiently and effectively operated with a smaller infrastructure footprint. The Canadian company has Elizabeth Spomer as President and Chief Executive of the Jordan Cove LNG project and the affiliated Pacific Connector Gas Pipeline. Spomer is a former senior LNG executive at BG Group of the UK who retired from the company before it was taken over by Royal Dutch Shell. The FERC letter

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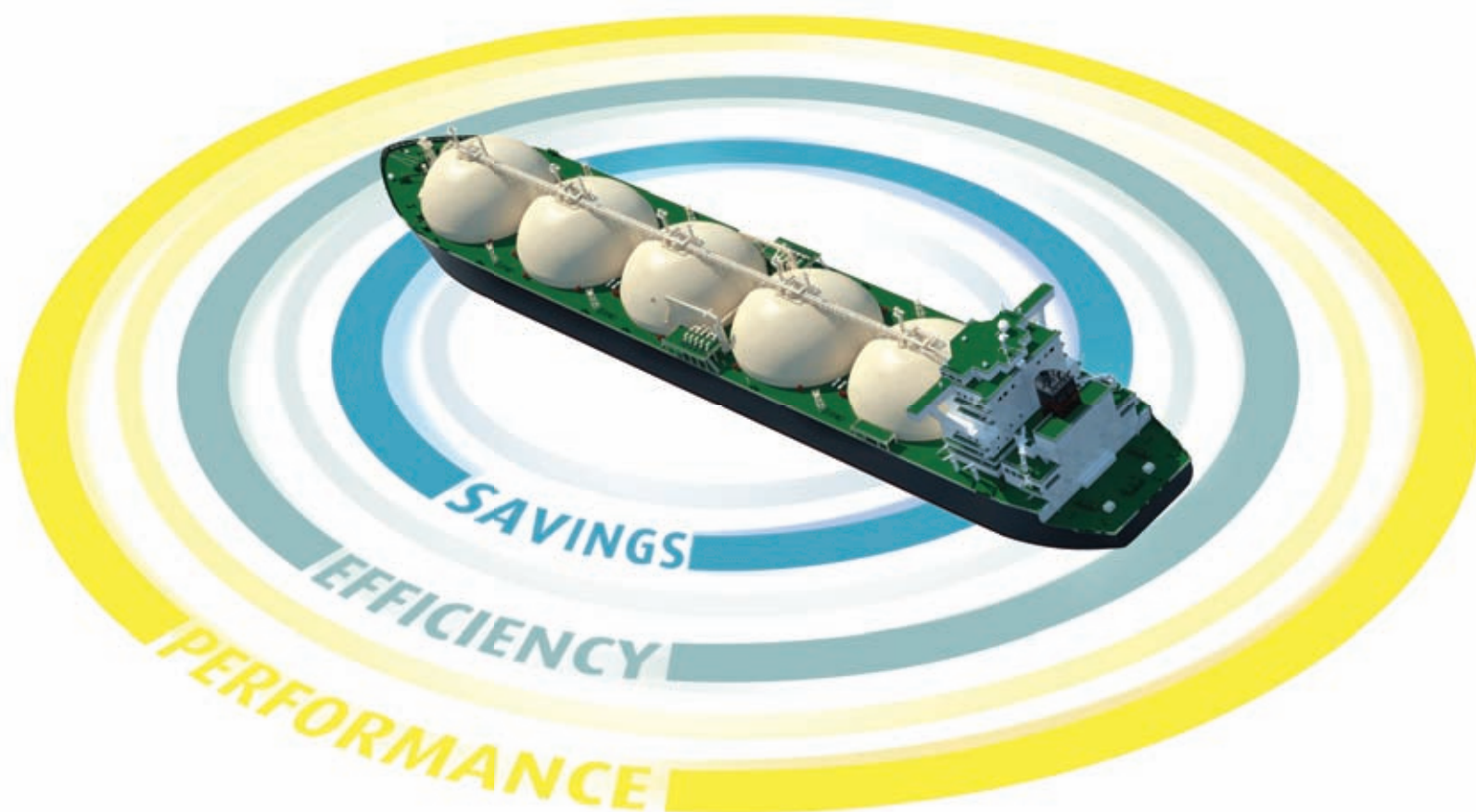
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confirming the re-launch of the project was sent as a reply to Spomer's notification of re-filing. "As stated in your letter, Jordan Cove intends to construct

and operate an LNG export terminal at Coos Bay, Oregon," said the FERC in outlining the revised plans for Jordan Cove. "The terminal would consist of a

gas processing plant, liquefying equipment, two storage tanks, a transfer line, loading platform, marine berth and access channel," the FERC noted. Jordan

Cove will also have a planned capacity to liquefy about 7.8 million tonnes per annum of LNG, an increase from the previous 6 MTPA, "for export to markets

across the Pacific Rim," according to the details revealed by FERC. The US regulators had initially rejected the project in early 2016 citing a "lack of market support" as it had failed to sign any capacity agreements. It subsequently did so. In March 2016 it signed a deal with Japan's JERA Co. Inc., a joint venture between Tokyo Electric Power Co and Chubu Electric, Japan's two largest importers of LNG cargoes. It then signed a preliminary 20-year accord in April 2016 with the Japanese trading house Itochu Corp. The two Japanese agreements give the Jordan Cove venture additional fire power for the approval process in addition to the revised design plans. Jordan Cove's affiliated Pacific Connector project also plans to construct and operate a 233-mile pipeline. "It would originate at interconnections with the existing systems of the Ruby Pipeline and Gas Transmission Northwest near Malin, Oregon, and end at Jordan Cove's terminal at Coos Bay," the FERC noted. "The pipeline would be capable of transporting about 1.2 billion cubic feet per day of natural gas," it added. Associated with the pipeline would be the new Klamath Compressor Station (41,000 horsepower) at the eastern starting point near the town of Malin, along with metering facilities. "Your letter also stated that Jordan Cove and Pacific Connector intends to file their applications on or about August 30, 2017. When Jordan Cove and



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Pacific Connector files their applications with the Commission, we will evaluate the progress made during the pre-filing process, based in part on your success in resolving the issues raised during scoping,” the FERC said. “Once we determine that the applications are ready for processing, we will establish a schedule for completion of the environmental document and for the issuance of all other federal authorizations,” the regulator added.

MONADELPHOUS Group, the Australian energy and LNG engineering company said it will partner with Jacobs Engineering Group Inc. of the US for a five-year upstream contract in Papua New Guinea for Oil Search Ltd, one of the partners in the PNG LNG plant and expansion project. Monadelphous and Jacobs have a contract for engineering, procurement and construction services on Oil Search’s oil and gas production facilities in the onshore Highlands region of PNG. Monadelphous, based in Perth, Western Australia, is an experienced player in the Australian

LNG industry build-out and has been most recently working on the Ichthys LNG project in the North Territory of Australia being developed by Japanese energy company Inpex and France’s total. The Australian company and Pasadena, California-based Jacobs said the value of the PNG contract was \$50 million. The Monadelphous-Jacobs joint venture will provide a wide range of brownfield project services from the second quarter of 2017, including EPC work on pipelines, utilities, the main facilities and supporting infrastructure. “The partnership, which combines Monadelphous’s in-field services expertise with the technical engineering capability Jacobs, will lead to productivity enhancements and cost savings for Oil Search,” a statement said. According to Monadelphous Managing Director Rob Velletri the contract builds on a decade-long relationship with Oil Search, having provided brownfield project and maintenance services since 2007. “The proposed contract represents a new chapter in our relationship with Oil Search, moving towards the

provision of end-to-end brownfield project delivery in the joint venture with Jacobs. It also reflects our position as a leading maintenance and brownfield project service provider in PNG with a strong safety record and local content strategy,” said Velletri. The work for Oil Search is linked to the continued upstream operations at PNG LNG, whose feed-gas resources will enable the addition of up to three more processing Trains to the current two Trains at the plant near Port Moresby. The shareholders in the existing PNG LNG plant, in addition to Oil Search, include operator ExxonMobil, Santos of Australia, JX Nippon Oil of Japan and the PNG Government. Additional resources for expansion of PNG LNG are held by France’s Total as well as Oil Search and ExxonMobil. The liquefaction expansion plans are being developed with resources from the Elk-Antelope field, one of the largest onshore resource discoveries in the Asia-Pacific region. Analysts say the proposals being discussed centre on adding new Trains at the Port Moresby plant rather than

constructing a new and separate facility. The existing PNG LNG project is a development that includes gas production and processing facilities in the Southern Highlands, Hela, Western, Gulf and Central provinces of PNG.

NAKILAT Shipping Qatar Ltd, a subsidiary of Qatar Gas Transport Co., has taken back a fifth ship as part of an agreement with Shell International Trading and Shipping to return management of Nakilat’s LNG fleet to Qatari hands. The latest transfer is part of the largest ever transition of LNG fleet operations. It involves 25 vessels which have so far delivered more than 320 million cubic metres of Qatar’s LNG to over 20 countries. Shell has provided a range of shipping services to Nakilat’s LNG fleet since it was established in 2006. The Anglo-Dutch company had provided ship management for 14 Q-Max and 11 Q-Flex LNG carriers as well as Shell’s shipping expertise. The fleet’s vessels comprise the 266,000 cubic metres capacity Q-Max carriers and the 210,000 cubic metres capacity

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Q-Flex ships. For the fifth hand-back Nakilat said it had assumed full ship management and operations of the Q-Max LNG carrier “Al Dafna” that Shell, as part of the planned and phased transition, first announced in October 2016. “With a cargo carrying capacity of 266,366 cubic meters, Al Dafna is wholly-owned by Nakilat and chartered by RasGas,” said Nakilat. “The vessel built in South Korea by Samsung Heavy Industries was delivered in October 2009 and has been in service ever since,” the Qatari company added. The vessels are being transitioned in three phases and will be managed by Nakilat’s in-house ship management arm. Nakilat said it had carried out “extensive studies and comprehensive preparations and planning” to ensure the successful management of these “essential assets” for Qatar’s gas supply chain. When the transfer accord was signed last October, Nakilat expressed its thanks to Shell for its professional management of the fleet over the previous eight years and was determined to uphold the same excellent standards for the vessels.

ORIGIN ENERGY, the Australian energy company undergoing a restructuring to adapt to the industry downturn, said it was taking an impairment charge mostly related to its main liquefied natural gas stake, the Australia Pacific LNG plant in Queensland, of around US\$1.45 billion. The charge will be formally announced with other earnings in its fiscal first-half financial statement to be released on February 16. Origin and LNG plant operator, the US major ConocoPhillips, each own 37.5 percent of the APLNG project and Chinese energy company Sinopec is also a shareholder, owning the remaining 25 percent. ConocoPhillips and Sinopec are expected to take similar write-downs based on their 5 stakes. During the last quarter, Origin noted an operational update that a total of 26 LNG cargoes were loaded and shipped from the APLNG facility on Curtis Island, near the port of Gladstone. The Australian upstream operator and producer of coal-seam gas, which also has utility interests, said most of the LNG cargoes were delivered to Sinopec and Japanese utility Kansai Electric, in accordance with their respective long-term Sales and Purchase Agreements. “Australia Pacific LNG (APLNG) has recognised an impairment charge on its

assets of which Origin expects to reflect its 37.5 percent share (A\$1.03 billion post tax) in the financial statement,” said the Sydney-based company. In addition, Origin said it expects to take hits on other investments, A\$578 million in the Browse Basin offshore northwest Australia and A\$285M for conventional exploration assets and an Italian operation called Energía Austral SpA, taking the total to A\$1.89 billion (US\$1.45Bln). Origin maintained in its gross earnings guidance that it had improved to the range of A\$2.45Bln to A\$2.61Bln for the fiscal 2017 financial year, subject to market conditions. “In determining the carrying value of its assets, APLNG considers a range of project and macro assumptions, including oil price, AUD-USD exchange rates, discount rates and costs,” Origin said. “The cumulative net effect of these has reduced the valuation over time but had not warranted a revision by APLNG of the carrying value of its assets until now,” the Australian company explained. “Since the last assessment at 30 June 2016, there has been a change in a number of relevant assumptions but principally an increase in US dollar interest rates,” the company added. “Origin’s valuation of its investment in APLNG is sensitive to changes in these assumptions which could impact the financial statements in the future,” Origin said. The impairment of the Browse Basin has been made following an assessment of the likely timing and potential commercialization of the resource. “Based on new information, Origin has formed the view that the Caldita-Barossa fields are now the lead prospects to be developed to backfill Darwin LNG and other commercialization alternatives are unlikely in the near term,” it explained, referring to new feed-gas resources for the Darwin LNG plant operated by ConocoPhillips in the Northern Territory. “Following a review of the carrying value of the assets to be included in the proposed Initial Public Offering of our conventional gas assets (announced in December 2016) an impairment of exploration assets that primarily offer low growth has been recognized,” Origin stated. After an extended sale process, the charge taken on Energía Austral, the project company of the proposed Cuervo hydroelectric plant in Chile’s Aysen region, reflected “the reduced prospects of an asset sale proceeding.”

POLAND has opened a trading office for liquefied natural gas in London's Mayfair as it aims to increase its presence in global LNG trading. The office was opened by Polish Gas and Oil Co. (PGNiG) and is expected to become fully operational by the end of the first quarter of 2017. The trading team is under the auspices of PGNiG Supply & Trading (PST), a subsidiary of the main Polish gas and power trading arm in Europe. "With this important step PGNiG goes global as a natural gas player," said Piotr Wozniak, President of the Management Board. "London is the European trade centre for this commodity. Our presence here will enable us to purchase natural gas for company purposes at more competitive prices. We will also be able to start LNG trading on global markets," said Wozniak. The Poles said they would increase their international presence with short-term and medium-term trading. They will also be sourcing alternative spot supplies for the LNG terminal in Swinoujscie, thus optimizing the booked capacity at the terminal. "Due to the increase in LNG supplies led by the US and Australia, we expect LNG to become commercially valuable for Europe," said Uwe Bode, managing director of PST. Poland's first LNG terminal at Swinoujscie on the Baltic coast received its first commercial cargo from Qatar about a year ago. The regasification terminal allows Poland to import about 3.7 million tonnes per annum of LNG, amounting to 30 percent of the country's natural gas needs, meaning 70 per cent will still have to be provided by pipelines from Russia.

The terminal project was started by Polskie LNG, established in 2007 by PGNiG. Ownership of the Swinoujscie terminal was then transferred to

national gas transmission network operator Gaz-System SA. The Polish terminal is the first onshore LNG import facility built in Eastern Europe,

including the former Soviet Union. The Baltic state of Lithuania has a floating import facility located in the port of Klaipeda, called the "Independence".

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SKANGAS, the Nordic liquefied natural gas market operator, has signed an agreement to supply LNG as back-up fuel for public transportation in the Finnish west coast city of Vaasa. Skangas, controlled by Finnish natural gas company Gasum, signed a contract with the Stormossen company, operator of a biogas fuel station in Vaasa. Stormossen has a contract to supply gas-fueled buses in Vaasa and also offers biogas for private cars. Skangas said it had signed a flexible LNG delivery contract, amounting to small volumes when needed, as a back-up for Stormossen's supply of biogas to their customers. The annual production of methane at the Stormossen biogas plant made from local waste corresponds to 1.5 million litres of diesel. To begin with, the gas will cover the needs of the city's 12 buses and approximately 1,000 private cars and LNG can be supplied as a back-up fuel. "The biogas is sustainable, local produced and neutral as to CO₂ emissions. It emits zero particles and close to zero NO_x (nitrogen oxide) compared to diesel and petrol," said Leif Akers, Managing Director of Stormossen. "Another advantage is that the Vaasa buses will move more

quietly than the old diesel buses," he said. "Choosing Skangas gives us the option for the steady supply of either liquefied natural gas or biogas as they have a reliable gas distribution chain outside the gas grid," explained Akers. "This is the first gas station but it will not be the last. We are aiming to increase the availability of gas as fuel in order to meet the market needs and public demands for a more sustainable and cleaner environment," he said. Tommy Mattila, Sales and Marketing Director at Skangas, said the gas fuel market was developing in all Nordic countries. "That Vaasa selected gas buses for public transportation serves as a perfect example," said Mattila. "We are happy to be able to contribute to the development supporting Stormossen with both liquefied natural or biogas, depending on customer needs," said Mattila. "From a larger perspective this is an example that natural gas plays an important role in the vehicle gas supply chain. The consequence is that natural gas will contribute in the future development of the biogas supply chain in the Nordic countries," he added.

SANTOS, the Australia LNG and energy company, with stakes in three Asia-Pacific LNG plants, posted an annual net loss of net loss of US\$1.04 billion, including a US\$1.1Bln asset write-down on its Gladstone coal-seam-gas-to-LNG plant it operates in the eastern state of Queensland. Adelaide-based Santos has the French company Total, Petronas of Malaysia and Korea Gas Corp. as its Gladstone LNG plant partners. Santos also has stakes in the ConocoPhillips-operated Darwin plant in the Northern Territory and the ExxonMobil-run Papua New Guinea LNG facility. The company said in its annual earnings statement that despite the losses "significant progress" was made on the Santos turnaround, including record production and sales volumes and a reduction in net debt to US\$3.5Bln. Santos had lost US\$1.95Bln in 2015. Amid the gloom LNG sales revenue in 2016 rose 27 percent to US\$887 compared with US\$696M in 2015 on additional liquefaction Trains coming on stream. Santos also reported an "excellent" PNG LNG operating performance with annual production logged in the fourth quarter at 8.3 million tonnes per annum compared

with the nameplate capacity of 6.9 MTPA. It stated that expansion of the PNG LNG plant was now likely and the project was currently evolving "In 2016, the Santos leadership team took tough and decisive action to stabilise the business and build the foundations for future growth," said Chief Executive Kevin Gallagher. "We restructured the business, removed substantial costs, all while maintaining safety and delivering record production and sales volumes," added Gallagher. Excluding impairments and other significant items, the company recorded an underlying profit of just US\$63 million. CEO Gallagher explained that the strategy remained one of transforming Santos into a low cost, reliable and high performance business. "At the heart of our strategy is portfolio simplification and focused growth across five core, long-life natural gas assets: Cooper Basin, GLNG, PNG, Northern Australia, and Western Australia Gas. Each asset has significant upside potential," the CEO stated. "We will continue to focus on the exploration, development, production and sale of natural gas, which has a significant role to play in securing Australia and Asia's energy future. Santos also has just

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SHELL is helping to advance the project to introduce the world's first liquefied natural-powered dredger to operate in the port of Rotterdam after signing a bunkering agreement. Shell subsidiary Shell Western LNG BV signed the accord with Dutch dredging company Van der Kamp to supply liquefied natural gas (LNG) as marine fuel to a new LNG-powered vessel. The new vessel, named "Ecodelta", is currently being built at the Dutch yard Barkmeijer. Shell said the dredger was expected to start operations in 2018 to keep Rotterdam's port basins at the right depth. "This will be one of the first LNG-powered dredgers in operation around the globe," the Anglo-Dutch company said. Shipping company Van der Kamp also specializes in anti-pollution operations and since 1980, it has had an agreement with the Dutch Government to combat oil pollution at sea. The company also carries beach replenishments. Van der Kamp said that distinguishing it from a conventional dredger, the newbuild "Ecodelta" operating with LNG fuel will also be equipped with two "sweeparms" to remove oil from the water surface, allowing it to quickly react to emergency response

situations. "This agreement shows the continued momentum of LNG as a fuel option," said Laurant Wetemans, Shell's General Manager Downstream LNG on

the accord to supply fuel to the Dutch vessel. "LNG is now an effective alternative to traditional fuels for ships around the world, and we are ready to

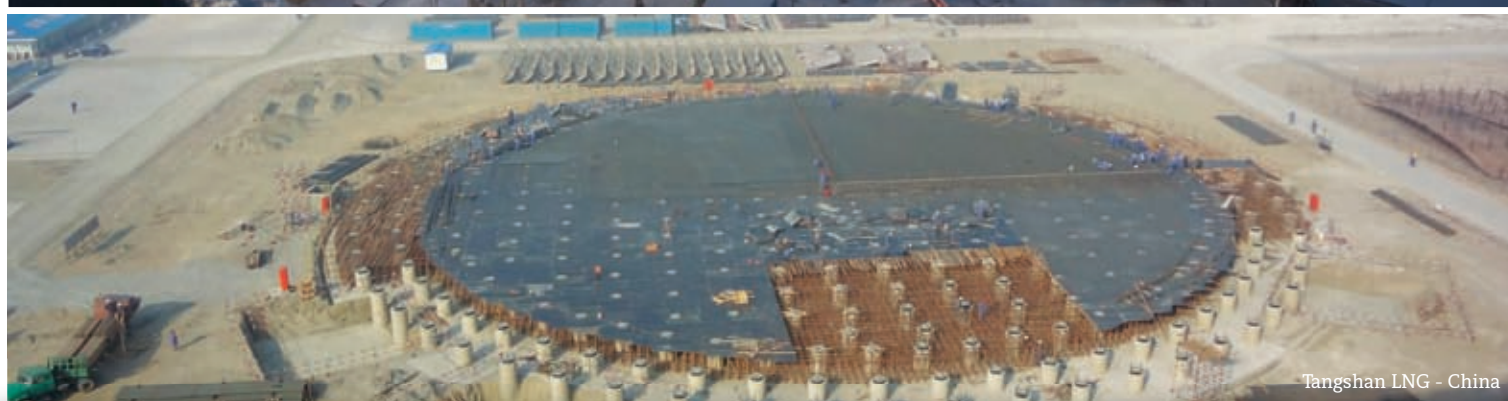
supply customers in northwest Europe. Working together in close collaboration with companies like Van der Kamp will help enable the move to a cleaner, more

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efficient shipping sector in the future,” said Wetemans. The planned 2018 debut of the LNG-fueled dredger will come as demand for LNG as a fuel in the shipping industry is increasing due to emissions reduction requirements. The recent International Maritime Organization decision for a global 0.5 percent sulphur cap in 2020 will help expand LNG demand for bunkering operations. Shell operates a break-bulk business at the Rotterdam Gate LNG regasification terminal to supply the region with small-scale shipments and has also contracted a specialized LNG bunker vessel to deliver to LNG-fueled ships in northwest Europe. The Anglo-Dutch major also owns Norwegian company Gasnor, which provides LNG fuel for ships and industrial customers in Norway and other Nordic countries.

SHELL sold more than 57 million tonnes of liquefied natural gas in 2016, though earnings from the volumes were lower and only partially offset by the start-up of the Gorgon LNG project in Australia as income from all of the Integrated Gas division dropped 27 percent to \$3.70 billion from \$5.05Bln in the previous year. The full-year LNG sales volumes were 57.11MT compared with 39.24MT in 2015, an increase of over 45 percent. LNG sales volumes in the fourth quarter amounted 15.34MT, 51 percent higher than for the same quarter a year ago, mainly reflecting Shell’s enlarged portfolio following the acquisition of BG Group. LNG liquefaction volumes for all of 2016 were 30.88MT, of which acquired BG assets contributed 8.56MT compared with 22.62MT in 2015. These LNG volumes included an increase associated with the Queensland Curtis LNG plant in Australia and Atlantic LNG in Trinidad

and Tobago. Shell’s main LNG operations are in its Integrated Gas division and excluding identified items, the earnings in the fourth quarter were \$907M compared with \$1.24Bln a year ago. Identified items were a net charge of \$879M, compared with a net charge of \$120M for the fourth quarter 2015. Shell said LNG earnings were impacted by added depreciation from the BG acquisition and lower prices were offset by higher volumes from the start-up of the Chevron-operated Gorgon project in Western Australia, where Shell is a shareholder. “Earnings were also impacted by higher taxation, and higher operating expenses, mainly due to the consolidation of BG. The impact of higher oil prices was more than offset by the decline in LNG prices. Earnings benefited from higher production volumes related to the contribution of BG assets, start-up of Gorgon and improved operational performance which more than offset the impact of the accounting reclassification of Woodside,” the report added. Shell’s overall earnings in the fourth quarter were \$1.03Bln compared with \$1.84Bln for the same quarter a year ago, a fall of 44 percent. Full year 2016 earnings attributable to shareholders were \$3.5Bln, down from \$3.8Bln in 2015. “We are reshaping Shell and delivered a good cash flow performance this quarter with over \$9 billion in cash flow from operations,” said Chief Executive Ben van Beurden. “Debt has been reduced and, for the second consecutive quarter, free cash flow more than covered our cash dividend,” he added. “Production and LNG volumes included delivery from new projects, with ramp-up continuing in 2017 and 2018. Meanwhile we are operating the company at an underlying cost level that is \$10 billion lower than

Shell and BG combined only 24 months ago,” the CEO stated. “We are gaining momentum on divestments, with some \$15Bln completed in 2016, announced, or in progress, and we are on track to complete our overall \$30Bln divestment programme as planned,” said Van Beurden. “Looking ahead, we will further focus the portfolio and strengthen the company’s financial framework in 2017. Our strategy is starting to pay off and in 2017 we will be investing around \$25 billion in high quality, resilient projects. I’m confident 2017 will be another year of progress for Shell to become a world-class investment,” he added. During the quarter, Shell noted that it was appointed by the Energy Market Authority of Singapore as one of the importers for the next tranche of LNG supply into Singapore, expected to commence from 2017. “Shell and another importer will each have exclusivity for three years to market up to 1 million tonnes of LNG per annum,” it added.

SWITZERLAND has hosted the publication of the Geneva-based International Standards body’s new ISO 20519 standard for ships and marine technology relating to bunkering of liquefied natural gas-powered vessels. The ISO said its requirements will help operators select vessel fuel providers that meet defined safety and fuel quality standards. According to a statement from the Swiss body, ISO 20519 contains requirements that are not covered by the IGC Code, the prevailing international code for the safe carriage by sea of liquefied gases in bulk. The working group for ISO 20519 included specialists from the maritime industry, equipment manufacturers, the Society for Gas as a Marine Fuel (SGMF),

trading companies, class societies, international registries and the US Coast Guard. ISO 20519 was produced at the request of the International Maritime Organization (IMO), the European Commission and the Baltic and International Maritime Council, the world’s largest international shipping association. “This sharing of knowledge was important to produce a standard that was both practical and would promote safety during LNG bunkering operations,” the ISO said. “In recent years, the ships and vessels fuelled with LNG have become larger, transit greater distances and may bunker in a greater number of ports in different countries,” the report said. “As a result, the number of parties involved in LNG bunkering is growing rapidly,” the ISO noted. “Standardizing safety practices had become necessary to ensure that, no matter where the bunkering took place, there would be a common set of requirements that were understood across the board - from LNG provider to ship personnel,” the ISO said. The ISO 20519 requirements include: liquid and vapour transfer systems, operational procedures, requirement for the LNG provider to provide an LNG bunker delivery note, training and qualifications of personnel involved and requirements for LNG facilities to meet applicable ISO standards and local codes. “The requirements of ISO 20519 can be incorporated as a management objective into existing management programmes and provide verifiable compliance,” explained Steve O’Malley, Chairman of the technical committee ISO-TC 8 and convener of the working group that developed the standard. “The requirement to comply with ISO standards is often incorporated into business contracts and may also



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be referenced by local regulations,” O’Malley added. The use of LNG as a vessel fuel is relatively new, so the standard is brought up to date periodically to incorporate lessons learned over time and technological changes. To facilitate this, a group was created to track LNG bunkering incidents and help identify when the standard should be updated.

TAMROTOR Marine Compressors, the Norway-based equipment supplier, was awarded a contract by Golar LNG to supply a compressed air system to the former conventional carrier “Hilli” being transformed into a floating liquefaction production hull in Singapore. The Hilli FLNG vessel will produce LNG when eventually deployed in a venture offshore the West African state of Cameroon. The conversion work on the “FLNG Hilli” is being carried out at the Keppel Shipyard in Singapore. The former carrier with Moss-type storage tanks was delivered in 1975 and was laid up by Golar before the market developed for FLNG production vessels. Compressor company TMC said the scope of its work on the “FLNG Hilli” project, the contract value of which is undisclosed, includes the manufacturing and delivery of seven 365 kilowatts (kW) “Smart Air” compressors to be installed on board. “Golar LNG’s life-of-field approach to the on-board compressed air system will enable them to significantly reduce both energy costs and harmful emissions,” said Per Kjellin, Managing Director of TMC. “This type of thinking contributes towards making offshore field developments even

more economically viable, so we are proud to be part of this project,” added Kjellin. The “FLNG Hilli” is scheduled to commence operations at the Kribi

field offshore Cameroon later in 2017. “The ‘FLNG Hilli’ is a big installation that requires major compressor power,” said the TMC CEO. “Although the vessel

will be located in benign, near-shore waters, it is still an offshore environment that places strict demands on operational uptime, especially given

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the project's ambitious production targets," added Kjellin. "Only compressors that are specially designed and built for marine applications can deliver the required reliability," he said. Golar LNG will provide liquefaction, storage, and off-loading services under a tolling agreement to Cameroon's state-owned oil and gas company Societe Nationale des Hydrocarbures and European energy company Perenco as upstream joint venture partners. "It is anticipated that the allocated reserves will be produced at a rate of 1.2 million tons of LNG per annum, over an approximate eight-year period," TMC noted.

TELLURIAN Inc., the developer of the US Driftwood LNG export project in Louisiana and founded by ex-Cheniere Energy Chief Executive Charif Souki and Martin Houston former head of LNG at the UK BG Group, completed a reverse takeover to gain a listing on the Nasdaq stock exchange. Tellurian had arranged the takeover of small

exploration and production company Magellan Petroleum Corp. and under the merger agreement its former CEO Antoine Lafargue becomes Chief Financial Officer of Tellurian. Another former Cheniere executive Meg Gentle remains Tellurian's President and CEO. "We look forward to creating value for our shareholders by delivering clean, low-cost, and reliable LNG to the global market," said Gentle. "We are developing large scale energy infrastructure on the US Gulf Coast, including the 26 million tonnes per annum Driftwood LNG facility in Calcasieu Parish, Louisiana, which is scheduled to begin construction in 2018," she added. "We expect our next major milestone to be filing our formal permit application with the Federal Energy Regulatory Commission for Driftwood LNG. We appreciate the local, state and federal support for this project and anticipate an efficient regulatory review of the application," Gentle stated. Before the completion of the reverse takeover and the gaining of the Nasdaq listing to enable the raising of additional

funds for Driftwood LNG and other planned ventures, Souki and Houston signed prominent industry players as stakeholders. French energy company Total acquired a substantial stake in Tellurian in December 2016. Total bought 23 percent of Tellurian after agreeing to pay \$5.85 per share for an investment amounting to \$207 million. General Electric's energy subsidiary GE Oil & Gas also in late 2016 acquired \$25M of preferred equity investment in Tellurian. Tellurian and the Driftwood LNG project were set in motion by Souki after he left Cheniere just before the Texas-based company's Sabine Pass LNG export plant in Louisiana came on stream in February 2016. Souki departed from Cheniere amid disagreements over remuneration and strategy with the new major investor in Cheniere, US billionaire and active investor Carl Icahn. The former Cheniere CEO Souki aims to replicate Sabine Pass with the Driftwood venture, currently in the engineering design and pre-filing phase of the permitting

process. Following the completion of the reverse takeover, Souki and Houston were confirmed as members of the board of the new Nasdaq-listed Tellurian Inc. along with CEO Gentle, Dillon J. Ferguson, Diana Derycz-Kessler, Brooke A. Peterson and Jean Jaylet. Other senior executives confirmed in their posts included R. Keith Teague as Executive Vice President and Chief Operating Officer, Daniel A. Belhumeur as General Counsel and Khaled Sharafeldin as Chief Accounting Officer, with Lafargue as CFO. The new Nasdaq ticker symbol for Tellurian is "TELL".

THE US Center for Liquefied Natural Gas, the trade association for LNG producers, shippers and terminal operators and developers, said the nation was now currently awash with natural gas and would have no problem meeting domestic needs as well as rising LNG exports. The CLNG statement came in the defence of the industry and in reaction to "unfounded comments" by a leading US environmental activist

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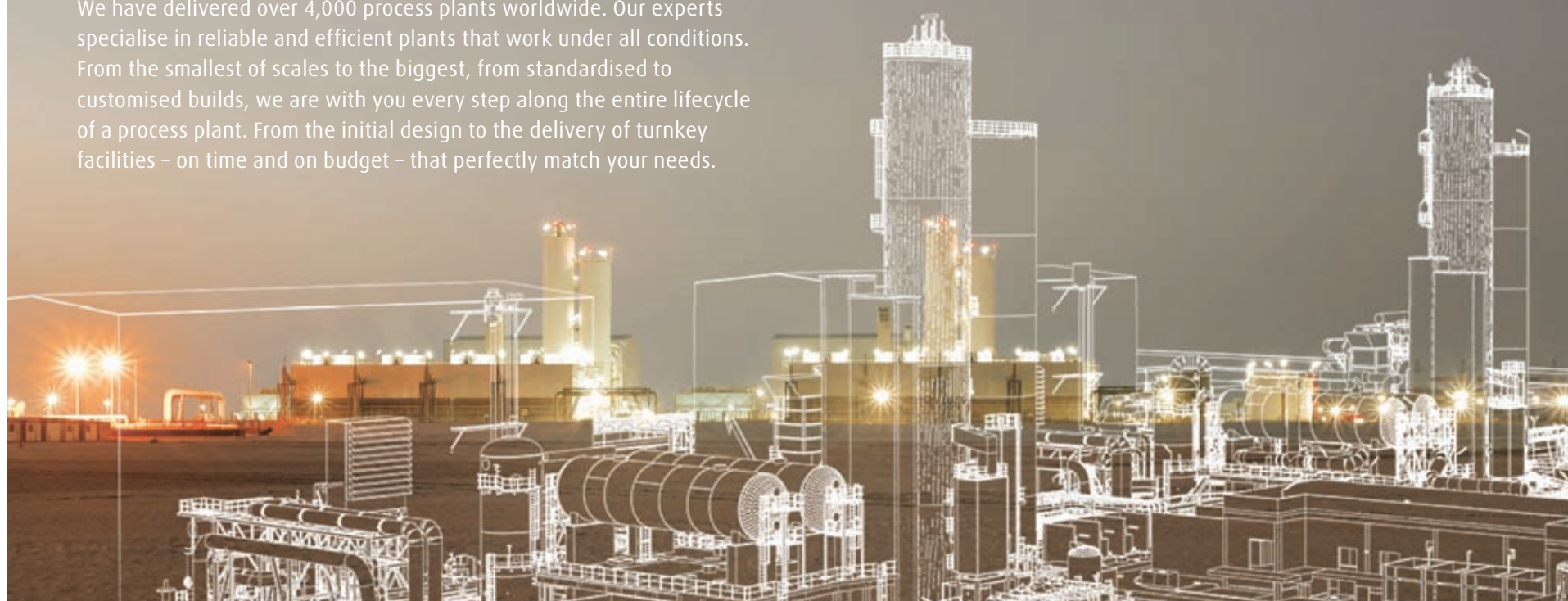
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group, the Sierra Club, over its challenge to the Department of Energy approval of the Freeport LNG project in Texas. “Just as previous challenges by Sierra Club to oppose the Freeport LNG project in a DC court have proven ineffective, the group’s comments on LNG exports are unfounded. The Sierra Club had previously argued that in granting authority to construct LNG facilities and export LNG, the DoE and the Federal Energy Regulatory Commission have not complied with the requirements of the National Environmental Policy Act by failing to consider the indirect, cumulative and nationwide effects of increased natural gas production and exports. The US is currently awash with natural gas, with proven reserves of over 324 trillion cubic feet,” stated CLNG Executive Director Charlie Riedl. “Additionally, annual US natural gas production is projected to increase from about 27 trillion cubic feet to 38 Tcf by 2040, more than enough to meet domestic needs,” said Riedl. “Due to our abundant supplies, the US Energy Information Administration projects only a slight rise in natural gas prices from current historic lows,” he added. “Thanks to the increased use of domestically produced natural gas, carbon emissions have fallen to a 25 year low, even while production continues to increase,” said Riedl. “With this abundance of natural gas, the US has the opportunity to export the resource to our allies around the globe, creating jobs, growing the economy and further decreasing carbon emissions,” he stated. The CLNG’s members, including the main US oil

and gas producers and utilities, see the expansion of natural gas exports as a crucial step in establishing a thriving and internationally competitive LNG

industry that will help boost trade income by billions of dollars. The Sierra Club, founded to help protect America’s wilderness, has now become a lobbying

group focused on campaigning against the oil and gas industry and in favour of more global warming legislation under the previous administration. It has



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particularly targeted LNG projects such as the Freeport joint venture led by US energy investor Michael Smith. It is located at Quintana Island in Texas. Each of the three Trains in the first phase of construction at Freeport will produce just over 5 million tonnes per annum of LNG and most has been contracted under use-or-pay liquefaction tolling agreements signed by the European and Japanese companies. Freeport is on schedule to ship its first LNG cargo by the end of 2018.

TOTAL, the French energy company, said liquefied natural sales rose by 8 percent in 2016 as new volumes came on stream at the Gladstone coal-seam-gas-to-LNG plant in the eastern Australian state of Queensland and a significant surge in cargoes is expected from stakes in liquefaction plants set to be completed soon in Australia and Russia. The company said annual LNG sales amounted to 10.99 million tonnes compared with 10.22MT in 2015. Total said fourth-quarter LNG sales were 2.75MT compared with 2.48MT in the same three months a year ago, a rise of 11 percent. Total's LNG sales volumes come from its stakes in the liquefaction plants such as the Bontang facility in Indonesia, Nigeria LNG and Angola LNG in West Africa and the Gladstone plant. The French company is involved in the Ichthys LNG joint venture in Australia's Northern Territory with Inpex Corp. of Japan and which is scheduled to come on stream before the end of 2017 with 8.9 million tonnes of output. In just over a year, LNG production is also expected to start at the Yamal liquefaction plant in Siberia, operated by Russian natural gas company Novatek and where Total and China National Petroleum Corp. have stakes. Yamal will produce 16.5MT from three Trains. Total's overall quarterly net income amounted to \$2.40 billion compared with \$2.07Bln in the same three months of 2015, an increase of 16 percent. Full-year net income posted

was \$8.28Bln compared with \$10.51Bln in 2015, a decrease of 21 percent. Total said that adjustments affecting net income included \$1.85Bln in the fourth quarter, "mainly due to the inventory effect and impairments on Gladstone LNG in Australia and Angola LNG" and the Laggan-Tormore project in the UK North Sea. The French company's Chairman and Chief Executive Patrick Pouyanne pointed out that after falling from \$100 a barrel in 2014 to \$52 a barrel on average in 2015, Brent crude prices were highly volatile in 2016, fluctuating between \$27 and \$58 a barrel. "In this difficult environment, the Group demonstrated its resilience by generating adjusted net income of \$8.3Bln and had the highest profitability among the majors due to the strength of its integrated model and commitment of its teams to reduce the breakeven," said the CEO. "The group's resilience was supported by outstanding production growth over the past two years (14.3 percent, including 4.5 percent in 2016)," said Pouyanne. "In the upstream, the group strengthened its position in the Middle East by entering the Al Shaheen field in Qatar, and in the US with the acquisition of shale-gas assets," he added. "The group is preparing future growth with the signing of major deals in Brazil with Petrobras, in Uganda and in Iran on the giant South Pars II project," stated Pouyanne. Hydrocarbon production was 2,462 thousand barrels of oil equivalent per day (kboe/d) in the fourth quarter 2016, an increase of 4.7 percent compared to the fourth quarter of 2015, with LNG playing a role as the Angola plant got back on stream. For the full-year, production was 2,452 kboe/d, an increase of 4.5 percent compared with 2015, due to the additional volumes in projects such as Gladstone LNG in Queensland, partly offset by falls in output "due to the security situation" in both Nigeria and Yemen.

TRAFIGURA, the Global commodities, plans to invest in a

liquefied natural gas import facility in Teesside in northeast England as it expands its LNG trading and UK gas market presence and forecasts a surge in cargoes from the United States. The first LNG cargo was received at the Teesport facility, near Middlesbrough, in February 2007 after it was set up by Excelerate Energy of the US as the first dockside regasification port and second operational LNG facility in the UK at the time after Grain LNG in Kent. Then in 2009, two more facilities opened at the UK fuel hub at Milford Haven in Wales, South Hook LNG, majority-owned by Qatar Petroleum, and Dragon LNG, built by BG Group and now owned by Royal Dutch Shell. The Teesport LNG facility was shut in 2015 after a lean time in the market when few cargoes were imported to the northeast Gasport and preference was for the big terminals at Milford Haven and the Grain LNG terminal in Kent, operated by National Grid. The total cost of the original infrastructure for the Teesside Gasport was less than \$80 million compared with about \$500M needed at the time to build a conventional onshore terminal. Trafigura said that by having access to an import location such as Teesside it would have greater flexibility as LNG supplies increase. "Given the growth in volumes globally and the flexibility of US supplies it is likely that LNG shipped from the US will make up the lion's share," said Hadi Hallouche, head of LNG trading at Trafigura, in an interview with the "Financial Times" newspaper when he revealed the Teesside plan. "LNG infrastructure is coming down in cost, and liquidity in the LNG market is getting deeper, making these kinds of projects possible," added Hallouche. The original Teesport facility had been the focus of an industry first when it opened. The first vessel that arrived at the Gasport in 2007 had received its LNG cargo via the first ever commercial transfer of LNG from one ship to another. The floating storage and regasification unit (FSRU) "Excelsior" then docked alongside a dedicated jetty

where it connected to the onshore facility that feeds into the UK natural gas grid - the National Transmission System. Trafigura said it now planned to invest in the revived Teesside facility and envisages starting imports in 2018. The site has been taken on a long-term lease from UK group PD Ports, which sees the Trafigura move as an "important step in positioning Teesport as a major energy hub for the UK". The two companies said they were working to obtain the necessary permits for the new project from the authorities. Trafigura said the revived Teesside facility would increase the UK's supply security and that it plans to invest in other terminals where it sees potential demand. "We're interested in having more infrastructure both in Europe and around the world," said Hallouche. Another import facility using an FSRU is being planned for Barrow-in-Furness in Cumbria, northwest England, with plans to import shipments from North America.

WILLIAMS PARTNERS, the US pipeline company, said regulators have authorized the Atlantic Sunrise expansion project, an expansion of the existing Transco gas pipeline to connect abundant Marcellus shale-gas supplies with markets in the Mid-Atlantic and Southeast US where LNG export plants are being developed. Williams, based in Tulsa, Oklahoma said the Federal Energy Regulatory Commission had issued a certificate allowing the joint venture to start construction soon. Following a comprehensive review lasting almost three years, the order issued by the FERC concluded that building the Atlantic Sunrise project would serve the public interest. "While we are still reviewing details of the certificate order, we are pleased FERC has approved this much-needed energy infrastructure project which will leverage existing infrastructure to help millions of Americans gain access to affordable Pennsylvania-produced natural gas," said Rory Miller, senior vice president of Williams Partners' Atlantic-Gulf operating area. "Pennsylvania is the second-largest producer of natural gas in the US. Projects like Atlantic Sunrise will help the state maximize the tremendous economic benefits that this local resource holds," stated Miller. The expansion is set to cost almost \$3 billion in building out the existing Transco

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Cannes, France
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Flame Natural Gas & LNG Conference
May 8-11, 2017
Hotel Okura, Amsterdam,
The Netherlands
<https://energy.knect365.com/flame-conference>

natural gas pipeline. The existing Transco pipeline company is a subsidiary of Williams and is the nation's largest and fastest-growing interstate transmission system. It delivers natural gas to customers through its 10,200-mile pipeline network whose mainline extends nearly 1,800 miles between New York City and South Texas. Atlantic Sunrise is designed to increase deliveries by 1.7 billion cubic feet per day. This would allow more natural gas to be directed south to domestic customers and as feed-gas as more LNG processing. Trains are scheduled to come on stream on the Gulf Coast. "The system provides cost-effective natural gas services to US markets in the Southeast and Atlantic seaboard states, including major metropolitan areas in New York, New Jersey and Pennsylvania, as well as international markets," said Williams. The company said it planned to start construction in mid-2017 after the receipt of all necessary permits. "These mainline facilities will create a much-needed path from the northern part of the Transco system to markets along the Eastern Seaboard for a portion of the project capacity in time for the 2017-2018 heating season," it said. Williams explained that construction on the Central Penn Line, the greenfield portion of the project, is targeted to begin early in the third quarter of 2017, which would allow the full project capacity to be placed into service in mid-2018. "This project is among the largest private investments of capital ever made in Pennsylvania and will support thousands of family-sustaining jobs during construction, many of them in blue-collar trade and manufacturing

sectors, and hundreds of long-term jobs once operational," said Gene Barr, President and CEO of the Pennsylvania Chamber of Business and Industry. The

Atlantic Sunrise expansion consists of 200 miles of pipe, including about 185 miles in Pennsylvania. It will also consist of above-ground associated equipment,

facilities and metering stations in the states of Virginia, Maryland, North Carolina, and South Carolina to allow for bi-directional flow. ■



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American Bureau of Shipping explains LNG fuel progress and guidance gained from early movers

LNG is an historic vessel power transition like sail-to-coal, coal-to-oil and now oil-to-gas

The American Bureau of Shipping, a leading provider of classification services to the marine and offshore industries, has updated its guidance on LNG bunkering in North America to support the transport sector's increasingly rapid transition to the use of cleaner fuels.

The second edition of ABS's "Bunkering of Liquefied Natural Gas-Fueled Marine Vessels in North America", numbering almost 200 pages, offers market-leading advice to shipowners and operators who may be looking to develop bunkering infrastructure in response to new emissions regulations and showcase their environmental stewardship.

Growth

"As the demand for LNG-fueled vessels and the supporting infrastructure continues to grow, ABS continues to offer the industries we serve with up-to-date information derived from the latest projects and our intimate knowledge of the evolving regulatory landscape in North America," said Patrick Janssens, ABS's Vice President, Global Gas Solutions.

"Both the marine and offshore industries are committed to using cleaner fuels, and we are committed to supporting our clients and members with that technical transition."

The first edition of the report was published in March 2014. Major updates in the second edition include important lessons learned from first adopters of LNG-fueled vessels and LNG bunkering projects, a "project roadmap" guide of the associated regulatory, stakeholder and technical issues and an in depth port directory highlighting ongoing projects and local development processes.

Since ABS established its Global Gas Solutions team in August 2013, it has been awarded several precedent-setting contracts that have reaffirmed its class leadership in the gas sector.

ABS has won the classification contracts for the world's first LNG-fueled containership, North America's first LNG barge, the world's first very large ethane carrier, the world's first compressed

natural gas carrier and the first dual-fueled OSV built in North America.

Noteworthy

Since the first edition was issued, significant progress has been made in North America with the use of LNG as a fuel for ships.

Of particular note, was the first LNG bunkering and gas-fueled vessel operation in North America.

This took place just over two years ago in Pascagoula, Mississippi, and was supported by the crew of the ship involved, the "Harvey Energy", Finnish propulsion company Wärtsilä, Martin, Energy, Gulf Coast Shipyard Group, Shell, ABS and the United States Coast Guard.

The ship was constructed by Gulf Coast Shipyard Group and was the first gas-fueled vessel to be constructed in North America. It is United States-flagged and classed by ABS.

This report captures the diverse practical knowledge emerging in the LNG and gas shipping sector and many of the lessons learned since the first edition of the ABS guide.

"It is a valuable tool to those companies considering using or supplying LNG for fuel," said Roy Bleiberg, Director of Global Gas Solutions at ABS.

Suitable

"It's not only suitable for companies interested in the potential economic benefits, or those whose ships will be trading in emissions control areas, it is also for those companies who are keen to establish and promote their environmental stewardship," stated Bleiberg.

The bunkering of the "Harvey Energy" advanced the maritime industry in North America. Gas is now the new marine fuel in the US and has joined the historic vessel power transitions of sail-to-coal then coal-to-oil and now oil-to-gas.

Harvey Gulf International Marine is also the operator of the first LNG marine bunkering facility in Port Fourchon, Louisiana.

This second edition of the guide was developed to meet the growing needs of



LNG-fueled 'Harvey Energy' constructed by Gulf Coast Shipyard

the industry and to provide guidance and clarification on areas of interest based on feedback received on the first edition.

"Significant enhancements have been provided, primarily in the areas of lessons learned from first adopters of LNG-fueled vessels and bunkering projects. These will help guide future users through the challenges and solutions achieved by existing projects," ABS said.

Underway

"Several projects in North America are well underway, and in some cases completed, and provide valuable information on the value chain of LNG supply, port infrastructure and end use," it added.

Here are extracts from that section:

Lessons Learned from Early Adopters:

Several companies have initiated and are well under way in their development of gas-fueled vessels and the corresponding infrastructure for LNG bunkering.

"Planning and execution of these projects involved a number of key decisions and resolution of regulatory, commercial and technical issues. The lessons learned from North America's first adopters of gas-fueled vessels provide valuable insight for future project developers who are considering making an investment in LNG as an alternative marine fuel," the report said.

"One of the common threads among North America's early adopters is having gained the awareness that making the switch to LNG requires patience and persistence navigating an uncharted course.

"When making the decision to build or convert vessels powered by gas, shipowners and operators must consider a number of regulatory factors and address technical challenges associated with applying new technology to their fleets for the first time," it added.

"The process to develop the first wave of gas-fueled initiatives in North America has required close collaboration, open communication, and shared best practices among classification societies, regulatory bodies such as the USCG and port authorities, vessel designers and shipyards to establish a baseline for these next-generation vessels," added SBS.

Key lessons learned from early adopters about making the switch to LNG as a fuel include:

The adoption of LNG as a marine fuel requires a dedicated team: Adoption of the new technologies and addressing the regulations is not a part time job. There is a lot to be considered, reviewed, and engineered and it takes a dedicated team to bring the whole project together.

The drivers for conversion to LNG are both economic and a commitment to environmental stewardship: Economics drive the decision for conversion but the commitment to environmental stewardship on the part of the early adopters weighs significantly in the business case for conversion.

Use trusted advisors and partners to leverage the limited industry experience in gas-fueled vessels. Experience is limited in this emerging industry and the relationships and partnerships used are critical during the transition to LNG fuel.

LNG is readily available for marine bunkering: However, access to (transportation) and traditional bunkering contracts (spot market) are challenges to address when accessing those supplies.

Proper crew training is essential to promote the safe use of LNG as a marine fuel: Just like when making any change within an existing program, training is fundamental. Recognizing this new technology means that resources have to be applied to provide necessary crew training.

Relationship with the Regulators. Early and often dialogue with the regulatory bodies, primarily the USCG, is essential to establishing formal lines of communication at all levels.

Decision to use LNG

The establishment of the North American Emissions Control Area (ECA) has proven to be a powerful driver for owners and operators engaged in Jones Act trading that in the last few years the LNG sector has been developing rapidly.

The primary drivers for selecting LNG as fuel were competitive pricing in terms of long-term prospects and environmental stewardship and sustainability.

Companies view this conversion as a significant step to reduce their carbon footprint, which is a major concern to customers across industry that are prioritizing “greener” ship designs with technology aimed at reducing emissions to the strictest limit within the North American ECA.

Because many ships run against demanding schedules requiring no lost time, one of the most effective ways to reduce the carbon footprint is to use fuels that are much more eco-friendly than Heavy Fuel Oils.

“The amount of time transiting or operating in the ECA is a key factor. Companies are developing specific ECA strategies that consider navigation routes and weather contingencies for gas-fueled fleets,” said ABS.

Time in ECA

“For some shippers, time spent in the ECA ranges from 40 percent to 100 percent, where calculations indicate that if vessels spend more than 30 percent of their time in the ECA, LNG is worth considering,” the report added.

“At least one ship owner envisions LNG fuel capacities large enough to propel vessels in trans-ocean services; eventually eliminating the use of HFOs altogether.

“Another deciding factor is the age of the existing fleet. For newer vessels, the life cycle economics favored conversion at the time of consideration.

Positive

“For older vessels, on the other hand, new-build programs provided the opportunity for LNG construction. Jones Act business creates an expectation of a 30-year life for newbuilds,” added ABS.

“That service life is more maintenance driven as opposed to being driven by heavy construction. Companies who adopt LNG as a fuel should expect to invest more time to maintain and care for their vessels to meet that 30-year life cycle.

“On the positive side, the use of methane, with its lower carbon content, some of the maintenance intervals move out as much as 80 percent longer.

“With carbon as being the major wear component of any engine, less carbon in the engine causes the wear factor to diminish significantly. Some operators are looking at moving maintenance intervals out on major components as much as 50 percent,” the report said.

“In terms of obstacles faced following the initial decision, early adopters unanimously agree that one of the biggest challenges has involved learning the myriad complexities of the operation and project work scope, not only technically, but from a regulatory standpoint; thus requiring a fulltime commitment to the project,” it added.

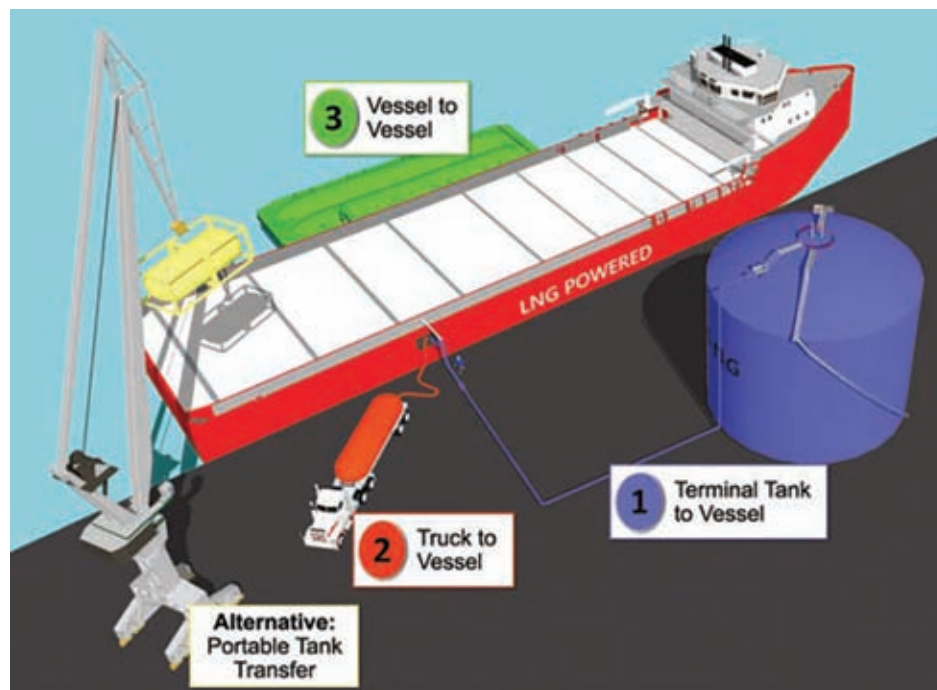
Partner selection: “In the case of shifting to gas-fueled vessels, the industry has had to rely on a synergy from which to draw expertise and understanding about LNG technology.

Jones Act

“No single person or organization has all the necessary expertise, yet. Therefore, the key is to draw on multiple people’s areas of expertise and understanding and to spread the information around to lean on a broader audience for the knowledge needed.

“For Jones Act vessels specifically, owners preferred to work with people who had designed and built LNG fueled vessels, as opposed to individuals who had minimal LNG background experience.

“Effective communication during the design and construction phase between the designer, shipyard, equipment suppliers, owner, the USCG and the class society is critical to ensure the applicable requirements are properly addressed and implemented.



ABS study considers three general options and an alternative option

“The installation of LNG dual fuel engines and associated systems is well understood in many areas of the world where LNG carriers are under construction.

Basics

“However, the experience with dual-fuel engines and LNG systems is limited in the US. Relative to the standards and requirements applicable to LNG carriers, the requirements for gas-fueled ships are in their infancy,” the ABS said.

“Additionally, the requirements established for one part of the world may not be adequate for the expansion of gas as a marine fuel in another part of the world.

“All LNG stakeholders should acknowledge that the basic requirements have been established for gas-fueled ships, but all aspects of a new design cannot be foreseen.

“As such, effective communications among all parties is imperative,” the report said.

“Close coordination and open communication among the organizations also promotes consistency between the reviews and ultimately a better understanding by all parties of the systems, associated hazards, and best practices to promote safety.

“ABS provides a series of technical training programs aimed to enhance the understanding of the design, operational, and regulatory aspects of using LNG as a fuel.

“We also provides surveyors experienced with LNG systems to the US from other divisions to support the installation, testing, and commissioning of the LNG fuel gas systems,” it added.

Vessel decisions: “Owners have made strategic decisions to use proven designs as a foundation and modify the designs as little as possible to accommodate the fuel-gas systems and equipment.

“When possible, using a sister vessel design for which one vessel was already delivered, the project can be simplified and allows the USCG, class society, owner and other partners to focus only on the gaps.

“Another strategic decision was to select a single service provided for the entire natural gas and power systems consisting of a fueling station, LNG fuel storage tank, vaporizers and associated piping within a tank connection space (cold box), gas valve unit enclosures, generator sets for propulsion and auxiliary power, and the associated control system,” it said.

Supply availability: “LNG suppliers are plentiful and there is confidence among them that there is an abundant supply of gas. Shippers often work with outside consultants to arrange for LNG supply and availability.

“In many respects, the single most important consideration in LNG supply for bunkering is lead time.

“There is currently no developed spot market for LNG for the volumes that most vessel operators/owners require. Unlike tradition bunker fuel supply, LNG supply and bunker decisions need to be made well in advance of the launch of the vessel, particularly, if new build liquefaction and bunkering facilities are required to meet the need for LNG” it said.

“Actual experience in arranging for a gas supply revealed a significant number of creative solutions to provide LNG.

“Options ranging from local plants to

railroad car transportation have been proposed and from a logistics standpoint, local suppliers are preferred so that weather issues do not affect supply.

services for LNG-powered and LNG-Ready vessels as well as LNG bunkering assets.

However challenging the journey, the US maritime industry already has begun

the process of adopting LNG as a fuel in North America.

Pioneering companies have a role to play not just in overcoming the technical

requirements but also in building the capacity - both physical and financial - that will encourage the wider development of LNG. ■

Spot market

“Shippers prefer buying fuel on the spot market whereas the LNG market is pushing for longer term fuel contracts so there are contract issues to negotiate.

“Companies are confident they will have a reliable supply of gas and believe with the quantities they are proposing to consume that any number of partners will put a program together that gets the gas liquefied, gets it on a barge and gets it alongside,” ABS said.

Conclusions

The US development of related LNG bunkering infrastructure also has continued, with both fixed and mobile applications emerging to meet the growing demand.

Despite the progress, there is a realisation that in order to support the trend towards the use of LNG as fuel, bunkering infrastructure needs to grow - and not just in North America.

Whatever their strategy, owners and operators are working in a nascent market that requires that they also adopt an innovative approach to financing.

They must consider the timing of investments in relation to the trading patterns of their assets, with an eye on future regulation but in the context of the current operating environment.

Through this era of change, ABS has played a critical supporting role in the development of LNG fuel infrastructure and the construction of commercial vessels in North America, providing classification

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Development and industrialization of new versions of LNG carrier membrane containment systems

David Colson, Commercial Vice-President, and Guillaume Leclerc, Innovation Manager, Gaztransport & Technigaz, France

Liquefied natural gas membrane containment systems from France-based Gaztransport & Technigaz, known as GTT, have been employed in more than 300 in-service LNG carriers.

The systems have evolved over the last 50 years in line with this extensive experience and new market requirements. We will look in this article at the development and industrialization of the two latest versions, the Mark V and the NO96 MAX.

The recent introduction of more efficient propulsions alternatives for LNGCs has led to the requirement for a reduction in the guaranteed natural daily boil-off rate (BOR) of the liquid natural gas (LNG) stored in the tanks of the LNGC.

Stronger

In addition, the market is also looking for stronger systems capable of operation in harsher offshore environments for Floating Production Storage and Offloading (FPSO) platforms and Floating Storage and Regasification Units (FSRUs).

GTT began the development of the Mark V and NO96 Max containment systems in 2013 in order to minimize the guaranteed BOR as well as to optimize system strength. A description of this development process is given, including the detailed technical analyses, the testing and validation procedures, and the step-by-step approach to reach final Class approval.

The subsequent industrialization process in collaboration with Samsung Heavy Industries, Hyundai Heavy Industries, and Daewoo Shipbuilding and Marine Engineering including construction of large-scale mock-ups and the development of new methodologies and tools for welding and erection is explained.

The final systems will be described as well as the timeline to complete the overall process by the end of 2016 to start construction of the first vessels equipped with these systems.

In order to meet the current requirements of Charterers, Ship-Owners and Offshore Operators, GTT has

successfully completed an innovation program on its Mark and NO membrane type containment systems.

These development activities, demonstrate the adaptability of the GTT membrane technology to the evolving requirements of the Liquid Natural Gas (LNG) Industry.

Transit

During the transit of LNGCs from the loading terminal to the discharge terminal and vice-versa, the boil-off (BO) of LNG, which naturally evaporates within the tanks, is traditionally used as fuel and is burnt in the propulsion system of the vessel.

In 2010, the traditional guaranteed boil-off rate (BOR) for an LNGC equipped with membrane tanks of capacity greater than 138,000 cubic metres capacity is 0.15% of cargo volume per day. This amount of natural boil-off generated was insufficient for the full propulsion requirements of the vessel.

Recent developments in propulsion systems have led to an increase in their thermal efficiencies (See Figure 1).

The industry moved from the use of steam turbines to the use of medium speed diesel engines, the so-called Dual-Fuel Diesel Electric (DFDE) engine, and now we see the arrival of the two-stroke engines with even greater full efficiencies.

At the same time, trading patterns of vessels have changed with the increase in the spot trade and vessels are now more likely to operate at lower speeds than the traditional cruising speed of 19 knots; speeds between 12 and 16 knots are common.

As a consequence, the natural BOR generated often exceeds the quantity required to fuel the vessel. In this case, the vessel would be either forced to re-liquefy or burn the extra boil-off.

Cost element

This results in extra cost (OPEX) or unnecessary wastage of gas and is not environmentally friendly.

For these reasons, GTT embarked on a development program of its containment systems which resulted in the success of

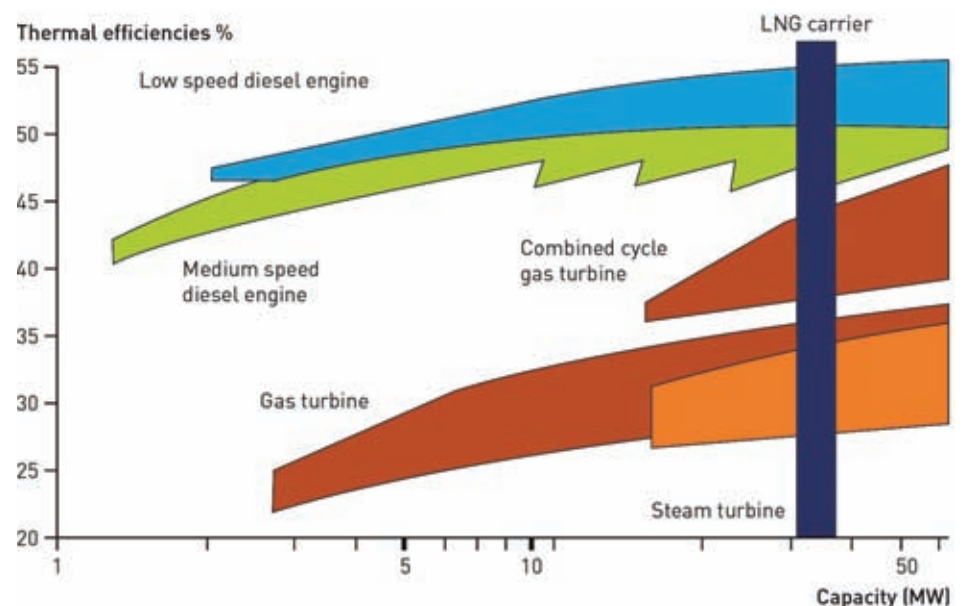


Figure 1: Requirement for lower BOR from use of more efficient propulsion

the Mark III Flex and NO Evolution systems. Vessels are now being delivered with guarantee BORs of as low as 0.09%V per day; a reduction of over 40%.

The next step in this reduction of BOR, has been the development of the Mark V and the NO. 96 Max containment systems.

Objectives

In addition, the market also requires, for specific off-shore applications as well as the future market development of tanks for the use of LNG as a fuel, as well as bunker barges and small scale distribution of LNG, containment systems able to operate with any level of LNG inside the tank.

The development of Mark V and NO96 Max also incorporated enhancements to allow their use in such applications without increasing detrimentally the guaranteed daily BOR (increasing system strength alters the thermal performance of the insulation materials and can lead to higher BOR).

The guaranteed daily BOR of GTT systems are shown. The goal of the evolution of the Mark and NO systems is to reduce by half the traditional daily BOR's pre-2010 to a maximum of 0.075%V (See Figure 2).

In order to increase system strength, the Mark V has benefited from the use of high density insulation foams already available with Mark III Flex system. A 210 kg/m³ density foam can replace the

traditional 130 kg/m³ foam, thereby increasing the compressive strength of the insulation two-fold.

For the NO96 Max system, as will be described later, the inherent design of the construction of the insulation boxes and the type of plywood used have been modified in order to optimize the strength and the BOR.

There is a compromise between boil-off and strength optimization as well as the possible modified filling limits for a standard 174.000 m³ LNG.

The lower filling limits can be raised (from 10% to 15% of tank height) and the higher filling limits can be lowered (from 70% to 50% of tank height). In doing so the vessel may have increase operational flexibility.

By applying these reinforcements to FPSO, FSRU or small-scale LNGCs, unlimited filling operations are possible, even under the harshest environmental conditions (e.g. Tandem off-loading from an FPSO to a dedicated shuttle LNGC).

Various systems

The current NO96 membrane systems consist of two identical barriers or membranes in 36% Ni steel (very low coefficient of expansion) positioned on top of pre-fabricated primary and secondary insulation birch plywood boxes containing either perlite or glass wool (for improved thermal performance) as insulating material.

For the current NO96 system, around

50% of the guaranteed daily BOR is directly related to thermal flow through plywood bulkheads used as bearing structure of the boxes.

The previously used reinforcement principle has been to increase the resistance of structural elements by increasing the amount of wood in the boxes (increased thickness of top covers and/or bulkheads, etc.). This increase in the amount of wood leads to an increase of the natural BO.

With the NO96 Max system, GTT proposes a new concept of the NO96 bearing structure. The conceptual breakthrough for NO 96 Max has been in fact the re-design of the insulation boxes.

The traditional NO96 box bulkhead structure has been replaced by a “pillar” design associated with the use of a high-density beech plywood. Based on this, the amount of wood in the structure has been reduced dramatically without any reduction in strength performance.

This reduction in the quantity of wood leads to improved thermal properties and a reduction of the guaranteed daily BOR down to 0.09%V.

Barriers

The two metallic Invar metallic barriers remain the same. There are no longer any side bulkheads to the boxes, which are assembled around high-density plywood pillars. To optimize the BOR, glass-wool is used as insulating material.

The failure mode under compression of the new pillars is different from that of the NO96 plywood bulkheads. The plywood bulkheads of NO96 are subjected to buckling under pressure loads which is not the case for the high-density pillars which do not buckle.

The failure mode capacity of the bearing structure is consequently 150 percent better in this case. The ultimate strength of the bearing pillar structure is so driven by the inherent compressive strength of the material and there is no longer any buckling.

The NO96 Max received “Approval In Principal” from the major class societies after an extensive and stringent validation process.

One “state of art” methodology employed and validated by class was the setting-up of a detailed numerical structural model which was then validated by dedicated test campaigns.

The feasibility of the production of the new boxes has already been demonstrated by GTT and DSME. Work is on-going to optimize the assembly

processes such as automatic positioning, drilling and screwing.

This work enables the yard and GTT to optimize the production cost of the system to provide a modern LNGC at a competitive market price.

Mark V

The current MARK III & MARK III Flex membrane systems are composed of a primary stainless steel 304L membrane positioned on top of a pre-fabricated insulation panel which incorporates the composite secondary barrier or membrane.

The composite secondary barrier is bonded between panels in order to join the panels together and to complete the secondary barrier.

In order to reduce the daily BOR, the thickness of the insulation panel can be increased from the standard 270mm (Mark III) up to 400 mm (Mark III Flex), thereby reducing the boil-off rate down to as low as 0.09%V per day.

Mark V takes the daily BOR reduction one step further and introduces two changes compared to the Mark III systems. The construction using a corrugated stainless steel 304L primary barrier with reinforced polyurethane panels is maintained.

However, the total thickness of the system is increased up to 480mm, thereby improving the thermal performance and reducing the daily BOR.

Design

This increase in thickness requires a modification in the design of the secondary barrier and GTT have introduced a metallic welded and corrugated membrane using Invar sheets (the same Invar material and thickness used in NO96, but supplied in 1m x 3m sheets instead of strakes).

In order to be able to assemble the welded secondary barrier, the prefabricated primary and secondary foam panels are no longer assembled but are now independent.

The secondary insulation panels are fixed to the inner hull with mastic ropes and the invar sheets are fitted and welded on the top of the secondary panels. After that, primary insulation panels are mechanically attached to the secondary insulation layer.

To finish the erection of the Cargo Containment System, the primary barrier is welded on the primary panels (same process compared to Mark III and Mark III Flex primary membrane).

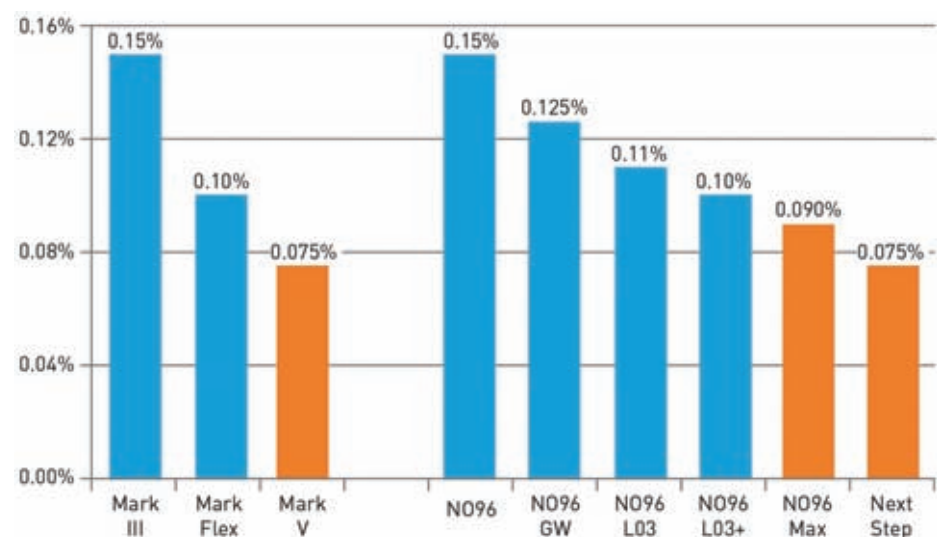


Figure 2: Guaranteed daily BOR of GTT systems developed since 2010

With the same principle as Mark III and Mark V primary membrane, the new secondary Invar membrane is corrugated in order to be flexible and to assure a good fatigue behaviour of this membrane.

Validation

The top part of the secondary insulation panels is designed and machined so that the corrugations of the secondary membrane can lie inside.

As with the NO96 Max system, the Mark V has undergone a thorough validation procedure culminating in the receipt of General Approvals for Ship Application from the major class societies.

Numerical assessments and experimental studies under static and dynamic conditions have been made on individual components (panels, corrugations, etc.) and also on assemblies (complete flat wall areas, corner panels etc.).

Experimental fatigue tests were carried out on components and membranes in order to demonstrate the superior fatigue life of the system under cryogenic and room temperature conditions. All these tests and analyses have shown the Mark V system is fit-for-purpose.

In parallel with this approval work, GTT has carried out studies and industrialization programs with Samsung and Hyundai to demonstrate the assembly of the system and also to optimize the industrial processes in order to obtain a cost-competitive containment system.

Further industrialization work has been carried out, both with the foam panel suppliers as well as for the production and folding of the secondary invar sheets.

Foam panel suppliers have constructed

mock-ups in order to understand the manufacturing process of the new panels and are now completing the cost optimization.

New tools have been developed by GTT for the efficient folding of the Invar sheets.

Since the start of the development, new and higher performance insulation foams have been introduced, which enable GTT to reduce the guaranteed daily BOR further and 0.07%V per day is now possible with the Mark V.

Conclusion

GTT has successfully introduced new containment systems (Mark III Flex and NO 96 evolution) since 2010 to reduce guaranteed daily BOR as well as addressing the requirements for increase system strength. More than 100 LNGCs using such systems have been already delivered or are under construction.

With the development of NO96 Max and Mark V, GTT is able to take these developments one step further.

These systems will allow a reduction of guaranteed daily BOR down to as low as 0.07% of cargo volume. At the same time, the systems have increased flexibility to allow for specific uses under extreme conditions.

Both systems are approved. Vessels can be ordered with NO96 Max or Mark V for delivery by the end of 2019 or early 2020. ■

This article is based on extracts from a previous conference presentation of the paper “Development and Industrialization of New Versions of the GTT Membrane Containment Systems for LNG carriers” by David Colson, Commercial Vice-President, and Guillaume Leclerc, Innovation Manager, Gaztransport & Technigaz, in Saint Rémy les Chevreuse, France.



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Malaysian LNG carriers manage to maintain their edge for profitability in challenging market

Even with state energy company Petronas as a core client, MISC has refocused strategy

Oversupply best describes the current LNG market. 15 new-build but uncontracted vessels are scheduled to come on-stream between now and 2019 and approximately more than 30 ships will end their current charter contracts during this period.

These numbers of unemployed vessels in a market that is traditionally driven by long-term charters can only spell trouble for LNG operators.

Tonnage

The double whammy of too much tonnage coupled with a persistently low oil price has conspired to drive down rates.

Steam vessels are commanding little more than \$20,000 a day on the spot market whilst those powered by tri-fuel diesel electric propulsion (TFDE) are averaging up to \$40,000 a day.

Compounding these challenges is the current trend for shorter charters. Gone, seemingly, are the 15-20 year contracts; these have been replaced with shorter periods of 10 years with a clear preference for even shorter five-seven year periods coupled with an option to extend.

Average rates for these shorter term contracts tend not to break through the \$70,000 a day threshold and there is a growing trend for charterers to pressurise these rates further.

In terms of cargoes, 2016 saw the deferral of a number of large-scale, high-cost liquefaction projects as final investment decisions (FIDs) were side-stepped.

The delayed projects included LNG Canada, Pacific Northwest LNG, Browse LNG and Abadi FLNG.

With limited opportunities for new cargoes, but with ample tonnage available, the outlook for LNG carriers remains challenging.

Long-term charter

Operating in this market is tough. At MISC, 27 of its fleet of 29 vessels are tied up on long-term charters, putting them in a stable position during the market fluctuations.

In the long-term charter market, its key customer is Malaysian national oil company, Petronas, which accounts for the

employment of 25 vessels, including two floating storage units (FSUs).

Recent contract extensions have required a number of the older vessels - those approaching 20 years - to undergo a repair and life extension (RLE) programme.

This involves comprehensive refurbishment and thorough analysis of the containment system to allow the vessels to remain in service for a further 10 years.

To date, four of the five Puteri-Class ships have successfully completed this programme and have had their contracts with Petronas extended.

Newbuilds

MISC continues to grow its LNG fleet based on secured contracts and speculative newbuilding is not an option.

Of the five orders with Hyundai Heavy Industries (HHI) recently, all have charter agreements in place with Petronas. Two vessels were delivered in September 2016 and January 2017 with the remainder due in second half of 2017 and the first quarter of 2018.

A core requirement of these new ships is to transport gas from floating LNG units and therefore MOSS-type containment system was selected.

This provides a more robust and superior containment and ensures a higher degree of operational flexibility for both MISC and Petronas.

Reheat steam was chosen for main propulsion and whilst often thought of as an older technology, the decision was taken after a thorough review of the new ships' operating pattern and assessments of the total cost of owning and operating the vessels based on their long-term time charter agreements.

Each of the newbuilds has adopted a range of green technology features that facilitate energy efficiency, emissions reduction, biodiversity management and end-of-life disposal.

Systems

These ships will also be installed with a Selective Catalytic Reduction (SCR) system allowing the diesel generator to comply with the latest IMO Tier III requirement.



MISC newbuilds with MOSS tanks can transport LNG from floating units

In addition, an Ozone Ballast Water Treatment System will be also fitted. To date, the construction of all five ships has recorded zero Lost Time Injury (LTIs) and zero Total Recordable Case Frequency (TRCF) with on-time delivery.

Whilst Petronas is MISC's main client, it continues to expand its market footprint.

Currently, it has two ships on long-term charter with the Yemen LNG project and their spot vessels have carried cargoes for Australia's North West Shelf plant and Woodside's Pluto LNG, Koch of the US, Brunei LNG, Royal Dutch Shell, France's Engie, BP of the UK, Swiss-based Trafigura, the US exporter Cheniere Energy, Gladstone LNG in Queensland and Pertamina of Indonesia.

Australia footprint

MISC's presence in the Australasian market is also growing. It currently has one vessel on a 12 month charter (with options to extend) with the North West Shelf (NWS) project.

This vessel, "Seri Anggun", has been working on a continuous charter with the NWS project since 2011.

In the same region, MISC has managed spot cargoes for Pluto LNG delivering to the Far East as well as a six-month contract with Gladstone LNG.

Back in 2015, MISC's 152,000 cubic metres capacity vessel "Seri Bakti" was the first LNG carrier to berth at the Gladstone LNG (GLNG) terminal operated by Santos in Queensland.

This resulted in the successful loading of a cargo and its subsequent delivery to the Pyeongtaek terminal in South Korea.

In a constantly changing LNG environment, carriers must adapt to survive. Long-term charters are evolving into shorter term contracts and this must be absorbed alongside the need to expand and diversify.

FSRUs

MISC's reach has extended beyond conventional LNG shipping to include FSRUs, FLNGs, small-scale LNG and even LNG bunkering.

Pursuing these opportunities and investing in new tonnage and innovative operating patterns will protect MISC's long-term viability and ensure a robust profit stream, even in tough markets.

While MISC is majority-owned by Petronas, the company competes at arm's length for business and proves its credentials in the same way that any first-class operator must do.

That said, Petronas is a hugely valuable customer. Petronas will always remain a core client, says MISC, but a refocusing of strategy has encouraged the company to search for and build relationships with other LNG companies.

MISC is also actively seeking to build additional long-term relationships to secure more third-party contracts.

Moving more Australian cargoes is firmly on MISC's wish list but the company recognises that new orders stemming from the country's growth in liquefaction have largely been soaked up by existing contracts.

However, some spot business is likely to be up for grabs for operators who can position their vessels intelligently. Aside from GLNG, MISC has been active in

securing a range of other spot cargoes from a number of LNG producers including, for the first time, Chinese charterers.

MISC is on record as saying that it will continue to grow its LNG fleet but only on the back of secured contracts. Speculative building is not an option.

Profile

MISC is a subsidiary of Petronas and was incorporated in 1968. It is one of the world's leading providers of international energy related maritime solutions and services.

The principal businesses of MISC comprise:

LNG shipping: A fleet of 25 LNG carriers delivering over 10 percent of global LNG demand. Additionally, two floating storage units.

Petroleum shipping: Wholly owned subsidiary, AET, operates a fleet of 81 petroleum tankers providing ocean transportation services as well as specialist lightering and dynamic positioning solutions.

Chemical shipping: A fleet of 14 double-hull IMO II vessels provide safe and reliable transport solutions for clean liquid cargoes including petroleum products, chemicals and vegetable oils.

Offshore solutions: Complete, comprehensive and innovative solutions from design to operations and catering for small, marginal and deepwater field developments. MISC owns and operates 13 offshore floating facilities.

Marine and heavy engineering: A separately listed subsidiary offers the full spectrum of oil and gas production facilities and services in offshore construction, offshore conversion and marine repair. It also operates the largest yard facilities in South East Asia.

Maritime education & training: MISC's Malaysian Maritime Academy (ALAM) is a world leading training centre for the development of seafaring professionals.

For over 30 years, ALAM has tutored more than 10,000 seafarers through a structured training and education system. The academy is ranked amongst

the top 10 percent in the world.

The company will gradually add to its vessels and modernize amid new Asia-Pacific opportunities. ■



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Corban Energy of US explains LNG link to operations for coal-fired power in West Virginia

John Schlosberg, Corban Energy, USA, and Kevin Peterson, Longview Power Plant, explain how LNG improves operational flexibility

Liquefied natural gas is being used as start-up fuel for a US coal-fired power plant in West Virginia, opening the way for more demand for small-scale LNG equipment in the form of storage tanks and vaporizers as the US power industry also seeks to upgrade some plants to “clean coal”.

The Longview coal-fired power plant, located near Morgantown in West Virginia, was commissioned and entered commercial operation in December 2011.

Greenfield

It was the first greenfield, coal-fired power plant constructed and placed into service in the northeast United States in over 20 years.

At an original budgeted cost of approximately \$2 billion, Longview is the largest privately-funded project in the state's history.

Longview has a net operating capacity of 700 megawatts. It employs a first-of-a-kind, advanced supercritical, pulverized coal-fired, main boiler that is more fuel-efficient than the older supercritical and sub-critical boilers found in most current coal-fired generating facilities throughout the US.

Longview's 2016 average heat rate was 8,842 MMBtu/kWh. This is approximately 15 percent better than the 2015 average for all US coal-fired generating stations.

This high combustion efficiency contributes to higher operational efficiencies and translates directly into lower carbon-dioxide (CO₂) emissions,

thus making Longview one of the premier High Efficiency Low Emissions (HELE) facilities in the US.

Secondary fuel

Utility scale, coal-fired power plants require a reliable source of a secondary fuel to perform plant start-ups and to provide flame stability during transient load operations.

For its secondary fuel, Longview chose natural gas. The main boiler burner warm up igniters and the auxiliary boiler were designed and permitted to use natural gas.

And, in 2008, Longview entered into a natural gas supply and transportation agreement with the local natural gas supplier.

Under the terms of the agreement, Longview paid for, constructed, owns and operates the pipeline that connects the generating station to the natural gas supply infrastructure.

The local utility gas supplier provides interruptible transportation service, under a large commercial and industrial customer, direct service tariff rate.

Curtailments

Longview anticipated that during cold weather events (i.e. when average ambient temperatures are at or lower than 40°F) the gas supply would be substantially or fully curtailed.

In addition, the region's gas supply infrastructure is being expanded to increased local economic development.

As a consequence, Longview was



One of 12 ISO LNG tank containers supplied to coal-fired plant

subjected to extended line curtailments during the summer months. This had a significant impact to Longview's ability to start up and, at times, change load (gas igniters in to support mill starts).

Longview's participation in the PJM Capacity Performance market in the 2016 delivery year, a “pay-for-performance” system of reliably delivering power to electricity customers, provided a major motivation to ensure a supplemental supply of start-up fuel.

So in 2016, Longview partnered with Corban Energy Group (CEG) of Elmwood Park, New Jersey, to design and install a large, modular, liquefied natural gas storage and vaporization system.

This modification provides enough start-up gas capacity onsite for two, full cold starts of the Longview facility.

CEG specializes in identifying and integrating natural gas technology into

custom systems designed to meet unique customer needs. The Longview LNG storage and vaporization system is one-of-a-kind.

Improvements

The system includes the following attributes and improvements:

- 12 UN-T75 ISO LNG tank containers, each with a combined liquid storage capacity of 132,000 gallons
- Three LNG vaporizers rated for continuous service at a total flow rate of 1.85 million scfh
- 1,200ft of 12-inch diameter underground, HDPE pipeline to deliver LNG to plant's existing start-up system
- Significant feed and pressure control valves, which allow pipeline-LNG systems crossover and mixing
- 1 MW of 480V on-site power
- Substantial safety interlocks
- Remote monitoring
- Enhanced controls and flow monitoring

The layout of the system is compact, while providing necessary safety clearances and allowing easy access to the ISO LNG tank containers by LNG road tankers, used to make fuel deliveries. Components are organized into three modular groupings.

Storage tanks

The 12, ISO LNG tank containers each have a net capacity of 11,000 gallons. They are designed to provide extended holding times with a net evaporation rate (NER) of less than 0.1% per day.



Hot water LNG vaporizers also supplied to Longview plant

They also include separate loading and liquid transfer connections, so that the transfer hoses do not need to be disconnected in order to refill the units.

Both inner and outer vessels are stainless steel. Tare weight is 12,680 kg and maximum gross weight is 36,000 kg. Overall size conforms to the standard 40 foot, ISO tank container format.

The units are approved, inspected and certified by BV and registered by the Bureau of International Containers (BIC).

The three natural gas-fired, water-bath vaporizers, include two, rated for 675,000 standard cubic feet per hour (scfh), and a third, rated for 505,000 scfh.

Vaporizers

Each vaporizer consists of twin, hot water boilers and a custom fabricated, water tank, with a gas tube bundle installed in tank. Water pumps recirculate 50/50 water/glycol mixtures between heat exchanger and the boilers.

Each system is equipped with a gas-fired engine-generator set for totally independent service. Each is fully equipped with the sensors, indicators, alarms, gauges and integrated control systems needed for safe operation.

This “inside the fence” start-up capability has been validated to support Longview operations throughout all seasons of the year.

Its installation has become a key asset in offsetting risks associated with the PJM Capacity Performance compliance requirements and the realities of aging and unreliable gas pipeline infrastructure.

Through a combination of staging liquid supply from storage vessels and adjusting firing

levels for the twin boilers in each vaporization units, the system provides fine-tuned, turn-down control, when lower heat input is desired

for start-up ramping rates. Through some “outside-the-box” thinking, which resulted in an innovative solution, Longview has secured a reliable,

supplemental start-up gas supply and is well prepared to participate successfully in the PJM Capacity Performance market. ■



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Equipment made to withstand harsh environments remains key to operating and isolation philosophies

Supply companies such as AEV, Orton and Control Seal offer most sizes for ranges of plants

With liquefied natural gas becoming ever more popular as a clean fuel, there has been tremendous investments in the liquefaction and export plants as well as small-scale facilities around the world.

Valves remain the heart of every plants operating and isolation philosophy and when the discussion is about LNG, which is a highly flammable fluid, the valves need special attention too.

Dehydration is an important process of LNG plants in which the feed gas is dried before being introduced in the main cryogenic heat exchanger (MCHE). This process is required to avoid any icing formation during the liquefaction process and to meet LNG specifications.

Molecular Sieve Particles for Adsorption: Molecular sieves are used to remove water vapors from feed gas.

A molecular sieve is a material with pores (very small holes) of uniform size. These pore diameters are similar in size to small molecules, and thus large molecules cannot enter or be absorbed, while smaller molecules can.

Dehydration (water vapor adsorption) utilizes hard, granular adsorbents manufactured in several types of materials including aluminosilicates such as Zeolite, ceramic balls, activated carbon and silica gels.

Zeolite (Type 4A & 5A) are mainly used for drying the natural gas in LNG plants.

Drying cycle is severe cyclic service: Once the Mol-sieve particles have

entrapped the water particles, it becomes necessary to remove the trapped water particles so that adsorbents are ready for drying the next batch of natural gas.

For this purpose, hot regeneration gas is passed in the opposite direction which carries the water particles to the regeneration gas cooler and regeneration gas separator. So, the dryer vessels undergo drying cycle and regeneration cycle alternatively.

Sometimes additional cycles like standby are accompanied with the drying and regeneration cycle.

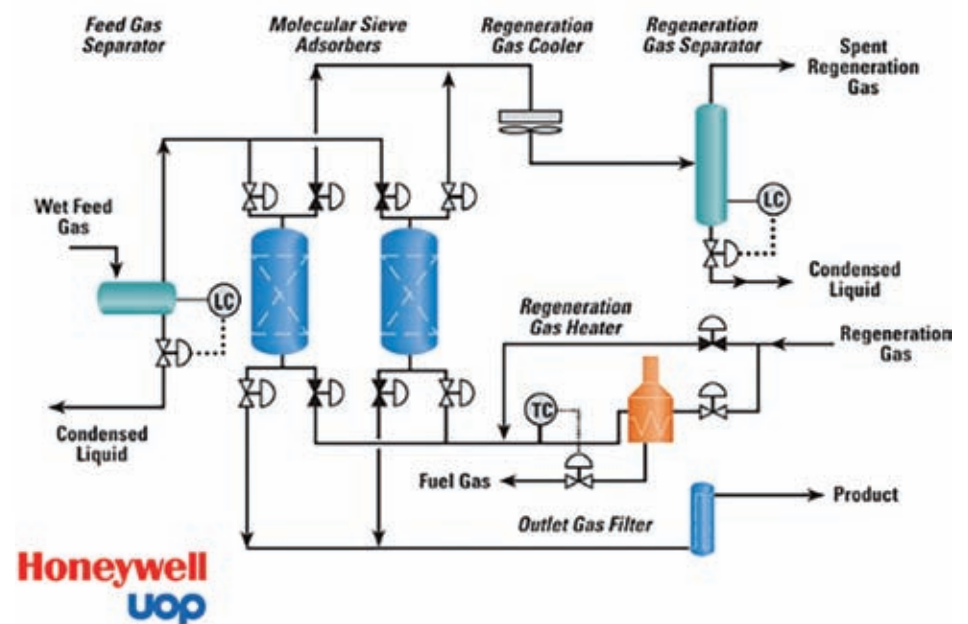
Concluding, this drying operation requires lot of cyclic operation (typically 3-4 cycles/day) and hence this drying cycle is called severe cyclic service.

Switching valves control the molecular sieve sequencing: one vessel in drying mode, and the opposite one in regeneration mode (and vice versa).

Required features of switching valves: Based on the above discussions, we can conclude that following features are required for valve in Mol-sieve service which is often categorized as severe cyclic service:-

i) Since the valve is required to open and close frequently (3-4 times a day), it becomes mandatory that the closure member should have minimum contact with the seats during opening and closing operation. If we consider this requirement, we can understand that

why conventional Ball valves & Gate



Drying process and the use of switching valves upstream and downstream of Dryer vessel (Courtesy: UOP)

valves are not used for Mol-sieve service. Conventional Ball valves have continuous line contact between closure member (ball) and seats. If conventional Ball valves are used in Mol-sieve service then the seats will wear out very soon and hence a tight shut off can't be provided. Also, due to continuous contact, the frictional resistance is high and hence the operational force requirements for the actuator will be very high. Similarly, Gate valves are not suitable for Mol-sieve service since there is considerable contact between gate and seats during the final opening and closing stage of the valve.

ii) It is necessary that valves should be cavity free because if the valve has a cavity then there is high possibility that the Mol-sieve particles will be trapped inside the valve cavity rendering the valve inoperable after some time.

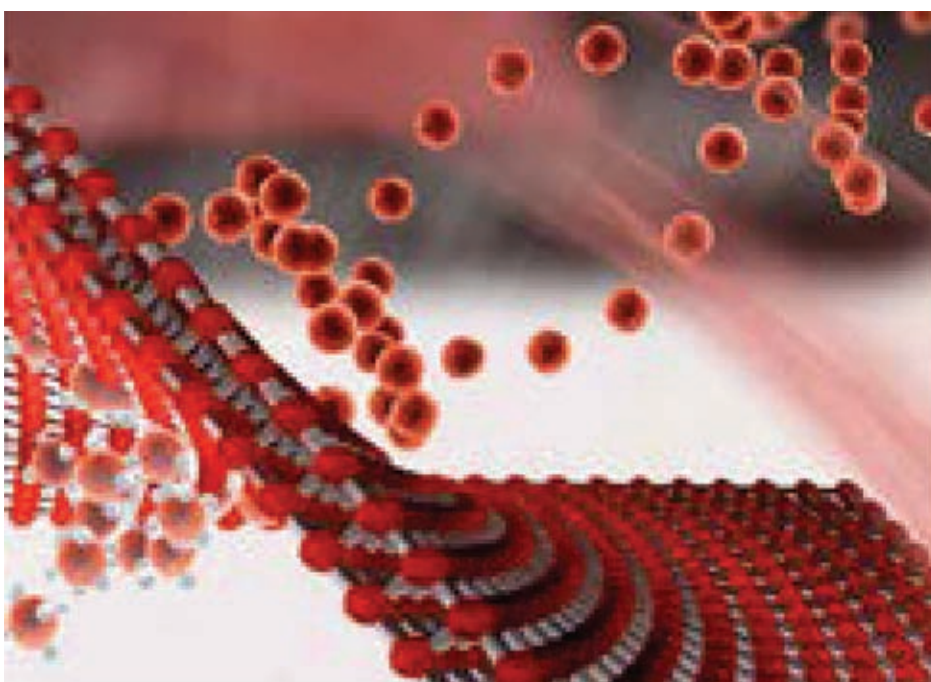
iii) The valves should have metallic hard faced seats. Since we can't eliminate the contact between the closure member

and seats completely during the shut off time, it is required that metallic hard faced seats are used to avoid any abrasion between closure member and seats.

iv) The temperature of regeneration gas used for regeneration ranges from 200 Degree C to 250 degree C. So, the switching valves have to undergo lot of thermal cycles as well. Generally the material of valve body is CS/LTCS and the material of closure member (disc/ball) is SS. So, consideration of valve material and gaps / tolerances calculations between closure member and seats should take into consideration the material expansion within the thermal transient.

v) Hard faced bushings should be used to avoid any abrasion by Mol-sieve particles. Also, it is recommended to use bushing protectors to avoid entry of Mol-sieve particles between the stem and valve body.

vi) The valve castings and welds are recommended to be 100% radiographed to



Adsorption principle (Courtesy: Zeochem)



Offshore LNG production and transfer concept (<https://www.chiyoda-corp.com/technology/en/lng/offshore.html>)

avoid any notches or cracks. Since the valve undergoes high cycling, so fatigue failure is a big concern for these valves.

vii) When rising stem valves are selected then end user should consider about fugitive emission requirements since the quarter turn valves have better fugitive emission requirements in comparison to rising stem valves. However, with the advent of PTFE infused packings and braided packings, even the rising stem valves can offer good fugitive emission performance.

viii) Actuation needs to have smooth and slow opening. A hydraulic speed control which minimizes wear and maximizes the cycle life can be used with the actuator. It is an important factor in minimizing wear. This allows total control of the ball coming out of the seat to eliminate circumferential acceleration and corresponding frictional wear on the bearings and packing.

ix) If valves are used for FLNG, then the valves should be light and compact.

Switching valves commonly used: Although this requirement is solely based on Licensor recommendations and End user experience, but following three valves are commonly used in the Mol-sieve service.

i) **Rising Stem Ball Valve:** The Rising Stem Ball Valves (RSBV) have been used primarily for/in molecular sieve service. This application requires a specific valve design offering high performance. The RSBV sealing mechanism is based upon axial movement only compared to a standard Ball, Gate, Plug and Butterfly valves having their sealing mechanism based upon shear force, friction and

tearing. The RSBV sealing is not liable to friction or tearing as there is no contact between ball and seat during rotation. The friction free quarter turn, mechanical energized sealing means no abrasion on the ball or valve body seat compared with other types of valves, giving exceptional long service life. The RSBV Helix Stem design has linear stem movement also 100% metal to metal sealing performance

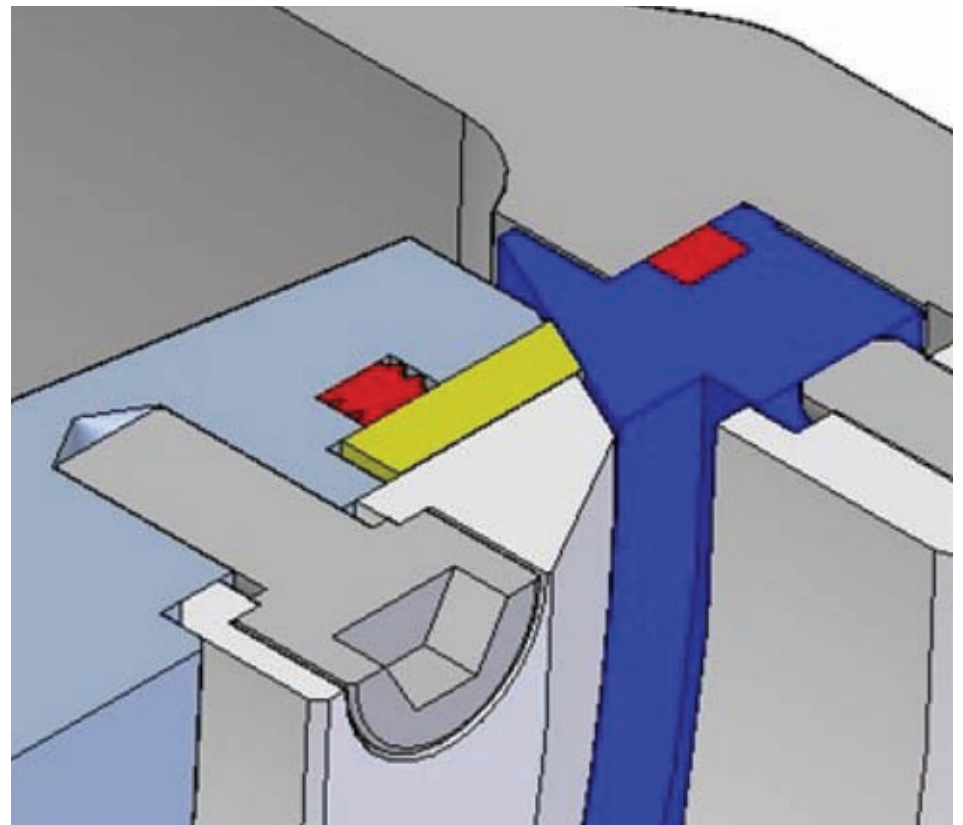
ii) **Triple Offset Butterfly valves:** Triple offset Butterfly valve are becoming popular as switching valves in Mol-sieve service due to their compact size, light weight and non-rubbing design.

The non-rubbing design produces a single, instantaneous point of contact between sealing elements when the closed position is reached. Also, the metal seal ring, located on the disc, is resilient by design - its resiliency allows for a uniform distribution of the contact force to seat across its circumference, ensuring excellent tightness, and compensates slight differences of expansion between body and disc.

However, when triple offset butterfly valves are used, some special considerations like solid seal ring instead of laminated seal ring, hard facing of seat area, use of solid stellited bearings and use of bearing protectors is recommended.

When triple offset butterfly valves are selected then end user should consider about pressure drop through the valves since the disc is always in middle of flow stream.

Also for these valves a horizontal or angular stem installation is preferred to avoid accumulation of Mol-sieve particles



Triple offset butterfly valves with replaceable seal ring and body seats (Courtesy: Orton Valves Italy)

in the seating area. Maintenance concept difference between a top entry valve and side entry butterfly valve should be properly studied during the design phase.

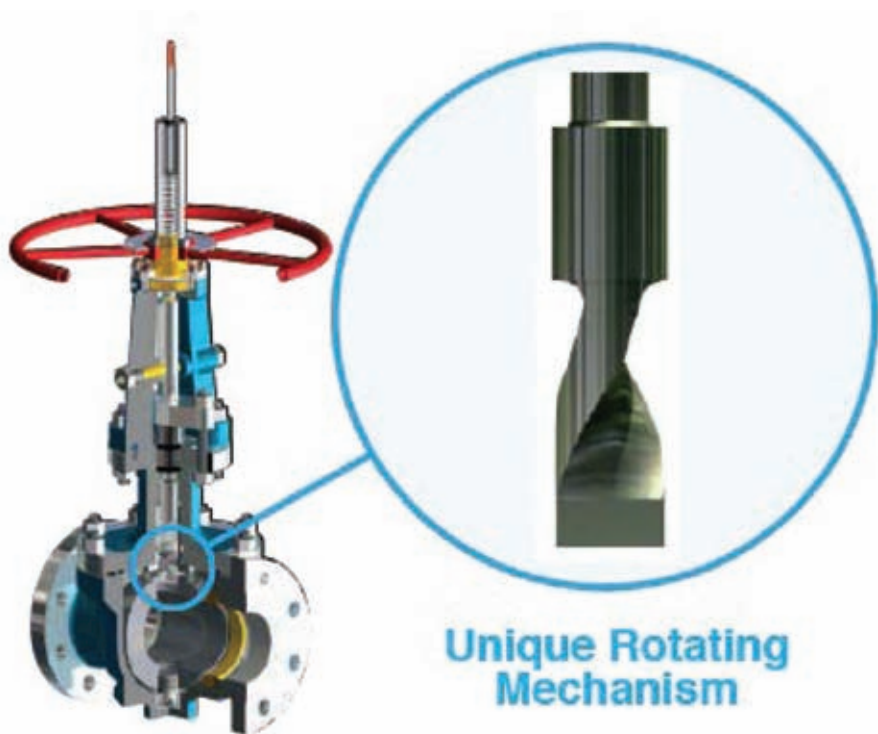
iii) **Eccentric Ball valves:** Eccentric ball valves have made a new entry to the field of valves in Mol-sieve service. The cam action of the valve provides a non-rubbing action which is a pre-requisite for valves in severe cyclic service.

Rotary Double Eccentric C-ball “no contact type” is designed to meet the most stringent services. The two vectors movement (rotation/translation) provided by the double eccentricity design allow to open and close the valve without friction or wearing at the seat & “C” contact. ■

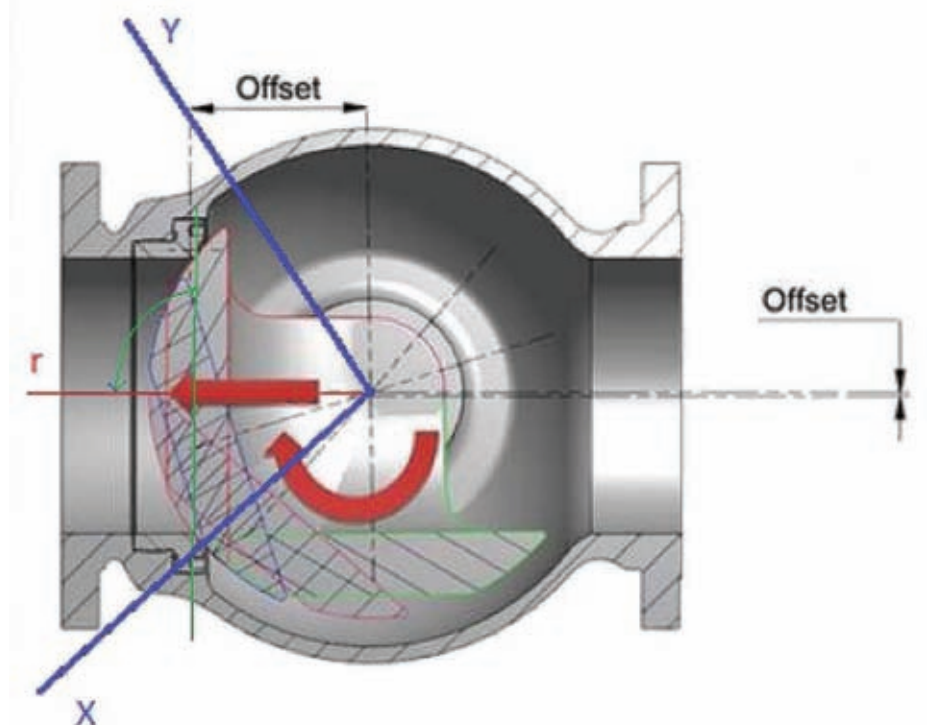
The article was written by Neeraj Batra, Piping Engineer at Chiyoda Corp., Yokohama, Japan.

Author's note:

“It is neither in the author's interest nor capability to endorse any valve for the Mol-sieve service. The valve selection is purely driven based on Licensor's recommendations and end-user experience. However, these valves undergo severe thermal cycling and operate in a service with particles. So, the internal selections and maintainability are prime factors that should be considered in the design phase.”



Rising stem Ball valve (Courtesy: Control Seal Netherlands)



Operation principle of eccentric Ball valves (Courtesy: AEV Belgium)

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LNG carrier	Capacity m³	Owned or Ordered by	Builder	Delivery Date	Flag	Power Plant	Cargo System	No. of tanks	Ship built for Export plant
Aamira	266,000	QGTC	Samsung	Dec-10	Liberia	DRL	TZ Mk. III	5	Qatargas IV
Abadi	135,000	Brunei Gas Carriers	Mitsubishi Nagasaki	Jun-02	Brunei	S	Moss	5	Brunei LNG
Adam LNG	162,000	Oman LNG	Hyundai	Dec-14	Marshall Is.	DFDE	TZ Mk. III	4	Oman LNG
Al Aamriya	210,100	J5 Consortium	Daewoo	Feb-08	Marshall Is.	DRL	GT NO 96	4	Qatargas
Al Areesh	151,700	Teekay LNG	Daewoo	Jan-07	Qatar	S	GT NO 96	4	Ras Gas II
Al Bahiya	266,000	QGTC	Samsung	Oct-09	Liberia	DRL	TZ Mk. III	5	Qatar-Atlantic
Al Biddah	135,275	J4 Consortium	Kawasaki Sakaide	Nov-99	Japan	S	Moss	5	Qatargas
Al Daayen	151,700	Teekay LNG	Daewoo	Apr-07	Qatar	S	GT NO 96	4	RasGas II
Al Dafna	266,000	QGTC	Samsung	Oct-09	Marshall Is.	LR DRL	GT NO 96	4	Qatar-Atlantic
Al Deebel	145,000	Peninsular LNG	Samsung	Dec-05	Bahamas	S	TZ Mk. III	4	Qatargas
Al Gattara	216,200	OSG/Nakilat	Hyundai	Oct-07	Marshall Is.	DRL	TZ Mk. III	4	Qatargas II
Al Ghariya	210,100	ProNav	Daewoo	Feb-08	Bahamas	DRL	GT No. 96	4	Qatargas
Al Gharaffa	216,200	OSG/Nakilat	Hyundai	Jan-08	Marshall Is.	DRL	TZ Mk. III	4	Various
Al Ghashamiya	216,000	QGTC	Samsung	Mar-09	Liberia	DRL	TZ Mk. III	4	Qatar-Atlantic Basin
Al Ghuwairiya	261,700	QGTC	Daewoo	Aug-08	Marshall Is.	DRL	GT NO. 96	5	Qatar-Atl’c Basin
Al Hamla	216,000	OSG	Samsung	Feb-08	Marshall Is.	DRL	TZ Mk. III	4	QatarGas
Al Hamra	137,000	National Gas Shipping	Kvaerner-Masa	Jan-97	Liberia	S	Moss	4	ADGAS
Al Huwaila	217,000	Teekay	Samsung	May-08	Bahamas	DRL	TZ Mk. III	4	RasGas III
Al Jasra	137,100	J4 Consortium	Mitsubishi Nagasaki	Jul-00	Japan	S	Moss	5	Qatargas
Al Jassasiya	145,700	Maran-Nakilat	Daewoo	May-07	Greece	S	GT No 96	4	RasGas
Al Kharaitiyat	216,200	QGTC	Hyundai	May-09	Liberia	DRL	TZ Mk. III	4	Qatargas III
Al Kharaana	210,000	QGTC	Daewoo	Oct-09	Marshall Is.	DRL	GT NO 96	4	Qatargas IV
Al Kharsaah	217,000	Teekay	Samsung	May-08	Bahamas	DRL	TZ Mk. III	4	RasGas III
Al Khattiya	210,000	QGTC	DSME	Oct-09	Marshall Is.	DRL	GT No. 96	4	Qatargas IV
Al Khaznah	135,500	National Gas Shipping	Mitsui Chiba	Jun-94	Liberia	S	Moss	5	ADGAS
Al Khor	137,350	J4 Consortium	Mitsubishi Nagasaki	Dec-96	Japan	S	Moss	5	Qatargas
Al Khuwair	217,000	Teekay LNG	Samsung	Jul-08	Korea	DRL	TZ Mk. III	4	RasGas
Al Mafyar	266,000	OSG/Nakilat	Hyundai	Oct-07	Marshall Is.	DRL	TZ Mk. III	4	Qatargas II
Al Marrouna	151,700	Teekay	Daewoo	Nov-07	Bahamas	S	GT NO 96		Ras Gas I
Al Mayeda	266,000	QGTC	Samsung	Jan-09	Liberia	DRL	TZ Mk. III	5	Qatar-US/Var.
Al Nuaman	210,000	QGTC	DSME	Dec-09	Marshall Is.	DRL	GT No. 96	4	Qatargas IV
Al Oraiq	210,000	J5 Consortium	Daewoo	Apr-08	Marshall Is.	DRL	GT No. 96	4	Various
Al Rayyan	135,360	J4 Consortium	Kawasaki Sakaide	Mar-97	Japan	S	Moss	5	Qatargas
Al Rekayyat	216,200	QGTC	Hyundai	Jun-09	Bahamas	DRL	TZ Mk.III	4	Qatar-Atlantic
Al Ruwais	210,100	ProNav	Daewoo	Nov-07	Germany	DRL	GT NO 96	4	Qatargas II
Al Sadd	210,100	QGTC	Daewoo	Mar-09	Liberia	DRL	GT NO 96	4	Qatar-Atlantic Basin
Al Saffiya	210,100	ProNav	Daewoo	Dec-07	Bahamas	DRL	GT NO 96	4	Qatargas II
Al Sahla	216,200	J5	Hyundai	Jun-08	Japan	DRL	TZ Mk. III	4	Ras Gas III
Al Samriya	261,700	QGTC	Daewoo	Sep-08	Marshall Is.	DRL	GT NO. 96	5	Qatargas II
Al Sheehaniya	210,100	QGTC	Daewoo	Feb-09	Liberia	DRL	GT NO 96	4	Qatar-Atlantic Basin
Al Shamal	217,000	Teekay LNG	Samsung	Jun-08	Qatar	DRL	TZ Mk. III	4	RasGas
Al Thakhira	145,000	Peninsular LNG	Samsung	Sep-05	Bahamas	S	TZ Mk. III	4	Qatargas
Al Thumama	216,000	J5 Consortium	Hyundai	Apr-08	Japan	DRL	TZ Mk. III	4	Rasgas
Al Utouriya	215,000	J5	Hyundai	Sep-08	Panama	DRL	TZ Mk. III	4	RasGas
Al Utourma	215,000	J5	Hyundai	Sep-08	Panama	DRL	TZ Mk. III	4	Ras Gas III
Al Wajbah	137,350	J4 Consortium	Mitsubishi Nagasaki	Jun-97	Japan	S	Moss	5	Qatargas
Al Wakrah	135,360	J4 Consortium	Kawasaki Sakaide	Dec-98	Japan	S	Moss	5	Qatargas
Al Zhubarah	137,570	J4 Consortium	Mitsui Chiba	Dec-96	Japan	S	Moss	5	Qatargas
Alto Acrux	147,000	LNG Marine Transport	Mitsubishi	Mar-08	Bahamas	S	Moss	4	Various
Amali	148,000	Brunei-Shell	DSME	Jul-11	Brunei	DFDE	GT No. 96	4	Brunei LNG
Amanl	154,800	Brunei-Shell	Hyundai	Nov-14	Brunei	DFDE	TZ Mk. III	4	Brunei LNG
Aman Bintulu	18,928	Perbadanan / NYK Line	NKK Tsu	Oct-93	Malaysia	S	TZ Mk. III	3	Petronas
Aman Hakata	18,800	Perbadanan / NYK Line	NKK Tsu	Nov-98	Malaysia	S	TZ Mk. III	3	Petronas
Aman Sendai	18,928	Perbadanan / NYK Line	NKK Tsu	May-97	Malaysia	S	TZ Mk. III	3	Petronas
Arctic Aurora	160,000	Dynagas	Hyundai	Jul-13	Marshall Is.	DFDE	TZ Mk. III	4	Various
Arctic Discoverer	140,000	K Line	Mitsui Chiba	Jan-06	Bahamas	S	Moss	4	Various
Arctic Lady	147,200	MOL/Hoegh LNG	Mitsubishi Nagasaki	Apr-86	Norway	S	Moss	4	Various
Arctic Princess	147,200	MOL/Hoegh LNG	Mitsubishi Nagasaki	Jan-06	Norway	S	Moss	4	Various
Arctic Sun	89,880	Arctic LNG Shipping	IHI Chita	Dec-93	Liberia	S	IHI SPB	4	ConocoPhillips/Marathon
Arctic Voyager	140,000	K Line	Kawasaki	Jul-06	Bahamas	S	Moss	4	Statoil
Arkat	148,000	Brunei-Shell	DSME	Feb-11	Brunei	DFDE	GT. No. 96	4	Brunei LNG
Arwa Spirit	165,000	Teekay LNG	Samsung	Sep-08	Marshall Is.	DFDE	TZ Mk. III	4	Various
Aseem	154,850	K Line-Petronet	Samsung	Nov-09	Malta	S	GT No 96	4	Qatar-India
Asia Endeavour	160,000	Chevron	Samsung	Dec-14	Bahamas	DFDE	TZ Mk. III	4	Various
Asia Energy	160,000	Chevron	Samsung	Sept-14	Bahamas	DFDE	TZ Mk. III	4	Various
Asia Excellence	160,000	Chevron	Samsung	Sept-13	Bahamas	DFDE	TZ Mk. III	4	Various
Asia Vision	160,000	Chevron	Samsung	June-14	Bahamas	DFDE	TZ Mk. III	4	Various
Barcelona Knutsen	173,400	Knutsen	Daewoo	May-10	N.I.S.	DFDE	GT NO 96	4	Various
Bebatic	75,060	Brunei Shell Tankers	Atlantique	Oct-72	Brunei	S	TZ Mk. I	6	Brunei LNG
Beidou Star	172,000	MOL	Hudong	Oct-15	Hong Kong	DRL	GT NO. 96	4	Various
Berge Arzew	138,088	BW Gas	Daewoo	Jul-04	Norway	S	GT NO 96	4	Sonatrach
BW GDF-Suez Boston	138,059	BW Gas	Daewoo	Jan-03	Norway	S	GT NO 96	4	Suez LN
BW GDF Suez Everett	138,028	BW Gas	Daewoo	Jun-03	Norway	S	GT NO 96	4	Suez LNG
Bilbao Knutsen	138,000	Knutsen / Marpetrol	IZAR Sestao	Jan-04	Spain	S	GT NO 96	4	Atlantic LNG
Bilis	77,730	Brunei Shell Tankers	La Seyne	Mar-75	Brunei	S	GT NO 82	5	Brunei LNG
Bishu Maru	162,000	K Line-Transpacific	Kawasaki Sakaide	Dec-15	Panama	S	Moss	4	Australia-Japan
British Diamond	155,000	BP Shipping	Hyundai	Sep-08	IOM	DFDE	TZ Mk. II	4	Indonesia-Various
British Emerald	155,000	BP Shipping	Hyundai	Jun-07	UK	DFDE	TZ Mk. III	4	Tangguh LNG
British Innovator	138,200	BP Shipping	Samsung	Jul-03	Isle of Man	S	TZ Mk. III	4	Various
British Merchant	138,000	BP Shipping	Samsung	Apr-03	Isle of Man	S	TZ Mk. III	4	Various
British Ruby	155,000	BP Shipping	Hyundai	Jan-08	U.K.	DFDE	TZ Mk. III	4	Various
British Sapphire	155,000	BP Shipping	Hyundai	Sep-08	IOM	DFDE	TZ Mk. III	4	Tangguh

British Trader	138,000	BP Shipping	Samsung	Dec-02	Isle of Man	S	TZ Mk. III	4	Engas
Broog	135,466	J4 Consortium	Mitsui Chiba	May-98	Japan	S	Moss	5	Qatargas
Bu Samara	266,000	QGTC	Samsung	Dec-08	Qatar	DRL	TZ Mk. III	5	Qatargas
BW Suez Paris	162,400	BW Gas	Daewoo	May-09	N.I.S.	DFDE	GT NO 96	4	Yemen-Atlantic
BW Suez Brussels	162,400	BW Gas	Daewoo	May-09	N.I.S.	DFDE	GT NO 96	4	Yemen-Atlantic
Cadiz Knutsen	138,826	Knutsen / Marpetrol	IZAR Puerto Real	Jun-04	Spain	S	GT NO 96	4	Engas
Castillo de Santisteban	173,600	Elcano	STX	Aug-10	Malta	S	GT NO. 96		Various
Castillo de Villalba	138,000	Elcano	IZAR	Nov-03	Spain	S	GT NO 96	4	Sonatrach
Catalunya Spirit	138,000	Teekay LNG Partners	IZAR Sestao	Mar-03	Liberia	S	GT NO 96	4	Atlantic LNG
Celestine River	145,000	KLNG	Kawasaki	Dec-07	Bahamas	S	Moss		Various
CESI Gladstone	174,100	MOL-China LNG	Hudong	Oct-16	Hong Kong	S	GT No 96	4	Australia-China
CESI Qingdao	174,100	MOL-China LNG	Hudong	Nov-16	Hong Kong	S	GT No 96	4	Australia-China
Cheikh Bouamama	75,500	Skikda LNG Transport	USC	Jul-08	Bahamas	S	TZ Mk. III	4	Sonatrach
Cheikh El Mokrani	75,500	Med LNG Corp	USC	Jun-07	Bahamas	S	TZ Mk. III	4	Sonatrach
Clean Energy	150,000	Dynagas	Hyundai	Mar-07	Marshall Is.	S	TZ Mk. III	4	Various
Clean Force	150,000	Dynagas	Hyundai	Jan-08	Marshall Is.	S	TZ Mk. III	4	Various
Clean Ocean	155,900	Dynagas	Hyundai	Mar-14	Marshall Is.	DFDE	TZ Mk. III	4	Various
Clean Planet	155,900	Dynagas	Hyundai	Mar-14	Marshall Is.	DFDE	TZ Mk. III	4	Various
Clean Vision	160,000	Dynagas	Hyundai	Jun-15	Marshall Is.	DFDE	TZ Mk. III	4	Various
Cool Explorer	160,000	Thenamaris	Samsung	Oct-13	Bermuda	DFDE	TZ Mk. III	4	Various
Cool Runner	160,000	Thenamaris	Samsung	May-14	Bermuda	DFDE	TZ Mk. III	4	Various
Cool Voyager	160,000	Thenamaris	Samsung	Oct-13	Bermuda	DFDE	TZ Mk. III	4	Various
Corcovado LNG	160,106	TMSC Gas	Daewoo	Jun-14	Malta	TFDE	GT No 96	4	Various
Creole Spirit	174,000	Teekay	Daewoo	Jan-16	Bahamas	MEGI-DF	NO. 96 GW	4	Cheniere
Cubal	160,400	Mitsui/NYK/Teekay	Samsung	Jan-12	Bahamas	DFDE	TZ Mk. III	4	Various
Cygnus Passage	145,400	Cygnus LNG	Mitsubishi	Feb-09	Panama	S	Moss	4	Various
Dapeng Moon	147,000	China Ships	Hudong	Jul-09	China	S	GT NO 96	4	Various
Dapeng Star	147,000	China Ships	Hudong	Nov-09	China	S	GT NO 96	4	Various
Dapeng Sun	147,000	China Ships	Hudong	Jul-07	China	S	GT NO 96	4	Woodside Energy
Disha	136,000	Petronet LNG Ltd.	Daewoo	Jan-04	Malta	S	GT NO 96	4	Qatargas
Doha	137,350	J4 Consortium	Mitsubishi Nagasaki	Jun-99	Japan	S	Moss	5	Qatargas
Duhail	210,100	ProNav	Daewoo	Jan-08	Germany	DRL	GT NO 96	4	Various
Dukhan	135,000	J4 Consortium	Mitsui Chiba	Oct-04	Japan	S	Moss	4	Qatargas
Dwiputra	127,385	Humpuss Consortium	Mitsubishi Nagasaki	Mar-94	Bahamas	S	Moss	4	Pertamina
Ebisu	147,547	Golar LNG	Kawasaki	Sep-08	Bahamas	S	Moss	4	Various
Ejnan	145,000	4J	Samsung	Jan-07	Bahamas	S	TZ Mk. III		RasGas
Ekaputra	136,400	Humpuss Consortium	Mitsubishi Nagasaki	Jan-90	Liberia	S	Moss	5	Pertamina
Energy Advance	145,000	Tokyo LNG Tankers	Kawasaki Sakaide	Mar-05	Japan	S	Moss	4	Darwin
Energy Atlantic	159,924	Alpha	STX Jinhae	Sep-15	Malta	DFDE	No. 96	4	Various
Energy Confidence	155,000	Tokyo LNG Tankers	Kawasaki	Apr-09	Panama	S	Moss	4	Various
Energy Frontier	147,600	Tokyo LNG Tankers	Kawasaki Sakaide	Sep-03	Japan	S	Moss	4	Darwin
Energy Horizon	177,000	Tokyo LNG Tankers	Kawasaki	Jul-11	Japan	S	Moss	4	Pluto LNG
Energy Navigator	147,000	Tokyo LNG Tankers	Kawasaki Sakaide	May-08	Japan	S	Moss	4	Various
Energy Progress	145,000	MOL	Kawasaki	Nov-06	Japan	S	Moss	4	Bayu Undan LNG
Esshu Maru	162,000	K Line-Transpacific	Kawasaki Sakaide	Dec-14	Panama	S	Moss	4	Australia-Japan
Excalibur	138,200	Exmar/ Excelerate	Daewoo	Oct-02	Belgium	S	GT NO 96	4	Various
Excel	138,106	Exmar/ MOL	Daewoo	Sep-03	Belgium	S	GT NO 96	4	Various
Excelerate	138,000	Exmar/Excelerate	Daewoo	Oct-06	Belgium	S	GT NO 96	4	Various
Excellence	138,000	GKFF Ltd.	Daewoo	May-05	Belgium	S	GT NO 96	4	Excelerate Energy
Excelsior	138,000	Exmar	Daewoo	Jan-05	Belgium	S	GT NO 96	4	Various
Exemplar	150,900	Excelerate	Daewoo	Jun-10	Belgium	S	GT NO 96	4	Various
Expedient	151,000	Excelerate	Daewoo	Nov-09	Belgium	S	GT NO 96	4	Various
Experience RV	174,000	Exmar/Excelerate	Daewoo	Jul-14	Marshall Is.	DFDE	GT NO 96		Various
Explorer	150,900	Exmar/Excelerate	Daewoo	Mar-08	Belgium	S	GT NO 96	4	Excelerate
Express	151,000	Exmar/Excelerate	Daewoo	May-09	Belgium	S	GT NO 96	4	Various
Exquisite	150,900	Excelerate	Daewoo	Sep-09	Belgium	S	GT NO. 96	4	Various
Fraiha	210,100	J5 Consortium	Daewoo	Sep-08	Marshall Is.	DRL	GT NO 96	4	Qatargas
FSRU Independence	170,000	Hoegh	Hyundai	Feb-14	NIS	DFDE	TZ Mk. III	4	Various
FSRU Lampung	170,000	Hoegh	Hyundai	May-14	Indonesia	DFDE	TZ Mk. III	4	Various
Fuji LNG	147,895	TMSC Gas	Kawasaki	Jun-04	Malta	S	Moss	4	Various
Fuwairit	138,000	Peninsular LNG	Samsung	Jan-04	Bahamas	S	TZ Mk. III	4	RasGas II
Galea	134,425	Shell Shipping	Mitsubishi Nagasaki	Oct-02	Singapore	S	Moss	5	Shell
Galia Spirit	140,620	Teekay LNG Partners	Daewoo	Jul-04	Liberia	S	GT NO 96	4	Engas
Gaselys	153,500	GdF/NYK	Atlantique	Mar-07	France	DFDE	CS 1	4	Engas
Gallina	134,425	Shell Shipping	Mitsubishi Nagasaki	Oct-02	Singapore	S	Moss	5	Shell
GasLog Chelsea	153,000	GasLog	Hanjin Korea	Dec-09	Panama	TFDE	TZ Mk. III	4	Various
Gaslog Geneva	174,000	GasLog	Samsung	Sept-16	Bermuda	TFDE	TZ Mk. III	4	Shell charter
Gaslog Gibraltar	174,000	GasLog	Samsung	Oct-16	Bermuda	TFDE	TZ Mk. III	4	Shell charter
Gaslog Glasgow	174,000	GasLog	Samsung	Jun-16	Bermuda	TFDE	TZ Mk. III	4	Shell charter
Gaslog Greece	174,000	GasLog	Samsung	Mar-16	Bermuda	TFDE	TZ Mk. III	4	Shell charter
GasLog Salem	165,000	GasLog	Samsung	Apr-15	Liberia	TFDE	TZ Mk. III	4	various
GasLog Santiago	155,000	GasLog	Samsung	Mar-13	Liberia	TFDE	TZ Mk. III	4	Various
GasLog Saratoga	155,000	GasLog	Samsung	Dec-14	Bermuda	TFDE	TZ Mk. III	4	Various
Gaslog Savannah	155,000	GasLog	Samsung	May-10	Bermuda	DFDE	TZ Mk. III	4	Various
GasLog Seattle	155,000	GasLog	Samsung	Oct-13	Bermuda	TFDE	TZ Mk. III	4	Various
GasLog Shanghai	155,000	GasLog	Samsung	Jan-13	Liberia	TFDE	TZ Mk. III	4	Various
Gaslog Singapore	155,000	GasLog	Samsung	Jul-10	Bermuda	DFDE	TZ Mk. III	4	Various
Gaslog Skagen	155,000	GasLog	Samsung	Oct-13	Bermuda	DFDE	TZ Mk. III	4	Various
Gaslog Sydney	155,000	GasLog	Samsung	May-13	Bermuda	DFDE	TZ Mk. III	4	Various
GDF-Suez Global Energy	74,000	Gaz de France	Chantiers	Dec-06	France	DFDE	CS1	4	Sonatrach
GDF-Suez Cape Ann	145,000	Hoegh LNG/MOL	Samsung	May-10	Liberia	DFDE	TZ Mk. III	4	Various
GDF-Suez Neptune	145,000	Hoegh LNG/MOL	Samsung	Dec-09	Liberia	DFDE	TZ Mk. III	4	Various
GDF-Suez Point Fortin	154,200	LNG Japan	Imabari/Koyo	Feb-10	Panama	DFDE	TZ Mk. III	4	Various
Gemmata	138,100	Shell Shipping	Mitsubishi Nagasaki	Mar-04	Singapore	S	Moss	5	Shell
Ghasha	137,510	National Gas Shipping	Mitsui	Jun-95	Liberia	S	Moss	5	ADGAS
Gigira Laitebo	177,000	MOL-Itochu	Hyundai	Feb-09	Panama	DFDE	TZ Mk. III	4	Various
Golar Arctic	140,645	Golar LNG	Daewoo	Dec-03	Marshall Is.	S	GT NO 96	4	Shell Spot
Golar Bear	160,000	Golar	Samsung	Mar-14	Bermuda	DFDE	TZ Mk. III	4	Various
Golar Celsius	160,000	Golar LNG	Samsung	Sep-13	Bermuda	DFDE	TZ Mk. III	4	Various

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Golar Crystal	160,000	Golar LNG	Samsung	Oct-13	Bermuda	DFDE	TZ Mk. III	4	Various
Golar Eskimo (FSRU)	160,000	Golar LNG	Samsung	Jan-15	Bermuda	DFDE	TZ Mk. III	4	Various
Golar Freeze	125,850	Golar LNG	HDW	Feb-77	UK	S	Moss	5	Various
Golar Glacier	162,000	Golar LNG	Hyundai	Sep-14	Marshall Is.	DFDE	TZ Mk. III	4	Various
Golar Grand	145,880	Golar LNG	Daewoo	2006	IoM		GT NO 96	4	Various
Golar Ice	160,000	Golar LNG	Samsung	Feb-15	Bermuda	DFDE	TZ Mk. III	4	Various
Golar Igloo (FSRU)	160,000	Golar LNG	Samsung	Oct-13	Bermuda	DFDE	TZ Mk. III	4	Various
Golar Kelvin	160,000	Golar LNG	Samsung	Jan-15	Bermuda	DFDE	TZ Mk. III	4	Various
Golar Maria	145,950	Golar LNG	Daewoo	2006	Marshall Is.		GT NO 96	4	Various
Golar Mazo	135,225	Golar LNG/CPP	Mitsubishi	Jan-00	Liberia	S	Moss	5	Pertamina
Golar Penguin	160,000	Golar LNG	Samsung	Mar-14	Marshall Is.	DFDE	TZ Mk. III	4	Various
Golar Seal	160,000	Golar LNG	Samsung	Aug-13	Bermuda	DFDE	TZ Mk. III	4	Various
Golar Singapore (FSRU)	160,000	Golar LNG	Samsung	June-15	Bermuda	DFDE	TZ Mk. III	4	Various
Golar Snow	160,000	Golar LNG	Samsung	Jan-15	Bermuda	DFDE	TZ Mk. III	4	various
Golar Tundra (FSRU)	160,000	Golar LNG	Samsung	Dec-15	Bermuda	DFDE	TZ Mk. III	4	Various
Golar Viking	140,000	Golar LNG	Hyundai	Jan-05	Marshall Is.	S	Moss	4	Various
Golar Winter	138,250	Golar LNG	Daewoo	Apr-04	Marshall Is.	S	GT NO 96	4	Petrobras
Grace Acacia	150,000	Algaet Shipping	Hyundai	Jan-07	Japan	S	TK MK III	4	Various
Grace Barleria	150,000	Swallowtail Ship	Hyundai	Oct-07	Japan	S	TZ Mk. III	4	Various
Grace Cosmos	150,000	AGH Shipping	Hyundai	Mar-08	Japan	S	TZ Mk. III	4	Various
Grace Dahlia	177,000	Tokyo Gas	Kawasaki	Oct-13	Japan	S	Moss	4	Various
Gracilis	138,830	Golar LNG	Hyundai	Jan-05	Marshall Is.	S	TZ Mk. III	4	Shell BG
Granatina	140,645	Shell Shipping	Daewoo	Dec-03	Singapore	S	GT NO 96	4	Shell
Grand Aniva	147,200	Sovcomflot/NYK	Mitsubishi	Jan-08	Japan	S	Moss	4	Various
Grand Elena	147,200	Sovcomflot/NYK	Mitsubishi	Oct-07	Japan	S	Moss	4	Various
Grand Mereya	147,200	Primorsk/MOL/K Line	Chiba	May-08	Japan	S	Moss	4	Sakhalin II
Hanjin Muscat	138,200	Hanjin Shipping	Hanjin	Jul-99	Panama	S	GT NO 96	4	Oman Gas
Hanjin Pyeong Taek	130,600	Hanjin Shipping	Hanjin	Sep-95	Panama	S	GT NO 96	4	Pertamina
Hanjin Ras Laffan	138,214	Hanjin Shipping	Hanjin	Jul-00	Panama	S	GT NO 96	4	QatarGas
Hanjin Sur	138,333	Hanjin Shipping	Hanjin	Jan-00	Panama	S	GT NO 96	4	Oman Gas
Hispania Spirit	140,500	Teekay LNG Partners	Daewoo	Sep-02	Spain	S	GT NO 96	4	Atlantic LNG
Hoegh Gallant FSRU	170,050	Hoegh LNG	Hoegh Hyundai	May-14	Marshall Is.	DFDE	TZ Mk. III	4	chartered
Hoegh Grace FSRU	170,050	Hoegh LNG	Hoegh LNG Hyundai	May-15	Marshall Is.	DFDE	TZ Mk. III	4	various
Hyundai Aquapia	135,000	Hyundai MM	Hyundai	Mar-00	Panama	S	Moss	4	Oman Gas
Hyundai	135,000	Hyundai MM	Hyundai	Jan-00	Panama	S	Moss	4	RasGas
Hyundai Ecopia	145,000	Hyundai	Hyundai	Nov-08	Panama	S	TZ Mk. III	4	Various
Hyundai Greenpia	125,000	Hyundai MM	Hyundai	Nov-96	Panama	S	Moss	4	Pertamina
Hyundai Oceanpia	135,000	Hyundai MM	Hyundai	Jul-00	Panama	S	Moss	4	Oman Gas
Hyundai Technopia	135,000	Hyundai MM	Hyundai	Jul-00	Panama	S	Moss	4	RasGas
Hyundai Utopia	125,182	Hyundai MM	Hyundai	Jun-94	Panama	S	Moss	4	Pertamina
Iberica Knutsen	138,000	Knutsen OAS	Daewoo	Aug-06	Norway	S	GT 96	4	Gas Natural
Ibra LNG	147,100	Oman Gas	Samsung	Jun-06	Panama	S	TK Mk. III	4	Oman LNG
Ibri LNG	145,000	Oman Gas	Mitsubishi	Jul-06	Panama	S	TK Mk. III	4	Oman LNG
Ish	137,540	National Gas Shipping	Mitsubishi Nagasaki	Nov-95	Liberia	S	Moss	5	ADGAS
K Acacia	138,017	Korea Line	Daewoo	Jan-00	Panama	S	GT NO 96	4	Oman Gas
K Freesia	135,256	Korea Line	Daewoo	Jun-00	Panama	S	GT NO 96	4	RasGas
K Jasmine	145,700	Korea Line	Daewoo	Mar-08	Panama	S	GT NO 96	4	Kogas offtake
K Mugungwha	152,000	K Line	Daewoo	Nov-08	Panama	S	GT NO 96	4	Various
Kita LNG	160,106	TMSC Gas	Daewoo	Jun-14	Malta	TFDE	GT No 96	4	Various
Kotawaka Maru	125,200	J3 Consortium	Kawasaki Sakaide	Jan-84	Japan	S	Moss	5	Darwin
Lala Fatma N'Soumer	145,000	Algeria Nippon Gas	Kawasaki Sakaide	Dec-04	Japan	S	Moss	4	Sonatrach
Larbi Ben M'Hidi	129,750	SNTM-Hyproc	La Seyne	Jun-77	Algeria	S	GT NO 85	5	Sonatrach
Lijmilya	261,700	QGTC	Daewoo	Sep-08	Marshall Is.	DRL	GT NO. 96	5	Various
LNG Abuja	126,530	Bonny Gas Transport	GD Quincy	Sep-80	Bahamas	S	Moss	5	Nigeria LNG
LNG Adamawa	141,000	Bonny Gas Transport	Hyundai	Jun-05	Bermuda	S	Moss	4	Various
LNG Akwa Ibom	141,000	Bonny Gas Transport	Hyundai	Nov-04	Bermuda	S	Moss	4	Various
LNG Aquarius	126,300	MOL/LNG Japan	GD Quincy	Jun-77	Marshall Is.	S	Moss	5	Various
LNG Barka	153,000	NYK	Kawasaki	Jan-09	Bahamas	S	Moss	4	Various
LNG Bayelsa	137,500	Bonny Gas Transport	Hyundai	Feb-03	Bermuda	S	Moss	4	Nigeria LNG
LNG Benue	145,700	BW Gas	Daewoo	Mar-06	Bermuda	S	GT NO 96	4	Nigeria LNG
LNG Bonny	177,000	Bonny Gas Transport	Hyundai	Oct-15	Bermuda	DFDE	TZ Mk III	4	Nigeria LNG
LNG Borno	149,600	NYK Line	Samsung	Aug-07	Japan	S	TZ Mk. III	4	Nigeria LNG
LNG Capricorn	126,300	MOL/LNG Japan	GD Quincy	Jun-78	Marshall Is.	S	Moss	5	Pertamina
LNG Cross River	141,000	Bonny Gas Transport	Hyundai	Sep-05	Bermuda	S	Moss	4	Various
LNG Dream	145,000	Osaka Gas	Kawasaki	Sep-06	Japan	S	Moss	4	Woodside Energy
LNG Ebisu	147,500	MOL	Kawasaki	Sep-08	Bahamas	S	Moss	4	Various
LNG Edo	126,530	Bonny Gas Transport	GD Quincy	May-80	Bahamas	S	Moss	5	Nigeria LNG
LNG Enugu	145,000	BW Gas	Daewoo	Oct-05	Bermuda	S	GT NO 96	4	Nigeria LNG
LNG Fimina	175,000	Bonny Gas Transport	Samsung	Oct-15	Bermuda	DFDE	TZ Mk III	4	Nigeria LNG
LNG Flora	127,700	J3 Consortium	Kawasaki Sakaide	Mar-93	Japan	S	Moss	4	Pertamina
LNG Fukurokuju	165,000	MOL	Kawasaki	June-15	Japan	S	Moss	4	Various
LNG Gemini	126,300	MOL/LNG Japan	GD Quincy	Sep-78	Marshall Is.	S	Moss	5	Pertamina
LNG Imo	148,300	BW Gas	Daewoo	Jun-08	Bermuda	S	GT NO 96	4	Nigeria LNG
LNG Jamal	135,330	Osaka Gas/J3 Consortium	Mitsubishi Nagasaki	Oct-00	Japan	S	Moss	5	Oman Gas
LNG Jupiter	145,000	NYK Line	Kawasaki	Jul-09	Bahamas	S	Moss	4	Various
LNG Jurojin	155,300	MOL	MHI Nagasaki	Nov-15	Japan	S	KM	4	Various
LNG Kano	148,471	BW Gas	Daewoo	Jan-07	Bermuda	S	GT No. 96	4	NLNG
LNG Lagos	177,000	Bonny Gas	Hyundai	Oct-15	Bermuda	DFDE	TZ Mk III	4	Nigeria LNG
LNG Leo	126,400	MOL/LNG Japan	GD Quincy	Dec-78	Marshall Is.	S	Moss	5	Pertamina
LNG Lerici	65,000	Exmar	Italcantieri Sestri	Mar-98	Italy	S	GT NO 96	4	Sonatrach
LNG Libra	126,400	Hoegh LNG	GD Quincy	Apr-79	Marshall Is.	S	Moss	5	Various
LNG Lokoja	148,300	BW Gas	Daewoo	Dec-06	Bermuda	S	GT No. 96	4	Nigeria LNG
LNG Ogun	148,300	NYK Line	Samsung	Aug-07	Japan	S	TZ Mk. III	4	Nigeria LNG
LNG Ondo	148,300	BW Gas	Daewoo	Sep-07	Bermuda	S	GT NO 96	4	Nigeria LNG
LNG Oyo	140,500	BW Gas	Daewoo	Dec-05	Bermuda	S	GT NO 96	4	Nigeria LNG
LNG Pioneer	138,000	MOL	Daewoo	Jul-05	Bahamas	S	GT No 96	4	Idku
LNG Port Harcourt	175,000	Bonny Gas	Samsung	Oct-15	Bermuda	DFDE	TZ Mk III	4	Nigeria LNG
LNG Portovenere	65,000	Exmar	Italcantieri Sestri	Jun-96	Italy	S	GT No 96	4	Sonatrach
LNG River Niger	141,000	Bonny Gas Transport	Hyundai	May-06	Bermuda	S	Moss	4	Various

LNG River Orashi	145,910	BW Gas	Daewoo	Nov-04	Bermuda	S	GT No 96	4	Nigeria LNG
LNG Rivers	137,231	Bonny Gas Transport	Hyundai	Jun-02	Bermuda	S	Moss	4	Nigeria LNG
LNG Saturn	153,000	MOL	MHI	Nov-15	Japan	S	Moss	4	Various
LNG Sokoto	137,231	Bonny Gas Transport	Hyundai	Aug-02	Bermuda	S	Moss	4	Nigeria LNG
LNG Taurus	126,300	MOL/LNG Japan	GD Quincy	Aug-79	Marshall Is.	S	Moss	5	Various
LNG Venus	155,000	Osaka/MOL	MHI	Oct-14	Japan	S	Moss	4	Various
LNG Vesta	127,547	Tokyo Gas Consortium	Mitsubishi Nagasaki	Jun-94	Japan	S	Moss	4	Pertamina
LNG Virgo	126,400	MOL/LNG Japan	GD Quincy	Dec-79	Marshall Is.	S	Moss	5	Pertamina
Lobito	160,400	Mitsui/NYK/Teekay	Samsung	Oct-11	Bahamas	DFDE	TZ Mk. III	4	Various
Lusail	138,000	Peninsular LNG	Samsung	May-05	Bahamas	S	TZ Mk. III	4	Qatar
Madrid Spirit	138,000	Teekay LNG Partners	IZAR Puerto Real	Jan-05	Spain	S	GT No 96	4	Engas
Magellan Spirit	165,500	Teekay LNG Partners	Samsung	Sep-08	Denmark	DFDE	TZ Mk. III	4	Various
Malanje	160,400	Mitsui/NYK/Teekay	Samsung	Jul-11	Bahamas	DFDE	TZ Mk. III	4	Various
Maran Gas Achilles	174,000	Maran	Hyundai Samho	Feb-16	Greece	DFDE	GT No 96	4	Various
Maran Gas Agamemnon	174,000	Maran	Hyundai Samho	May-16	Greece	DFDE	GT No 96	4	Various
Maran Gas Alexandria	161,870	Maran	Hyundai Samho	Sep-15	Greece	DFDE	TZ Mk. III	4	Various
Maran Gas Amphipolis	173,400	Maran	Daewoo	Aug-16	Greece	DFDE	GT No 96	4	Various
Maran Gas Apollonia	161,870	Maran	Daewoo	Jan-14	Greece	DFDE	GT No 96	4	Various
Maran Gas Asclepius	145,000	Kristen Navigation	Daewoo	Jul-05	Bermuda	S	GT No 96	4	Qatar
Maran Gas Coronis	145,700	Maran	Daewoo	Sep-07	Greece	S	GT No 96	4	Rasgas II
Maran Gas Delphi	159,800	Maran	Daewoo	Feb-14	Greece	DFDE	GT No 96	4	Various
Maran Gas Efessos	159,800	Maran	Daewoo	Jun-14	Greece	DFDE	GT No 96	4	Various
Maran Gas Hector	174,000	Maran	Hyundai Samho	Nov-16	Greece	DFDE	GT No 96	4	Various
Maran Gas Lindos	159,800	Maran	Daewoo	Jun-15	Greece	DFDE	GT No. 96	4	Various
Maran Gas Mystras	155,900	Maran Gas	Daewoo	May-15	Greece	DFDE	GT No 96	4	various
Maran Gas Pericles	174,000	Maran	Hyundai Samho	June-16	Greece	DFDE	GT No 96	4	Various
Maran Gas Posidonia	161,870	Maran	Daewoo	May-14	Greece	DFDE	GT No 96	4	Various
Maran Gas Roxana	173,400	Maran	Daewoo	Jan-17	Greece	DFDE	GT No 96	4	Various
Maran Gas Sparta	161,870	Maran	Hyundai Samho	April-15	Greece	DFDE	G TZ Mk. III	4	Various
Maran Gas Troy	155,900	Maran Gas	Daewoo	May-15	Greece	DFDE	GT No 96	4	various
Maran Gas Ulysses	174,000	Maran	Hyundai Samho	Jan-17	Greece	DFDE	GT No 96	4	Various
Maria Energy	174,000	Tsakos	Hyundai	Mar-15	Marshall Is.	TFDE	GTT Mk II	4	Various
Marib Spirit	165,000	Teekay LNG	Samsung	May-08	Marshall Is.	DFDE	TZ Mk. III	4	Various
Matthew	126,540	Suez LNG Shiping	Newport News	Jun-79	Bahamas	S	TZ Mk. I	6	Atlantic LNG
Mekaines	266,000	Nakilat	Samsung	Mar-09	Liberia	DRL	GT No 96	4	Qatar-Atlantic Basin
Meridian Spirit	165,500	Teekay LNG	Samsung	Jan-10	Denmark	DFDE	TZ Mk. III	4	Various
Mesaimmer	210,100	Nakilat	Hyundai	Mar-09	Liberia	DRL	GT No 96	4	Qatar-Atlantic Basin
Methane Alison Victoria	145,000	GasLog	Samsung	Aug-07	Bermuda	S	TZ III	4	Eq.Guinea LNG
Methane Becki Anne	170,000	GasLog	Samsung	Sep-10	Bermuda	TFDE	TZ Mk. III	4	Various
Methane Heather Sally	145,000	GasLog	Samsung	Jul-07	Bermuda	S	Tz Mk. III	4	Eq.Guinea LNG
Methane Jane Elizabeth	145,000	GasLog	Samsung	Jun-06	Bermuda	TFDE	TZ Mk. III	4	Engas
Methane Julia Louise	170,000	GasLog	Samsung	Dec-09	Bermuda	TFDE	TZ Mk. III	4	Various
Methane Kari Elin	138,200	Shell	Samsung	Jun-04	Bermuda	S	TZ Mk. III	4	Various
Methane Lake Charles	145,000	Shell	Samsung	Feb-07	Bermuda	S	TZ Mk. III	4	Marathon Oil
Methane Lydon Volney	145,000	Shell	Samsung	Aug-06	Bermuda	S	TZ Mk. III	4	Engas
Methane Mickie Harper	170,000	Shell-GasLog	Samsung	Nov-10	Bermuda	TFDE	TZ Mk. III	4	Various
Methane Nile Eagle	145,000	Shell-GasLog	Samsung	Dec-07	Bermuda	S	TZ Mk. III	4	Engas
Methane Patricia Camila	170,000	Shell-GasLog	Samsung	Oct-10	Bermuda	TFDE	TZ Mk. III	4	Various
Methane Princess	138,159	Golar LNG	Daewoo	2003	UK	S	GT No 96	4	Spot BG
Methane Rita Andre	145,000	GasLog	Samsung	Mar-06	Bermuda	S	TZ Mk. III	4	Engas
Methane Shirley Elizabeth	145,000	GasLog	Samsung	Apr-07	Bermuda	S	TZ Mk. III	4	Marathon Oil
Methane Sprit	165,000	Teekay LNG	Samsung	Mar-08	Singapore	DFDE	TZ Mk. III	4	Various
Methania	131,230	Distrigas	Boelwerf	Oct-78	Belgium	S	GT No 85	5	Sonatrach
Milaha Qatar	145,000	Milaha	Samsung	Apr-06	Denmark	S	TZ Mk. III	4	Qatar
Milaha Ras Laffan	138,270	Milaha	Samsung	Mar-04	Denmark	S	TZ Mk. III	4	RasGas II
Min Lu	147,000	China Ships	Hudong	Aug-09	China	S	GT No 96	4	Various
Min Rong	147,000	China LNG Ships	Hudong	Feb-09	Hong Kong	S	GT No 96	4	Australia-China
Mostefa Ben Boulaid	125,260	SNTM-Hyproc	La Ciotat	Aug-76	Algeria	S	TZ Mk. I	6	Sonatrach
Mourad Didouche	126,130	SNTM-Hyproc	Atlantique	Jul-80	Algeria	S	GT No 85	5	Sonatrach
Mozah	266,000	QGTC	Samsung	Aug-08	Qatar	DRL	TZ Mk III	5	Qatargas II
Mraweh	137,000	National Gas Shipping	Kvaerner-Masa	Jun-96	Liberia	S	Moss	4	ADGAS
Mubaraz	137,000	National Gas Shipping	Kvaerner-Masa	Jan-96	Liberia	S	Moss	4	Various
Muraq	210,100	J5-K Line	Daewoo	May-08	Marshall Is.	DRL	GT No 96	4	Qatar-At'l'c Basin
Murwab	210,100	J5 Consortium	Daewoo	May-08	Marshall Is.	DRL	GT No. 96	4	Qatargas
Muscat LNG	149,170	Oman Gas/MOL	Kawasaki Sakaide	Mar-04	Japan	S	Moss	4	Oman Gas
Neo Energy	149,700	Tsakos	Hyundai	Feb-07	Liberia	S	GTT Mk II	4	Various
Nizwah LNG	145,000	Oryx LNG Carriers	Kawasaki Sakaide	Dec-05	Japan	S	Moss	4	Oman Gas
Northwest Sanderling	127,525	Australia LNG	Mitsubishi Nagasaki	Jun-89	Australia	S	Moss	4	NWS
Northwest Sandpiper	127,500	Australia LNG	Mitsui Chiba	Feb-93	Australia	S	Moss	4	NWS
Northwest Seaeagle	127,450	Australia LNG	Mitsubishi Nagasaki	Nov-92	Bermuda	S	Moss	4	NWS
Northwest Shearwater	127,500	Australia LNG	Kawasaki Sakaide	Sep-91	Bermuda	S	Moss	4	NWS
Northwest Snipe	127,747	Australia LNG	Mitsui Chiba	Sep-90	Australia	S	Moss	4	NWS
Northwest Stormpetrel	127,600	Australia LNG	Mitsubishi Nagasaki	Dec-94	Australia	S	Moss	4	NWS
Northwest Swallow	127,708	J3 Consortium	Mitsui Chiba	Nov-89	Japan	S	Moss	4	NWS
Northwest Swan	138,000	Australia LNG	Daewoo	Mar-04	Australia	S	GT NO 96	4	NWS
Northwest Swift	127,590	J3 Consortium	Mitsubishi Nagasaki	Sep-89	Japan	S	Moss	4	NWS
Oak Spirit	173,400	Teekay	Daewoo	Jan-16	Bahamas	MEGI-DF	NO. 96 GW	4	Cheniere
Ob River	150,000	Lance Shipping	Hyundai	Oct-07	Marshall Is.	S	TZ Mk. III	4	Various
Onaiza	210,100	Nakilat	Daewoo	Apr-09	Liberia	DRL	GT NO 96	4	Qatar-Atlantic Basin
Pacific Arcadia	147,200	NYK Line	MHI	Oct-14	Bahamas	S	KM		Various
Pacific Enlighten	145,000	LNG MT	Mitsubishi	Mar-09	Japan	S	Moss	4	Various
Pacific Eurus	137,000	LNG Marine Transport	Mitsubishi Nagasaki	Mar-06	Bahamas	S	Moss	4	Darwin
Pacific Notus	137,006	Pacific LNG Shipping	Mitsubishi Nagasaki	Sep-03	Bahamas	S	Moss	5	Darwin
Palu LNG	160,106	TMSC Gas	Daewoo	Jun-14	Malta	TFDE	GT No 96	4	Various
Papua	171,800	MOL-China	Hudong	Jan-15	Hong Kong	DFDE	SSD	4	PNG LNG
Polar Eagle	89,880	Polar LNG	IHI Chita	Jun-93	Liberia	S	IHI SPB	4	ConocoPhillips/Marathon
Prachi	173,000	NYK-SCI	Hyundai	Nov-16	Singapore	TFDE	GT No 96	4	Petronet
Provalys	153,500	Gaz de France	Chantiers	Nov-06	France	DFDE	CS1	4	ELNG
Puteri Delima	130,400	MISC	Atlantique	Jan-95	Malaysia	S	GT NO 96	4	Petronas

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Puteri Delima Satu	137,100	MISC	Mitsui Chiba	Apr-02	Malaysia	S	GT NO 96	4	Petronas
Puteri Firuz	130,400	MISC	Atlantique	May-97	Malaysia	S	GT NO 96	4	Petronas
Puteri Firuz Satu	137,100	MISC	Mitsubishi Nagasaki	Sep-04	Malaysia	S	GT NO 96	4	Petronas
Puteri Intan	130,400	MISC	Atlantique	Aug-94	Malaysia	S	GT NO 96	4	Petronas
Puteri Intan Satu	137,100	MISC	Mitsubishi Nagasaki	Dec-01	Malaysia	S	GT NO 96	4	Petronas
Puteri Mutiera Satu	137,100	MISC	Mitsui Chiba	Apr-05	Malaysia	S	GT NO 96	4	Petronas
Puteri Nilam	130,400	MISC	Atlantique	Jun-95	Malaysia	S	GT NO 96	4	Petronas
Puteri Nilam Satu	137,100	MISC	Mitsubishi Nagasaki	Sep-03	Malaysia	S	GT NO 96	4	Petronas
Puteri Zamrud	130,400	MISC	Atlantique	May-96	Malaysia	S	GT NO 96	4	Petronas
Puteri Zamrud Satu	137,100	MISC	Mitsui Chiba	Apr-87	Malaysia	S	GT NO 96	4	Atlantic LNG
Raahi	136,000	Petronet LNG Ltd	Daewoo	Dec-04	Malta	S	GT NO 96	4	Qatargas
Ramdane Abane	126,130	SNTM-Hyproc	Atlantique	Jul-81	Algeria	S	GT NO 85	5	Sonatrach
Rasheeda	266,000	QGTC	Samsung	Jun-10	Liberia	DRL	TZ Mk. III		Various
Ribera del Duero Knutsen	173,400	Knutsen	Daewoo	Nov-10	Nor-NIS	DFDE	GT NO. 96	4	Various
Salalah LNG	147,000	Oman Gas/MOL	Samsung	Dec-05	Japan	S	TZ Mk. III	4	Oman
SCF Polar	71,500	Sovcomflot	Kockums	Aug-69	Liberia	S	GT NO 82	6	Sonatrach
Seishu Maru	162,000	K Line-Transpacific	Kawasaki Sakaide	Jan-15	Panama	S	Moss	4	Australia-Japan
Seri Alam	138,000	MISC	Samsung	Oct-05	Malaysia	S	TZ Mk. III	4	Yemen LNG
Seri Amanah	145,000	MISC	Samsung	Mar-06	Malaysia	S	TZ Mk. III	4	Yemen LNG
Seri Anggun	145,000	MISC	Samsung	Nov-06	Malaysia	S	TZ Mk. III	4	Yemen LNG
Seri Angkasa	145,000	MISC	Samsung	Feb-07	Malaysia	S	TZ Mk. III	4	Petronas
Seri Ayu	145,000	MISC	Samsung	Oct-07	Malaysia	S	TZ Mk. III	4	Various
Seri Bakti	152,300	MISC	Mitsubishi	Mar-07	Malaysia	S	GT NO 96	4	Petronas
Seri Balhaf	152,000	MISC	Mitsubishi	Sep-08	Malaysia	S	GT NO 96	4	Various
Seri Balquis	152,000	MISC	Mitsubishi	Dec-08	Malaysia	S	GT NO 96	4	Various
Seri Begawan	152,300	MISC	Mitsubishi	Dec-07	Malaysia	S	GT NO 96	4	Various
Seri Bijaksana	152,300	MISC	Mitsubishi	Feb-08	Malaysia	S	GT NO 96	4	Petronas
Seri Camellia	150,000	MISC	Hyundai	Nov-16	Malaysia	S	Moss	5	Petronas
Seri Cenderawasih	150,000	MISC	Hyundai	Jan-17	Malaysia	S	Moss	5	Petronas
Sestao Knutsen	138,000	Knutsen	IZAR Sestao	Jan-07	Spain	S	GT NO 96	4	Atlantic LNG
Sevilla Knutsen	173,400	Knutsen	Daewoo	Jun-10	N.I.S.	DFDE	GT NO 96	4	Various
Shahamah	135,500	National Gas Shipping	Kawasaki Sakaide	Oct-94	Liberia	S	Moss	5	ADGAS
Shangra	266,000	QGTC	Samsung	Nov-09	Liberia	DRL	TZ Mk. III	5	Qatargas IV
Shen Hai	147,100	China LNG	Hudong Zhonghua	Sep-12	China	AB/CC Steam	GT NO 96	4	Various
Simaisma	147,700	Maran Gas Maritime	Daewoo	Jul-06	Greece	S	GT No 96	4	Qatar
SK Splendor	138,375	SK Shipping	Samsung	Mar-00	Panama	S	TZ Mk. III	4	Oman Gas
SK Stellar	138,375	SK Shipping	Samsung	Dec-00	Panama	S	TZ Mk. III	4	RasGas
SK Summit	138,000	SK Shipping	Daewoo	Aug-99	Panama	S	GT NO 96	4	RasGas
SK Sunrise	138,306	I. S. Carriers	Samsung	Sep-03	Panama	S	TZ Mk. III	4	RasGas
SK Supreme	138,200	SK Shipping	Samsung	Jan-00	Panama	S	TZ Mk. III	4	RasGas
Sohar LNG	137,250	Oman Gas/ MOL	Mitsubishi Nagasaki	Oct-01	Malta	S	Moss	5	Oman Gas
Solaris	155,000	GasLog	Samsung	Jul-14	Bermuda	TFDE	TZ Mk. III	4	Various
Sonangol Benguela	160,500	Sonangol	Daewoo	Sep-11	Bahamas	S	GT No. 96	4	Angola LNG
Sonangol Etosha	160,500	Sonangol	Daewoo	Sep-11	Bahamas	S	GT No. 96	4	Angola LNG
Sonangol Sambizanga	160,500	Sonangol	Daewoo	Sep-11	Bahamas	S	GT No. 96	4	Angola LNG
Southern Cross	172,000	MOL	Hudong	May-15	Hong Kong	DRL	GT NO. 96	4	Various
Soyo	160,400	Mitsui/NYK/Teekay	Samsung	May-11	Bahamas	DFDE	TZ Mk. III	4	Various
Spirit of Hela	177,000	MOL	Hyundai	Oct-09	Panama	DFDE	TZ Mk. III	4	Various
Stena Blue Sky	145,700	Stena	Daewoo	Jan-06	Panama	S	GT No 96	4	Various
Stena Clear Sky	171,800	Stena	Daewoo	Sep-10	Panama	DFDE	GT NO 96	4	Various
Stena Crystal Sky	171,800	Stena	Daewoo	Jul-10	Panama	DFDE	GT NO 96	4	Various
STX Kolt	145,700	STX Panocean	Korea Hanjin	Nov-08	Panama	DFDE	TZ Mk. III	4	Various
Suez Point Fortin	154,200	Trinity LNG	Koyo Japan	Nov-09	Panama	S	TZ Mk. III	4	Yemen LNG
Taitar No. 1	145,000	NYK Line	Mitsubishi	Oct-09	Liberia	S	Moss	4	Various
Taitar No. 3	145,000	NYK Line	Mitsubishi	Jan-10	Liberia	S	Moss	4	Various
Taitar No. 4	145,000	NYK	Mitsubishi	Jan-10	Liberia	S	Moss	4	Various
Tangguh Batur	145,700	Sovcomflot/NYK	Daewoo	Dec-08	Cyprus	S	GT NO 96		Tangguh
Tangguh Foja	155,000	K Line	Samsung	Jul-08	Panama	DFDE	TZ Mk. III	4	Tangguh LNG
Tangguh Hiri	155,000	Teekay LNG	Hyundai	Nov-08	IOM	DFDE	TZ Mk. III	4	Tangguh
Tangguh Jaya	145,700	K Line	Samsung	Nov-08	Panama	DFDE	TZ Mk. III	4	Tangguh
Tangguh Palung	155,000	K Line	Samsung	Mar-09	Panama	DFDE	TZ Mk. III	4	Tangguh
Tangguh Sago	155,000	Teekay LNG	Hyundai	Mar-09	IOM	DFDE	TZ Mk. III	4	Tangguh LNG
Tangguh Towuti	145,700	Sovcomflot/NYK	Daewoo	Oct-08	Cyprus	S	GT NO 96	4	Tangguh
Tembek	216,200	OSG/Nakilat	Samsung	Sep-07	Marshall Is.	DRL	TZ Mk. III	4	Qatargas II
Tenaga Satu	130,000	MISC	Dunkerque	Sep-82	Malaysia	S	GT NO 88	5	Petronas
Trinity Arrow	154,900	K Line	Imabari Shipbuilding	Mar-08	Panama	S	TZ Mk. III	4	Various
Umm Al Amad	210,100	J5	Daewoo	Aug-08	Marshall Is.	DRL	GT NO 96	4	Ras Gas III
Umm Al Ashtan	137,000	National Gas Shipping	Kvaerner- Masa	May-97	Liberia	S	Moss	4	ADGAS
Umm Bab	145,000	Kristen Navigation	Daewoo	Nov-05	Bermuda	S	GT NO 96	4	Qatargas
Umm Slaal	266,000	QGTC	Samsung	Nov-08	Qatar	DRL	TZ Mk. III	5	Qatargas
Valencia Knutsen	173,400	Knutsen	Daewoo	Sep-10	Nor-NIS	DFDE	GT NO. 96	4	Various
Velikiy Novgorod	170,200	SovComFlot	STX	Feb-14	Liberia	DFDE	GT No. 96	4	Various
Wakaba Maru	125,000	J3 Consortium	Mitsui Chiba	Apr-85	Japan	S	Moss	5	Pertamina
WilEnergy	125,500	Awilco LNG	Mitsubishi	Oct-83	NIS	S	Moss	5	Various
WilForce	156,000	Teekay LNG	Daewoo	Aug-13	NIS	DFDE	GT NO 96	4	Various
WilGas	125,500	Awilco LNG	Mitsubishi	Jul-84	NIS	S	Moss	5	Various
WilPower	125,500	Awilco LNG	Mitsubishi	Jul-84	NIS	S	Moss	5	Various
Woodside Cheney	174,000	Maran	Hyundai Samho	March-16	Greece	DFDE	GT No 96	4	Various
Woodside Donaldson	165,500	Teekay LNG	Samsung	Dec-09	Singapore	DFDE	TZ Mk. III	4	Various
Woodside Goode	159,800	Maran	Daewoo	Jul-14	Greece	DFDE	GT No. 96	4	Various
Woodside Rogers	155,900	Maran Gas	DSME	Jul-13	Greece	DFDE	GT NO 96	4	Various
Yari LNG	159,983	TMSC Gas	Daewoo	Jun-14	Malta	TFDE	GT No 96	4	Various
Yenisei River	155,000	Dynagas	Hyundai	Jul-13	Marshall Is.	DFDE	TZ Mk. III	4	Various
YK Sovereign	127,125	SK Shipping	Hyundai	Dec-94	Panama	S	Moss	4	Pertamina
Zarga	266,000	QGTC	Samsung	Dec-09	Liberia	DRL	TZ Mk. III	5	Qatar-Atlantic
Zekreet	135,420	J4 Consortium	Mitsui Chiba	Dec-98	Japan	S	Moss	5	Qatargas

Any observations, additions or suggested revisions to the LNG journal World LNG Carrier Fleet list should be sent to editor@lngjournal.com

LNG Import Terminals

Explanatory Notes

- The tables do not include the following types of LNG facilities :
 - ♦ Small marine satellite terminals receiving LNG from liquefaction plants in their own country (such as exist in Norway) or which receive LNG transhipped from nearby reception terminals in their own country (such as in Japan)
 - ♦ Satellite LNG storage facilities that receive LNG transported only by road or rail
- Expansions of LNG reception terminals are only shown if they involve new storage tanks
- Where there is a blank in the table the information is uncertain or unknown.

Any comments on the tables, and corrections / additional information from terminal shareholders and project developers would be most welcome, and should be sent to [John McKay](mailto:John.McKay@lngjournal.com) e-mail editor@lngjournal.com

Country	Location (Project)	Owners	Start up	Storage	
				Tanks	Capacity
Belgium	Zeebrugge	Fluxys	1987	4	380,000
Canada	Canaport Saint John	Irving Oil, Repsol	2009	3	480,000
Chile	Quintero	ENAP, Metrogas, Enagas	2009	3	334,000
	Mejillones	Engie, Codelco	2010	1	175,000
China	Beihai LNG, Guangxi	Sinopec	2015	2	320,000
	Dalian	PetroChina	2011	3	480,000
	Dongguan, Guangdong	Jovo Group	2013	2	160 000
	Fujian LNG (Xiuyu)	CNOOC, Fujian I&D Corp.	2008	2	640,000
	Guangdong	CNOOC,BP	2006	3	480,000
	Haikou, Hainan LNG	CNOOC	2014	3	480,000
	Ningbo, Zhejiang	CNOOC, Zhejiang Energy	2012	3	480,000
	Qingdao, Shandong	Sinopec	2014	3	480,000
	Rudong	PetroChina	2011	3	530,000
	Shanghai	CNOOC, Shenergy Group	2009	3	495,000
	Shanghai, Mengtougou	Shanghai Gas	2008	3	120 000
	Tangshan, Hebei	PetroChina	2013	3	480,000
	Tianjin FSRU	CNOOC	2014	1	60,000
	Zhuhai, Gaolan	CNOOC	2013	3	480,000
Dominican Republic	Punta Caucedo	AES Andres	2003	1	160 000
Finland	Pori	Gasum Skangas	2016	1	30,000
France	Fos Tonkin	Elengy	1972	3	150,000
	Montoir-de-Bretagne	Elengy	1980	3	360,000
	Fos Cavaou	Engie, Total	2010	3	330,000
	Dunkirk LNG	EDF, Fluxys, Total	2016	3	570,000
Greece	Revithoussa	DEPA	2000	2	130,000
India	Dabhol	GAIL, NTPC (Ratnagiri Gas & Power)	2009	3	480,000
	Dahej	Petronet LNG	2004	4	592,000
	Hazira	Shell India, Total	2005	2	320,000
	Kochi, Kerala	Petronet LNG	2013	2	320,000
Indonesia	Arun	Pertamina	2015	5	507,000
Italy	Panigaglia	Snam	1969	2	100,000
	Porto Levante (offshore GBS)	ExxonMobil, Qatar Petroleum, Edison Gas	2009	2	250,000
Japan	Negishi	Tokyo Gas	1969	14	1,180,000
	Sodegaura	Tokyo Gas	1973	35	2,660,000
	Ohgishima	Tokyo Gas	1998	4	850,000
	Higashi-Ohgishima	Tokyo Electric	1984	9	540,000
	Futtsu	Tokyo Electric	1985	10	1,110,000
	Yokkaichi LNG	Chubu Electric	1988	4	320,000
	Kawagoe	Chubu Electric	1997	6	840,000
	Yokkaichi Works	Toho Gas	1991	2	160,000
	Chita LNG Joint	Toho Gas, Chubu Electric	1978	4	300,000
	Chita LNG	Toho Gas, Chubu Electric	1983	7	640,000
	Chita - Midorihama	Toho Gas	2001	2	400,000
	Senboku I	Osaka Gas	1972	4	180,000
	Senboku II	Osaka Gas	1977	18	1,585,000
	Himeji	Osaka Gas	1984	8	740,000
	Himeji LNG	Kansai Electric	1979	7	520,000
	Yanai	Chugoku Electric	1990	6	480,000
	Niigata	Nihonkai LNG, Tohoku Electric	1984	8	720,000
	Oita	Oita Gas, Kyushu Electric	1990	5	460,000
	Tobata	Kitakyushu LNG	1977	8	480,000
	Fukuoka	Saibu Gas	1993	2	70,000
	Sodeshi	Shizuoka Gas	1996	3	337,200
	Hatsukaichi	Hiroshima Gas	1996	2	170,000
	Kagoshima	Nippon Gas	1996	2	136,000
	Shin-Minato	Sendai City Gas	1997	1	80,000
	Nagasaki	Saibu Gas	2003	1	36,000
	Sakai	Kansai Electric, Cosmo Oil	2006	3	420,000
	Mizushima	Nippon Oil, Chugoku Electric	2006	2	320,000
	Sakaide	Shikoku Electric, Cosmo Oil	2011	1	180,000
	Ishikari LNG	Hokkaido Gas, Hokkaido Electric	2012	2	380,000
	Okinawa	Okinawa Electric Power	2012	2	280,000
	Naoetsu	Inpex	2013	2	360,000
	Joetsu	Chubu	2011	3	540,000
	Hachinohe LNG	Nippon Oil	2015	2	280,000
	Hitachi LNG	Tokyo Gas	2015	1	230,000
Korea	Incheon	Kogas	1996	20	2,880,000
	Kwangyang	POSCO	2005	4	530,000
	Pyeong-Taek	Kogas	1986	23	3,360,000
	Samcheok	Kogas	2014	3	600,000
	Tong-Yeong	Kogas	2002	17	2,620,000
Mexico	Altamira	Vopak, Enagas	2006	2	300,000
	Energia Costa Azul	Sempra LNG	2008	2	320,000
	Manzanillo	Samsung, Kogas, Mitsui	2012	2	300,000
Netherlands	Gate LNG	Gasunie, Royal Vopak	2011	3	540,000
Poland	Swinoujscie	Baltic Gaz System	2015	2	320,000
Portugal	Sines	REN Atlantico	2004	3	390,000

LNG Import Terminals (continued)

Country	Location (Project)	Owners	Start up	Tanks	Storage Capacity
Puerto Rico	Penuelas	EcoElectrica	2000	1	160,000
Singapore	Singapore	Singapore Energy Authority	2013	3	540,000
Spain	Barcelona	Enagas	1969	8	840,000
	Huelva	Enagas	1988	5	610,000
	Cartagena	Enagas	1989	5	587,000
	Bilbao	Enagas, EVE	2003	3	450,000
	Sagunto	GNF, Osaka Gas, Oman Oil	2006	4	600,000
	Reganosa, Ferrol	Galicia, Sonatrach, Tojeiro	2006	2	300,000
	El Musel, Gijón,	Enagas	2013	2	300,000
Taiwan	Yung-An	CPC	1990	6	690,000
	Tai-chung	CPC	2009	3	480,000
Thailand	Map Ta Phut	PTT LNG	2011	2	320,000
Turkey	Marmara Ereglisi	Botas	1994	3	255,000
	Izmir	EgeGaz	2006	2	280,000
USA	Everett	Suez LNG NA	1971	2	155,000
	Lake Charles	Shell, ETE	1982	4	425,000
	Elba Island	Kinder	2001	5	535,000
	Cove Point	Dominion	2003	5	530,000
	Freeport	Freeport LNG Development	2008	2	320,000
	Cameron	Sempra LNG	2009	3	480,000
	Golden Pass, TX	Qatar Petroleum, ExxonMobil	2010	5	775,000
	Pascagoula, MS	Gulf LNG, Kinder	2012	2	320,000
UK	Isle of Grain	National Grid	2005	8	1,000,000
	South Hook	ExxonMobil, Qatar Petroleum, Total	2009	5	775,000
	Dragon LNG, Milford Haven	Shell, Petronas	2009	2	310,000

LNG Import Terminal Projects

Country	Location/Project	Owners/Project Developers	Start up	Tanks	Storage Capacity
China	Swatuo, Guangdong	CNOOC	2017	2	320,000
	Yingkou, Liaoning	CNOOC	2017	2	320,000
	Qidong, Jiangsu	Shell-Guanghui	studies		
	Yuedong LNG, Jieyang, Guangdong	CNOOC	2017	2	320,000
	Tianjin North	Sinopec	2017	2	320,000
Finland	Tornio	Gasum Skanga	2018	1	30,000
India	Ennore	Indian Oil Corp	2018	2	320,000
	Mundra	Gujarat State Petroleum, Adani Group	2018	2	320,000
	FSRU Andhra Pradesh	Engie, Andhra Pradesh Gas	2018	1	135,000
	Pipovav LNG (FSRU), Gujarat	Swan Energy	2018	2	320,000
	Andhra Pradesh	Hindustan LNG, Andhra Pradesh	studies	1	135,000
Indonesia	Labuhan Maringgai	Perusahaan Gas Negara	2018	1	135,000
Japan	Soma, Fukushima	Japan Petroleum	2018	1	230,000
Malaysia	Lahad Datu LNG, Sabah	Petronas	2018	studies	
Philippines	Pagbilao LNG	Energy World Corp.	2018	1	130,000
UK	Port Meridian, Barrow-in-Furness	Port Meridian Energy Ltd.	2018	1	150,000
Uruguay FSRU	Montevideo	Gas Sayago, Mitsui Osk Lines	2018	1	230,000

LNG FSRU Import Facilities

Country	Location (Project)	Owners	Start up
Argentina	Bahia Blanca GasPort	Excelerate/YPF Repsol	2008
	Escobar GasPort	Excelerate/Enarsa	2011
Brazil	Pecem, FSRU	Petrobras	2009
	Guanabara Bay FSRU	Petrobras	2009
	Salvador, Bahia FSRU	Petrobras	2013
Colombia	Cartagena FSRU	Promigas, Sociedad Portuaria El Cayao	2016
Egypt	Ain Sokhna, Suez	EGAS, Hoegh	2015
	Ain Sokhna, Suez	EGAS, BW Gas	2015
Indonesia	Lampung	Hoegh LNG, PGN LNG	2014
	Nusantara (Jakarta Bay)	Golar LNG, Pertamina	2012
Italy	Livorno	OLT Offshore LNG Toscana	2013
Jordan	Aqaba, Jordan	Golar LNG	2015
Kuwait	Mina Al-Ahmadi	KPC	2009
Lithuania	Klaipeda	Klaipedos Nafta Hoegh LNG	2014
Malaysia	Malacca FSRU	Petronas	2012
Pakistan	Port Qasim	Excelerate, Engro Corp	2015
UAE	Ruwais, Abu Dhabi	Gasco (UAE)	2016
	Jebel Ali Port, Dubai	DSA (UAE)	2010
UK	Teesside GasPort	Excelerate	2007

LNG Export Projects

Country	Location/Project	Project Developers	Planned Start Up	Number of Trains	Capacity In MTPA
AUSTRALIA	Browse LNG	Woodside, BHP, BP Chevron, Shell, Mitsubishi, Mitsui	2021+	2	10.0
	Ichthys LNG	INPEX, Total	2017	2	8.4
	Prelude FLNG	Shell, Inpex, Kogas CPC	2018	1	3.5
	Sunrise LNG	Woodside, Osaka Gas, ConocoPhillips, Shell	2020+	1	3.5
	Wheatstone LNG	Chevron, Apache, Shell , Kuwait FPEC	2017	2	9.0
CANADA	Aurora LNG BC	CNOOC, Inpex Corp. and JGC Corp.	2024	4	24.0
	Bear Head LNG, Nova Scotia	LNG Ltd.	2024	4	8.0
	GNL Quebec, Saquenay	Freestone Capital and Breyer Capital	2024	4	10.0
	Goldboro LNG, Nova Scotia	Pieridae Energy	2024	2	10.0
	Grassy Point LNG	Woodside Petroleum	2024	studies	
	Kitimat LNG, BC	Woodside, Chevron	2024	2	10.0
	LNG Canada, BC	Shell, Mitsubishi, Kogas, PetroChina	2024	2	12.0
	Melford LNG project, Nova Scotia	H-Energy Hiranandani Group	Studies		
	Pacific Northwest LNG, BC	Petronas, Japex, Sinopec, Indian Oil, Brunei Petroleum	2021	2	12.0
	Steelhead LNG, Bamfield	Steelhead LNG Corp	2021	2	12.00
	Vancouver Tilbury	WesPac Midstream	2021	1	3.25
	Woodfibre LNG, Squamish	Pacific Oil & Gas Co	2020	2	2.1
EQ.GUINEA	Equatorial Guinea Fortuna FLNG	Ophir and Golar LNG	2019	1	2.0
INDONESIA	Sengkang LNG	Energy World Corp.	2017	4	2.0
MALAYSIA	Rotan FLNG (Sabah)	Petronas	2019	1	1.5
MOZAMBIQUE	Area 1 Onshore	Anadarko Petroleum and partners	2021	2	10
	Area 4 Onshore	Eni and partners	2021	2	10
	Area 4 FLNG	Eni and partners	2019	1	2.5
NIGERIA	NLNG Train 7	NNPC, Shell, BP, Total	2020+	1	8.4
PAPUA NEW GUINEA	Elk-Antelope LNG	Total, InterOil, Oil Search, Petromin	Studies		
RUSSIA	Yamal LNG Siberia	Novatek, Gazprom, Total	2018	3	16.5
	Sakhalin II expansion	Gazprom, Shell, Mitsui, Mitsubishi	2021	studies	
	Vladisvostok LNG	Gazprom, Itochu, various	2021	2	10.0
USA	Alaska LNG Nikiski	Alaska Gasline Development Corp.	2022	3	20.0
	Annova LNG, Brownsville	Exelon Corp.	2021	6	6.0
	Cameron LNG, Louisiana	Sempra	2018	5	24.92
	Corpus Christi Liquefaction, Texas	Cheniere	2019	5	22.5
	Cove Point LNG, Maryland	Dominion	2018	1	5.25
	Delfin LNG, Louisiana	Delfin, Hoegh	2021	3	9.0
	Driftwood LNG, Louisiana	Tellurian Investments	2022	6	26.0
	Elba Island, Georgia	Kinder Morgan, EIG Energy	2018	10	2.5
	Freeport LNG, Texas	Freeport LNG	2018	4	20.4
	Golden Pass, Texas	Qatar Petroleum, ExxonMobil	2021	3	15.6
	Jordan Cove, Coos Bay	Veresen Inc.	2024	2	7.8
	Lake Charles, Louisiana	Shell, ETE	2024	3	15.0
	Magnolia LNG	Louisiana LNG Ltd.	2021	4	8.0
	Port Arthur LNG	Sempra	2021	2	10.0
	Rio Grande LNG	NextDecade	2021	6	27.0
	Sabine Pass LNG, Louisiana	Cheniere	2016-19	5	22.5
	Texas LNG Brownsville	Chandra, Meyer, Samsung, others	2021	2	4.0
	VG LNG (Cameron Parish)	Venture Global	2021	5	10.0
	VG LNG (Plaquemines)	Venture Global	2021	10	20.0

LNG Exporters

Country	Location/Project	Shareholders	Start up	Liquefaction		Storage	
				Trains	capacity (nominal) mtpa	No. of tanks	Total capacity m³
ABU DHABI (UAE)	Das Island (Adgas)	ADNOC, Mitsui, BP, Total	1977 1994	2 1	3.2 2.5	3	240,000
ALGERIA	Arzew	Sonatrach GL4Z	1964	3	1.1	3	35,000
	Arzew	Sonatrach GL1Z	1978	6	7.8	3	300,000
	Arzew	Sonatrach GL2Z	1980	6	8.0	3	300,000
	Arzew	Sonatrach	2014	1	4.7		
	Skikda	Sonatrach GL1K II	1980	3	3.0	5	308,000
	Skikda	Sonatrach (rebuild)	2013	1	4.5		
ANGOLA	Soyo	Sonangol, Chevron, BP, ENI, Total	2012	1	5.2	2	370,000
AUSTRALIA	Karratha	NWS Woodside, Shell, BHP	1989	2	5.0	4	260,000
		(BP, Chevron	1992	1	2.5	1	130,000
		(Mitsubishi/Mitsui)	2004	1	4.4	1	130,000
		NWS partners	2008	1	4.4	1	130,000
		Darwin (Bayu Undan) ConocoPhillips, Santos, Eni, Inpex, TEPCO, Tokyo Gas	2006	1	3.5	1	188,000
	Australia Pacific LNG	ConocoPhillips, Origin Energy, Sinopec	2016	2	7.5	2	320,000
	Gladstone LNG	Santos, Petronas, Total, Kogas	2015	2	7.8	2	280,000
	Gorgon LNG	Chevron, Shell, ExxonMobil	2016	3	15.6	2	360,000
	Pluto LNG	Woodside, Tokyo Gas, Kansei	2012	1	4.8	2	240,000
	QCLNG	Shell, CNOOC	2014	2	8.0	2	280,000
BRUNEI	Lumut	Brunei/Shell/Mitsubishi/Total	1972-74	5	7.2	3	176,000
EGYPT	Damietta	Union Fenosa, EGPC, EGAS	2004	1	5.0	2	300,000
	Idku	EGPC, EGAS, Shell, Engie, Petronas	2005	2	7.2	2	280,000
EQ. GUINEA	Bioko Island	Marathon, Sonagas, Mitsui, Marubeni	2007	1	3.4	2	272,000
INDONESIA	Bontang I	Pertamina, VICO, JILCO, Total	1977	2	5.2	5	635,000
	Bontang II		1983	2	5.2		
	Bontang III		1989	1	2.8		
	Bontang IV		1993	1	2.8		
	Bontang V		1997	1	2.8		
	Bontang VI		1999	1	3.0		
	Sulawesi LNG	Medco Energi, Pertamina, Mitsubishi	2015	1	2.0	1	170,000
	Tangguh	BP, MI Berau, CNOOC, Nippon, LNG Japan	2008	2	7.6	2	340,000
MALAYSIA	Bintulu (MLNG Satu)	Petronas, Sarawak, Mitsubishi	1983	3	8.1	4	260,000
	Bintulu (MLNG Dua)	Petronas, Shell, Sarawak, Mitsubishi	1995	3	7.8	1	65,000
	Bintulu (MLNG Tiga)	Petronas, Shell, Sarawak, Mitsubishi, Nippon Oil	2003	2	6.8	1	120,000
	Bintulu Train 9	Petronas	2016	1	3.6		
	Kanowit FLNG	Petronas	2016	1	1.2		
NIGERIA	Bonny Island	NNPC, Shell, Total, Eni	1999	2	6.4	2	168,400
		Nigeria LNG (formed by above)	2002	1	3.2	1	84,200
		Nigeria LNG	2006	2	8.2		
		Nigeria LNG	2008	1	4.1	1	84,200
NORWAY	Snøhvit/Melkoya Island	Statoil, Total, GDF-Suez, Petoro	2007	1	4.2	2	280,000
OMAN	Oman LNG	Oman Govt., Shell, Total, Korea LNG	2000	2	7.1	2	240,000
		Mitsubishi, Mitsui, Partex and Itochu					
		Oman Govt., Oman LNG Union Fenosa, Osaka Gas, & Itochu	2006	1	3.7	2	240,000
PAPUA NEW GUINEA	PNG LNG	ExxonMobil, Oil Search, Santos, JX Nippon Oil	2014	2	6.9	2	320,000
PERU	Peru LNG	Hunt Oil, Shell, Marubeni, SK Group	2010	1	4.4	2	260,000
QATAR	Qatargas 1-T1&2	QP, ExxonMobil, Total, Marubeni, Mitsui	1997	2	6.4	4	340,000
	Qatargas 1-T3	QP, ExxonMobil, Total, Marubeni, Mitsui	1999	1	3.1		
	Qatargas II-T1	QP, ExxonMobil	2009	1	7.8		
	Qatargas II-T2	QP, ExxonMobil, Total	2009	1	7.8	8	1,160,000
	Qatargas III-T1	QP, ConocoPhillips, Mitsui	2010	1	7.8		
	Qatargas IV-T1	QP, Shell	2010	1	7.8		
	RasGas I- T1&2	QP, ExxonMobil, Kogas, Itochu, LNG Japan	1999	2	6.6		
	RasGas II- T3	QP, ExxonMobil	2004	1	4.7	6	840,000
	RasGas II- T4	QP, ExxonMobil	2005	1	4.7		
	RasGas II- T5	QP, ExxonMobil	2007	1	4.7		
	Rasgas III – T6	QP, ExxonMobil	2009	1	7.8		
	Rasgas III – T7	QP, ExxonMobil	2010	1	7.8		
RUSSIA	Sakhalin Island	(Sakhalin Energy) Gazprom, Shell, Mitsui, Mitsubishi	2009	2	9.6	2	200,000
TRINIDAD & TOBAGO	Point Fortin Train 1	BP, Shell, Suez, NGC	1999	1	3.0	2	204,000
	Train 2	BP, Shell	2002	1	3.3	1	160,000
	Train 3	BP, Shell	2003	1	3.3	1	160,000
	Train 4	BP, Shell, NGC	2005	1	5.2	1	160,000
USA	Cheniere Sabine Pass	Cheniere Energy	2016	1	4.5	5	800,000
	Kenai - Alaska	ConocoPhillips, Marathon Oil	1969	2	1.3	3	108,000
YEMEN	Bal-Haf	Yemen LNG, Total, Yemen Gas, Hunt Oil, SK Group, Hyundai	2009	2	6.7	2	320,000

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