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Emerging Asia-Pacific markets fire Australian LNG export development

China and India seen as outlets for new capacity amid ramp-up of import infrastructure

China's liquefied natural gas imports are forecast to increase by 21 percent to 32 million tonnes in 2017, with the Chinese aiming to increase the share of natural gas in the energy mix from 5 percent to 10 percent by 2020, with policy efforts directed at the electricity generation and transport sectors.

After contracting in 2015, China's LNG imports rebounded in 2016, increasing 13 percent year-on-year. LNG imports grew alongside pipeline imports and domestic production, suggesting robust growth in consumption.

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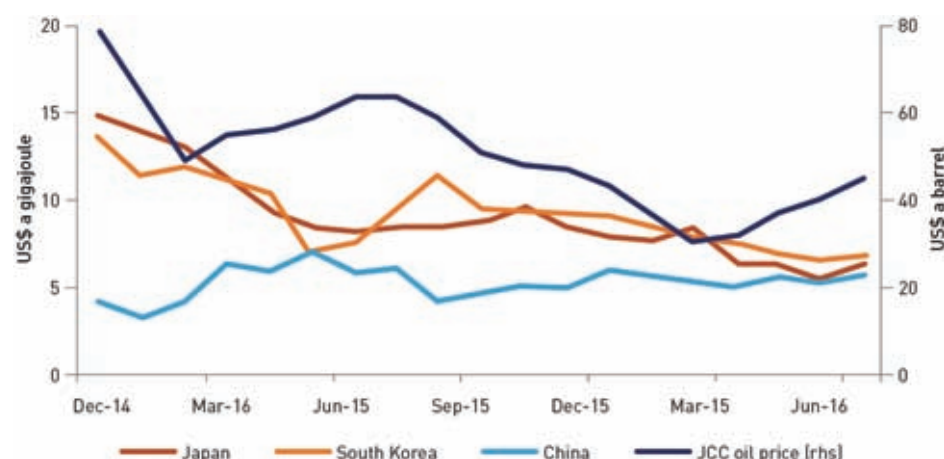
While China will also draw on both domestic reserves and pipeline imports to meet future gas demand, the commencement of long-term LNG contracts with Australian projects will support increased LNG imports.

The flow of cargoes from the Australia Pacific coal-seam-gas-to-LNG plant in Queensland supports this view, with figures coming from the quarterly report from the Australian Ministry of Industry and Office of the Chief Economist, as well as earnings releases by LNG players such as stakeholder Origin Energy.

According to Origin, most cargoes shipped from the Australia Pacific LNG's facility on Curtis Island in Queensland in the third quarter went to the Chinese energy group Sinopec and Japanese utility Kansai Electric Power at average prices of US\$282 per tonne.

The APLNG roundup came in the third-quarter report of Origin, the Australian utility and coal-seam-gas producer and main shareholder in the plant with ConocoPhillips.

Origin is the upstream feed-gas supplier and holds a 37.5 percent stake in the Curtis Island plant. ConocoPhillips has the same shareholding as Origin while Sinopec holds the remaining 25 percent.



How prices have developed in market for Australian LNG exports. China and India are seen as growing outlets for WA and Queensland volumes

Sinopec has signed up for 7.7 million tonnes per annum of LNG from APLNG for 20 years from the two processing Trains, while 1 MTPA will be supplied to Kansai Electric.

Those cargoes are now beginning to flow, as are spot volumes from many Australian plants.

Shipments

Origin's production and earnings report said the cargoes sent to China and Japan cost 2 percent more than the US\$275 per tonne in the previous quarter.

The APLNG cargo prices equated to US\$5.37 per million British thermal units and US\$5.23 per MMBtu for the third and second quarters respectively.

The average size of cargoes shipped from APLNG is around 150,000 cubic metres.

"Australia Pacific LNG achieved a number of significant milestones in October including production of the first cargo from Train 2 and successful completion of the 120-day Train 1 operational lenders' test, with all requirements met or exceeded," said Origin's Chief Executive for its Integrated Gas division, David Baldwin.

"During the quarter, a total of 19 cargoes were shipped from APLNG's facility on Curtis Island, predominantly to Sinopec and Kansai in accordance with

their respective long-term Sale and Purchase Agreements. A total of 53 cargoes have been shipped to date," Baldwin added.

It is also noted that in the Asia-Pacific region, expectations of persistent low spot prices encourage countries to continue to expand LNG import infrastructure, according to the quarterly report on commodities from the Australian Ministry of Industry.

"Despite relatively flat export volumes in June quarter, Australia's LNG exports have expanded rapidly over the past year. In 2015-16 Australia exported 37MT of LNG, an increase of 47 percent on the previous financial year," the report said.

The value of Australia's LNG exports is forecast to increase by 41 percent to \$23 billion in 2016-17, as a result of higher export volumes and increasing LNG prices.

Australia's LNG export volumes are forecast to increase by 40 percent to 51MT in 2016-17.

On stream

An additional 15 million tonnes of LNG export capacity is expected to be completed by mid-2017, bringing total operational capacity to around 66MT.

This includes the second and third trains at the Gorgon project in Western Australia, and the second Train at the

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Australia Pacific LNG project in Queensland.

Increased exports to Japan, South Korea and China are expected to drive the rise in Australia's export volumes.

"While prospects for total import growth in Japan and South Korea are subdued, Australian producers are expected to capture an increasing share of both country's imports with the commencement of a number of long-term contracts over the outlook period," the government report said.

Australian LNG exports to India have increased in September and October 2016, while its neighbour Pakistan signed an additional deal to purchase a Floating Storage and Regasification Unit (FSRU) for its second LNG import terminal.

The new Pakistani facility is seen taking some Australian shipments after it comes on line in mid-2017.

Imports of LNG by emerging Asian economies are expected to rise by 42 percent to 31 million tonnes in 2017.

Export values

The value of Australia's LNG exports is also forecast to increase by 41 percent to \$23 billion in 2016-17, supported by higher LNG prices and export volumes.

"LNG contract prices, under which most Australian LNG is sold, are forecast to increase in line with oil prices," the report said.

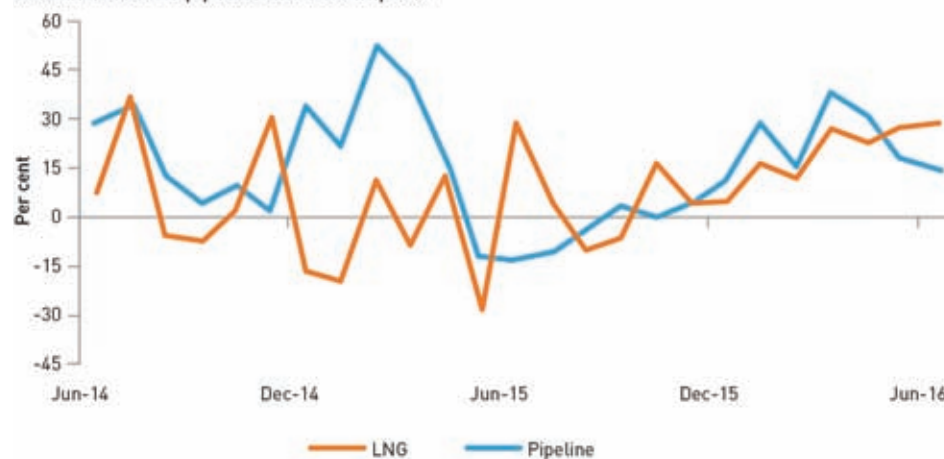
"Higher export volumes will be driven by the addition of around 15MT of LNG export capacity, bringing total operational capacity to around 66MT by mid-2017.

"After declining over the first five months of 2016, prices for Australian LNG delivered to markets in North East Asia increased in June," the report said.

"The average price of

LNG exports into

Growth in China's pipeline and LNG imports



Demand in China is for pipeline and LNG cargo imports

Japan, Australia's largest market and the world's largest importer, increased by 18 percent to US\$6.51 a gigajoule (\$6.17 per million British thermal units)," it added.

"The recent uptick in prices reflects the effect of the oil price rally in early 2016, with most LNG delivered into Asia sold under contracts linked to the Japanese Customs-cleared Crude (JCC) oil price, by a time lag of three to four months.

"The North East Asian spot price has increased over the past few months, averaging US\$5.80 a gigajoule (\$5.49 per MMBtu), but remains around historic lows, as a result of growing excess capacity in the market," the report said.

Prices for LNG delivered to North East Asia were expected to rise in the final quarter before flattening out.

"LNG contract prices are then expected to rise further in 2017, consistent with the forecast recovery of oil prices to US\$55 a barrel," the report stated.

In contrast, spot prices are forecast to remain low, as the entry of new capacity in the US and Australia ensures that the market remains well supplied.

The implications of a potential divergence between contract and spot

LNG prices remain to be seen, with one scenario that buyers begin to reduce LNG purchases to take-or-pay levels and seek to buy larger volumes on the spot market.

"Another issue that could affect spot markets relates to the future of destination clauses in contracts, which prevent buyers from re-directing LNG to other ports.

"China, Japan and South

Korea have agreed to contracts for imports starting over the next few years that will likely exceed their needs.

Destinations

"Against this backdrop, Japan's Fair Trade Commission has recently launched an investigation into whether destination clauses in contracts are uncompetitive.

"A move to loosen destination restrictions in contracts would make it easier for over-contracted buyers to enter the spot market as sellers, adding to downward pressure on spot prices," the report noted.

After several years of flat or declining LNG trade, growth in world trade is expected to increase by 7 percent in 2016 and 10 percent in 2017 to reach 285MT.

Growth will be driven by demand in emerging Asia and Europe and supported by a major expansion of LNG export infrastructure in Australia and the US.

However, the Australians reported that exploration activity declined for a sixth consecutive quarter.

Spending

"Australia's petroleum exploration expenditure declined to \$283M in the June quarter, down 34 per cent quarter-on-quarter and 59 percent year-on-year. This is the sixth consecutive quarterly decline, and exploration activity is now at its lowest level since the March quarter 2006," the report said.

That's as coal-seam gas continues to drive increased Australian natural gas production.

Australian gas production is estimated to have increased 23 percent in 2015-16 to around 82 billion cubic metres.

"The increase was driven by higher CSG production, which continues to expand to support new LNG export capacity on the east coast, while conventional gas production also rose.

"Australia's gas production is forecast

"LNG contract prices, under which most Australian LNG is sold, are forecast to increase in line with oil prices"



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to rise to 104 Bcm in 2016–17, as LNG export capacity continues to increase,” the report said.

Among the projects in Western

Australia, the Gorgon plant on Barrow Island is now operating as normal after being halted for two months after its first shipment in March, due to problems with

one of its cooling systems. Meanwhile, LNG contract prices, under which most Australian LNG is sold, are expected to increase as oil prices recover.

While this should drive up the average price of Australian LNG, persistent low spot prices are expected to weigh on the value of uncontracted production.

European demand

Lower than expected JCC oil prices in the June 2016 quarter, which saw LNG contract prices increase less quickly than previously expected in the second half of 2016, and a small downward revision to the oil price forecast, have affected the outlook for export earnings.

“Prospects for import growth in traditional demand centres remain subdued,” the Australian report said.

The Australian government report also forecasts an LNG recovery in Europe.

“Europe is expected to be another key source of demand growth to 2017. LNG imports are forecast to increase by 25 percent to 60MT in 2017.

“Indigenous production in Europe is expected to fall sharply, partly resulting from lower production at Europe’s largest natural gas field, Groningen in the Netherlands.

“The Dutch government announced it would lower the annual production cap at the Groningen gas field from 27 Bcm to 24 Bcm from October 2016, continuing efforts to reduce the frequency and intensity of earthquakes associated with production from the field,” the report explained.

Overall, the global LNG market is going through a period of significant transformation, with a major expansion of liquefaction capacity underway. ■

This article is based on a report from the Australian Ministry of Industry and Office of the Chief Economist.

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Current status examined of the LNG market opportunities in emerging nation like Myanmar

Nomita Nair, Chris Hughes and Ben Rosen of international law firm Berwin Leighton Paisner

With an increasingly open economic policy, growing political stability and the lifting of key US sanctions, Myanmar is ripe for investment.

However, Myanmar faces a severe electricity shortage. Despite having an estimated 18.7 trillion cubic feet of natural gas reserves, only less than 30 percent of Myanmar's population has access to electricity.

Strategy

This current level of national electrification poses a hindrance to foreign investors and domestic business owners who struggle to operate in an environment with a deficient and unreliable power supply.

Currently, the vast majority of Myanmar's natural gas is exported to neighbouring countries such as China and Thailand.

This supply comes principally from the offshore gas fields at Yadama and Yetagun, with commercial operations at Shwe and Zawtika having commenced in 2013.

The latest rounds of offshore and onshore oil and gas tenders also introduced major operators into the energy landscape but these sources of supply are only expected to come on stream over the next 10 years.

With most of the current production destined for foreign markets, the government is considering how it can prioritise and satisfy its domestic demand for electricity generation.

Expanding electricity access will require considerable investment and planning. As such, there are several initiatives in motion to provide universal electricity access in Myanmar.

Energy plans

1. National Electrification Project (NEP)

The government, in conjunction with the World Bank, has devised a plan to provide universal electricity access by 2030. This project is divided into 4 separate stages:

- Extending the distribution networks to connect further communities to the national power grid;
- Off-grid electrification of the most remote areas which are beyond the reach of the existing national grid;

- Technical assistance and project management for governmental departments to implement the NEP; and
- Contingent emergency response (CER). This operates as an emergency fund from the International Development Agency (IDA) to cope with an economic crisis or natural disaster.

The NEP will operate on a gradual step-by-step basis, achieving 50% electrification by 2020, 75% by 2025 and so on up to 2030. There are positive signs that progress is already being made on this front.

In 2015, the World Bank approved a \$400 million IDA credit to Myanmar for the purposes of grid extension and off-grid electrification.

2. National Energy Master Plan (NEMP)

The NEMP, supported by the Japan International Cooperation Agency (JICA), is an energy policy coordination body that aims to achieve 100% electrification by 2030 through the use of mixed energy resources such as coal, gas, hydroelectric and renewable energy.

The inspiration for using a mixed energy supply derives from the need to ensure a reliable energy supply while supporting economic growth in an efficient and environmentally responsible way. The NEMP should also provide the foundations for the long-term energy supply of Myanmar.

3. Assistance from the Asian Development Bank (ADB)

ADB has various projects in the pipeline with a view to supporting economic growth and alleviating poverty in Myanmar. One such example is the Power Transmission Improvement Project.

This is a loan from ADB to assist in the completion of the transmission ring that supplies electricity to the Yangon region, thereby supporting economic growth in the economic hub of the country.

How is LNG part of the solution?

One of the options available to Myanmar to plug this electrification gap is the use of liquefied natural gas

LNG is typically transported by ship to regasification terminals that could be



Myanmar's recent gas discoveries have been in offshore Rakhine Basin

land-based or floating and then fed through a pipeline network to be consumed by the end recipient.

The construction of a land-based LNG regasification facility may be less economically feasible due to the high capital costs and the long implementation period which will far exceed Myanmar's current electrification timeline.

Given the urgent need for electricity access for Myanmar's fledgling economy in the short term, the most viable method is by means of a floating storage and regasification unit (FSRU) to meet domestic demand as a result of the shorter procurement lead time.

While LNG may accommodate the demand for energy both in the short, medium and long term, a review of the current energy strategy in Myanmar is crucial to understand how LNG fits into this bigger picture.

Project proposals

There have been various proposals put forward to incorporate LNG into Myanmar's energy mix.

A review of these LNG projects is necessary to fully appreciate the size of the challenge ahead for interested parties.

1. Dawei Special Economic Zone (SEZ)

In 2015, Royal Dutch Shell plc, Thai-based companies, Italian-Thai and LNG Plus, put forward plans to establish an LNG terminal at the Dawei SEZ in the Tanintharyi Region of Myanmar.

From there the intention is for LNG to be transported to Thailand, businesses in Dawei and other parts of Myanmar.

The World Bank and the International

Financial Corp. (IFC), a member of the World Bank Group, have expressed interest in providing loans for the LNG terminal to be built, which will form part of a wider \$1.7 billion project at the Dawei SEZ, including a gas-fired power plant.

Energy is, however, unlikely to reach and benefit the rest of Myanmar for some years. In this respect, the Dawei SEZ terminal does not provide an immediate solution to Myanmar's larger energy deficit and so, energy imports appear to still be the go-to option in the short to medium term.

2. Thailand PTT Floating Storage and Regasification Unit

Thai state-owned company PTT announced plans in 2015 to invest \$400 million in a FSRU with a capacity of 3 million tonnes together with Thai utility Ratchaburi Electricity. However, the vast majority of LNG imported by this project would not be destined for domestic use.

3. MOEE September 2016 Tender

On 8 September 2016 the LNG Business Implementation and Development Central Committee of the Ministry of Electricity and Energy (MOEE) published an Invitation for Letter of Expression of Interest (LOI).

The aim of the LOI is to attract foreign companies to invest in the implementation of "bulk import and regasification of LNG project(s) in Myanmar through private sector participation".

The MOEE hopes this will be a competitive process and one which will lead to a lucrative contract for the successful bidder.

This is the second such tender, the first of which was issued in 2013 and did not progress to the formal procurement stage.

What can foreign companies expect from the current tender?

Given the lack of traction with the previous tender in 2013, there is certainly concern whether the current tender will progress much further.

At this stage, details are light as to the technical specifications and the nature of the project that is envisioned by the government. There is also little information available about the ownership and contracting structure that the government expects.

However, the World Bank through the IFC, is due to be involved in the tender as well as related consultations and feasibility studies, which bodes well for the process.

In many other jurisdictions which face similar electricity shortages and propose such tenders, there are two main ways to implement the project, namely supply-side or buyer-side models.

MOEE's tender suggests that the

supply-side model is preferred. Under this model, the tenderer is tasked with procuring the LNG and all infrastructure required, including an FSRU, in order to regasify the LNG.

An offtaker would then be party to a gas sales agreement with the tenderer, but would not be responsible for any capital expenditure nor operating costs of the FSRU and certainly not the sourcing of LNG.

There are several important factors to be borne in mind by investors who will be looking at this project:

Policy considerations: In the short term, procuring a FSRU should not be a lengthy process. However, in the longer term, MOEE, may have to consider other options such as expanding or constructing new onshore regasification terminals as well as to prepare for domestic supply coming on stream.

Alternatively, the government may have to review other energy resources as envisaged under the energy master plans detailed above. Investors should be prepared for changes in policy that could affect the viability of their project.

Supporting infrastructure: Whilst

plans may be in place to provide universal electricity access by 2030, in that interim period there is a real risk of power outages which may cause a number of delays to a project of this sort. Other hindrances to a successful project include unreliable internet and telecoms services and inadequate transport links for the ships to both harbour and feed the gas into pipelines.

Capacity and skill shortages: Decades of isolation has resulted in a workforce lacking in the skills to carry out a project of this sort. Finding suitable local employees may be a stumbling block or require extensive training and capacity building.

Project bankability : Many energy projects are financed off-balance sheet, for instance through project financing.

While there have been some international financings in Myanmar, the laws and regulations required to safeguard offshore financing structures are also in a state of flux and precedents are still not firmly established.

There is also a lack of standardisation in procurements processes and documentation, which create barriers to attract international lenders.

Conclusion

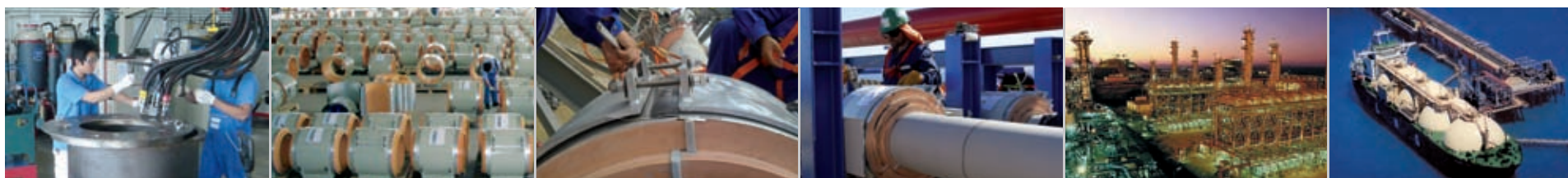
Through a gradual policy of political and economic liberalisation and reform, Myanmar is transitioning from decades of stagnation and isolationism.

However, Myanmar must, and indeed is, acting quickly to address its electricity crisis. It is endowed with considerable natural riches which will bolster its anticipated economic growth over the coming years.

Successfully exploiting its natural gas reserves and plugging the interim gap from LNG imports may be part of the solution provided the government takes steps to mitigate the current risks and attract investment.

The government's openness to receiving external advice at the early stages of an LNG project is positive as the experience of well-run international processes will certainly benefit Myanmar in terms of execution and value for money. ■

Nomita Nair, Chris Hughes and Ben Rosen are at international law firm Berwin Leighton Paisner and they regularly advise businesses on investment in Myanmar.



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For the Record

AMEC Foster Wheeler, the UK-based LNG and energy engineering company, was awarded a consultancy contract by Inpex Corp. for the Ichthys LNG export project in Australia that has entered the final year of first-phase construction at a cost of \$US37.5 billion. Inpex is developing the liquefaction plant at Bladin Point near the port of Darwin in Australia's Northern Territory in a joint venture also involving French energy company Total. The Japanese-led project is set to come on stream between July and September 2017, about nine months behind schedule. "The scope of work involves Amec Foster Wheeler providing a team of production and maintenance assessors to carry out competency assessments for the Ichthys Operations and Maintenance teams across all project assets," Amex FW said. "This includes the Central Processing Facility, Floating Production Storage and Offtake vessel and the Bladin Point LNG onshore processing plant," Amex FW explained. The Japanese company's plant will produce 8.9 million tonnes per annum of LNG from two processing Trains. "The assessments will be aligned to Australian national competency standards for the process industry," it added. Amec FW said its contract would run until April 2017, with the assessments to be conducted at construction yards in Korea, offshore Western Australia, and at the onshore LNG facility in Darwin. The Ichthys joint venture also includes an 890 kilometres pipeline linking all the facilities from the feed-gas fields offshore northwest Australia to the Bladin Point plant. "This is the latest example of Amec Foster Wheeler's market leading capability being used to benefit a world-class LNG project," said Roberto Penno, Amec FW Group President for all operations outside America. "We are proud to be involved in the Ichthys LNG project and will utilize our significant global Operations and Maintenance expertise to deliver this important role," added Penno. When completed the liquefaction plant will supply LNG cargoes to five Japanese utilities, Tokyo Gas, Osaka Gas, Kansai Electric Power, Chubu Electric Power and Toho Gas.

AUSTRALIA is gradually growing its exports from its project in Western Australia and Queensland. The newest export plant, the Gorgon facility on Barrow Island in Western Australia, shipped five cargoes in September as it continued to ramp up production while India emerged as a main target for shipments from some of Australia's seven export facilities now operating. Three Gorgon cargoes were delivered to Japan, while one went to India and another to Taiwan. The Barrow Island facility is scheduled to start up Train 2 in the week ahead. September exports from the three Western Australia plants, including the Northwest Shelf plant and the Pluto facility, both operated by Woodside, amounted to a total of 33 cargoes, or 2.2 million tonnes of LNG. According to Australian consultancy EnergyQuest, whose Chief Executive is Dr Graeme Bethune, there were five cargoes from Australian projects delivered to India in September, two each from the NWS and Pluto and one from Gorgon. "This is a significant jump in Australian exports to India, one of the few significant markets exhibiting import growth," Bethune said in his report. The three coal-seam-gas-to-LNG plants at Gladstone in Queensland, delivered 25 cargoes, one more than in August. Based on vessel tracking data, Adelaide-based EnergyQuest estimates that total Australian LNG exports in September were 4.03 million tonnes, or 61 cargoes. As for the Darwin LNG plant in the Northern Territory, operated by ConocoPhillips, it shipped just three cargoes in the month before shutting for planned maintenance. The September shipments totals included 28 confirmed cargoes delivered to Japan, 14 to China, five to India, four to Korea, two to Singapore and Taiwan and one each to Malaysia and the United Arab Emirates. Among the plants on Curtis Island, The Santos-operated Gladstone LNG facility shipped eight September cargoes while Shell's Queensland Curtis LNG delivered 10 cargoes.

BP of the UK said its decision to abandon its planned exploration and drilling programme in the Great Australian Bight offshore South Australia did not mean it was quitting the country and it was still ready to invest in the Browse Floating LNG project offshore Western Australia. The cancellation of the programme followed a review of BP's upstream strategy, including its decision to focus exploration

on opportunities likely to create value in the near to medium term. BP said it had determined that the project in the Bight, known as the GAB, which would have cost an initial A\$600 million (\$US455M), would not be able to compete for capital investment with other upstream opportunities in its global portfolio. "We have looked long and hard at our exploration plans for the Great Australian Bight but, in the current external environment, we will only pursue frontier exploration opportunities if they are competitive and aligned to our strategic goals," said Claire Fitzpatrick, BP's Managing Director for exploration and production in Australia. "We expect to continue to consider further opportunities to invest and grow our business here," said the BP executive. The UK company has a stake in Australia's oldest LNG export plant, the Northwest Shelf Venture in Western Australia, which is currently investing in new feed-gas sources to prolong its lifespan. NWS LNG is operated by Australian company Woodside. That company is also behind the Browse FLNG project, currently on hold as regards a final investment decision, but which includes BP as one of the partners. "BP is a long-term, significant investor in Australia, most visibly through our retail network and refinery and also as partners in the North West Shelf and Browse ventures," added Fitzpatrick. Federal Resources Minister Matthew Canavan said that while disappointing, BP's exit was a commercial decision for the company. He called on BP to propose other areas of exploration that will "make good" the surrendering of its Bight commitments. The Australian Petroleum Production and Exploration Association said BP's decision was a "stark reminder that global investment in Australian resource projects cannot be taken for granted."

CANADIAN politicians in the province of British Columbia said the Pacific Northwest LNG project led by Malaysia's Petronas should take a positive view from the decision of the National Energy Board of Canada to issue an extended 40-year export licence to the venture. "British Columbia's aspiration to build a liquefied natural gas export industry is gaining momentum with Pacific Northwest LNG's receiving of an extended export licence," said BC Minister of Natural Gas Development Rich Coleman. "The provincial

government understands Pacific Northwest LNG is currently reviewing every element of its facility before a major investment decision can be determined," said Coleman. "We respect this process and await the result," he added. The federal government imposed 190 environmental and planning conditions in granting a go-ahead for the venture on September 27. The conditions are likely to lead to much higher costs. Petronas and its partners are currently conducting a total project review over the coming months before announcing the next steps for the joint venture aimed at building a liquefaction plant at Lelu Island, near the port of Prince Rupert. The other partners in the all-Asian venture are India Oil Corp., Japan Petroleum Exploration Co., China's Sinopec and Petroleum Brunei. The liquefaction plant, if it is ever built, would be primarily located on federal lands and waters administered by the Prince Rupert Port Authority, about 15 kilometres south of the BC port. The Malaysian company and its partners in their initial plan expected to have plant throughput of around 3.2 billion standard cubic feet per day of natural gas and produce around 20 million tonnes per annum of LNG over a 30-year period. "Export approvals from Canada's National Energy Board are essential, providing proponents with the assurance they need to secure customer contracts and, ultimately, reach a final investment decision," explained BC Minister Coleman. "This extension immediately improves Pacific Northwest LNG's long-term certainty and strengthens its competitive positioning in the global market," Coleman added.

CHENIERE Energy said its Sabine Pass LNG production plant in Louisiana, the first US export facility in the new wave under construction, has received permission from the regulator to formally start operations on fully completed third processing Train. The Federal Energy Regulatory Commission authorized Sabine Pass to commence service for liquefaction and export activities. "Based on FERC staff inspections and review of the commissioning activities, Sabine Pass has demonstrated that the above-mentioned facilities have been constructed in accordance with Commission approval and applicable standards and can be expected to operate safely as designed," the regulator said. Two Trains out of a planned total of six

were already on stream at Sabine Pass, giving a combined nameplate capacity of 9 million tonnes per annum from the 4.5 MTPA Trains. The first Train at Sabine Pass was able to ship its first commissioning cargo in February 2016. US LNG cargoes have already been shipped from Sabine Pass to nations such as Chile, Brazil, Spain, Portugal, the United Arab Emirates, Kuwait, Japan and China. Cheniere also completed a scheduled four-week maintenance shutdown of the plant. US engineering company Bechtel Inc., the world's leading liquefaction plant builder, was contracted as lead engineer and construction company for all six Trains at Sabine Pass. Of the remaining facilities under construction, Train 4 is also progressing and is expected to be completed by August 2017. As regards Cheniere's second export plant being constructed at Corpus Christi on the Gulf Coast of Texas, the company has told regulators that the total build was more than 40 percent complete. The Texas liquefaction plant is being built on the shore of Corpus Christi Bay, at the north end of

the La Quinta Channel. The Phase 1 EPC contract for Corpus Christi includes building two LNG Trains, each with 4.5 MTPA of capacity, two storage tanks, one complete berth and a second partial berth. The contract for Phase 2 includes one LNG Train, one additional tank, and completion of the second berth. The total capacity at the second plant will be 13.5 MTPA with prospects of expansion.

CHINESE liquefied natural gas imports almost doubled in September as supplies expanded and flowed wider in Asia from new liquefaction and export volumes in Australia. China's import terminals received 2.53 million tonnes of LNG in September, a 95.5 percent rise on the 1.29MT imported in the same month of 2015, according to data from the General Administration of Customs. More LNG arrived in China from the new export plants in Queensland, which use coal-seam-gas to make LNG at three plants at Curtis Island near the port of Gladstone. China had received one LNG cargo in August from the US plant at Sabine Pass in Louisiana but none in

September. The vessel involved was the 161,870 cubic metres capacity "Maran Gas Apollonia", which unloaded its shipment on August 21 at the Guangdong Dapeng Bay LNG terminal on the Pearl River delta. The facility is owned and operated by China National Offshore Oil Corp. The Chinese received 20.02MT for all of 2015 at its network of terminals, now numbering 14 facilities. The total of annual imports for 2016 is likely to be little changed from last year. China also has a large domestic natural gas supply base from its own production as well as imported pipeline gas supplies, so the fall in LNG shipments has to be viewed in that context. The big three Chinese national oil companies, China National Offshore Oil Corp., PetroChina and Sinopec are not presently able to absorb all of their contracted LNG supplies and are sellers of uncontracted volumes. Overall, the 14 LNG import terminals have a utilization rate of only 50 percent at present. There are also new players standing by to import LNG or build new import terminals. The Beijing Government is working on ways to

deregulate the LNG import business by gradually opening up the sector to players other than the big three.

CIMIC, the Australian energy and liquefied natural gas engineering group, better known by its former name of Leighton Holdings, is making a takeover bid for Sydney-based construction rival UGL worth A\$524 million (US\$400M) as the industry runs out of LNG projects. Cimic, which itself is controlled by Hochtief Group, bid A\$3.15 in cash per share of UGL, a 47 percent premium on UGL's closing price on the Australian Securities Exchange on October 7 of \$2.15. Cimic said it would conduct a strategic review of UGL's businesses to "drive operational efficiencies and improvements to project delivery" while also assessing the value of the target's assets. The Australian engineering group changed its name companies that said it was branching out from the LNG, energy and resources sector amid a global downturn and would be moving more into large-scale civil infrastructure markets. The bid for UGL follows the

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start in August 2016 of legal proceedings in the United States against Chevron Corp. and US engineering company KBR Inc. in a financial dispute involving an A\$1.86 billion (US\$1.4Bln) contract for the Gorgon LNG plant in Western Australia. Cimic under previous name Leighton was commissioned in 2009 to build the jetty for the US\$54Bln Gorgon plant on Barrow Island, located 70 kilometres off the Pilbara coast of Western Australia. The dispute is over changes to the project and Cimic's insistence that it is owed A\$1.86Bln for the work rather than a lesser sum. Cimic said in a statement at a time in a statement that a notice of dispute was issued in February 2016 in relation to the Gorgon LNG Jetty and Marine Structures Contract. As part of the consortium's original design, the jetty was to have been built to a length of 2.1 kilometres, consisting of steel trusses approximately 70 metres long supported by 55 concrete caissons leading to the loading platform four kilometres from the shore. The plant, operated by Chevron and with Royal Dutch Shell and ExxonMobil as the other shareholders, has been beset by start-up and production problems since April 2016 just weeks after it shipped its first cargo. In its bid for UGL, Cimic said the target's competencies were complementary to Cimic's existing operations and will enhance its capabilities in new markets. Cimic already holds more than 13 percent of UGL's equity and said its full bid would be using available funds or existing debt facilities. The board of UGL said it would meet as soon as possible to consider the offer and would then provide further advice to shareholders. "In the meantime, the board of UGL recommends that shareholders take no action in relation to the CIMIC announcement," UGL said.

CLEAN ENERGY Fuels Corp. has opened its first public liquefied natural gas station in Washington State, connecting a US Pacific Coast supply chain aimed at the trucking industry from southern California, through Oregon to the Canadian border. Clean Energy has also secured a local trucking company contract for the facility located along Interstate 5 in Fife, a suburb of the port of Tacoma. The Washington State station adds to Clean Energy's "Americas Natural Gas Highway", allowing trucking fleets to operate from state to state using natural gas as clean vehicle fuel. The Tacoma

station, located at 3013 20th Street East, was designed, built and will be operated and maintained by Clean Energy. US oil tycoon T. Boone Pickens, one of the main advocates of LNG fuel for trucking, retains an interest in Clean Energy and founded its predecessor company, Pickens Fuel Corp. to promote clean energy on America's roads. The Pickens vision now makes more sense economically because of the huge US natural gas surplus from shale-gas development. The Tacoma station consists of two LNG fast-fill pumps and is open to the public 24/7. Clean Energy also announced in September that it had completed a public natural gas station in Central Point, Oregon, linking California to Washington State for vehicles filling up on LNG on the West Coast. "We continue to focus on key transportation corridors like the I-5 to expand our natural gas infrastructure," said Chad Lindholm, Vice President of Sales at Clean Energy. "As our partners like Interstate make the transition to natural gas, we can offer the fueling stations they need to expand along with them," Lindholm stated. A trucking company Interstate Distributor Co., headquartered in nearby Tacoma, will use the station at Tacoma for its fleet of LNG-fueled haulage trucks operating throughout the Pacific Northwest. "As the first national freight carrier in the Pacific Northwest to use natural gas vehicles for our fleet, we're very happy to see another station become available that can support our regional distribution network," said Interstate Distributor Co. Chief Executive Marc Rogers. "We made the transition to natural gas early so we would be ahead of the game, and now that the infrastructure is here, we're more and more confident each day that we made the right decision," Rogers added.

DRIFTWOOD LNG, the US project company run by former employees of Sabine Pass export plant owner Cheniere Energy, has applied to the US Department of Energy for authorization to export up to 26 million tonnes per annum from a proposed plant on the Gulf Coast of Louisiana. Driftwood has asked the DoE for a long-term, multi-contract permit to export up to the equivalent of 1,496.5 billion cubic feet a year for 30 years of domestically produced natural gas to nations with and without a Free Trade Agreement with the US. Driftwood LNG would export the cargoes from its proposed liquefaction plant to be located on the west side of the Calcasieu River,

near Carlyss in the state's Calcasieu Parish. The application was made on behalf of Tellurian Investments, based in Houston and described as a developer of LNG projects along the US Gulf Coast, funded by Charif Souki, former Chief Executive and Chairman of Cheniere and Martin J. Houston, a former Chief Operating Officer of UK LNG company BG Group, now part of Shell. Souki has since head-hunted former London-based Cheniere Marketing executive Meg Gentle to be CEO of Driftwood and then named Cheniere's former Executive Vice President of assets Keith Teague as the new Chief Operating Officer of Tellurian. Souki's Driftwood venture will be a major competitor to Cheniere's Sabine Pass plant, already operating on the Gulf Coast since February 2016 with two of a planned six processing Trains completed. Driftwood is in the engineering design and pre-filing phase of the project to match Sabine Pass in production volumes from five processing Trains. Souki's company expects construction to begin in 2018 and the project to become operational in 2022. More Technical and project details about the Driftwood venture were also revealed in the DoE application, including the fact that the plant will be located on around 790 acres. "Driftwood LNG has purchased approximately 140 acres and has leased an additional 650 acres with the right to enter into a long-term lease for up to a total of 50 years," it said. The facility will consist of five LNG plants. Each plant will be comprised of one gas pre-treatment unit and four liquefaction units. Each liquefaction unit will consist of a refrigeration compressor driven by aero-derivative gas turbines. The liquefaction technology will be Chart Industries' proprietary Integrated Pre-Cooled Single Mixed Refrigerant process. LNG will be stored onsite in three LNG storage tanks, each with a capacity of approximately 235,000 cubic metres. The marine loading facility will be located along the Calcasieu River and will consist of three berths for LNG ships with a cargo capacity ranging from 125,000 and 216,000 cubic metres capacity.

DUTCH Royal Boskalis Westminster of the Netherlands has ordered two dual-fuel tugs able to run on liquefied natural gas for towage duties under joint ventures it operates in the Port of Singapore. Boskalis, based in the Dutch town of Papendrecht, operates two Singapore tug ventures with Keppel Smit

Towage and Maju Maritime. The LNG fuel tugs are expected to be delivered in 2018 and will be capable of running entirely on LNG. For this reason, the Maritime and Port Authority of Singapore will award a grant of up to S\$2 million (US\$1.45M) for each tug under its LNG Bunkering Pilot Programme. Boskalis said the 65-tonne bollard pull Azimuth Stern Drive (ASD) tugs will be built by Keppel Singmarine in Singapore using the shipyard's proprietary design. "The LNG fuel will be supplied by Shell, for which two Head of Agreements have been signed, and bunkered through FueLNG, a joint venture between Shell and Keppel," the Dutch company said. "The two LNG-fueled tugs will be the first clients of LNG as marine fuel in the pilot for the development of Singapore into one of the world's main LNG bunkering ports," Boskalis added. "With a large global fleet, Boskalis is constantly on the lookout for ways to reduce emissions and innovate in terms of sustainability and looks forward to rolling this out in other LNG ports and terminals around the world," it said. "Boskalis believes that the use of LNG as a marine fuel for harbor tugs will play a viable role in reducing emissions that no other fossil fuel can currently achieve," the Dutch company added. Keppel Smit Towage was set up as a joint venture in 1991 between Keppel and Smit Singapore, a wholly-owned subsidiary of Boskalis. That joint venture merged operationally with Maju Maritime, another venture by Keppel and Boskalis, in early 2010. The two companies have a combined fleet of 68 tugs and provide harbour towage services in Singapore and Diego Garcia as well as in Malaysia, Indonesia, Taiwan and China together with joint venture partners. The two new tugs will be their first to run on LNG.

EGYPT Natural Gas Holding Co. has released tender documents to secure almost 100 LNG shipments in 2017-2018 to meet rising demand before offshore pipeline supplies come on stream from the world-class Zohr natural gas field. Egypt has launched what is one of the largest LNG cargo tenders for 96 shipments. EGAS, in announcing the purchasing process, said it had also included 12 optional cargoes in the tender. EGAS noted in its documents that the payment period in which suppliers can expect to get paid in US dollars has been extended from 90 days after the date of delivery to between 120 and 180 days,

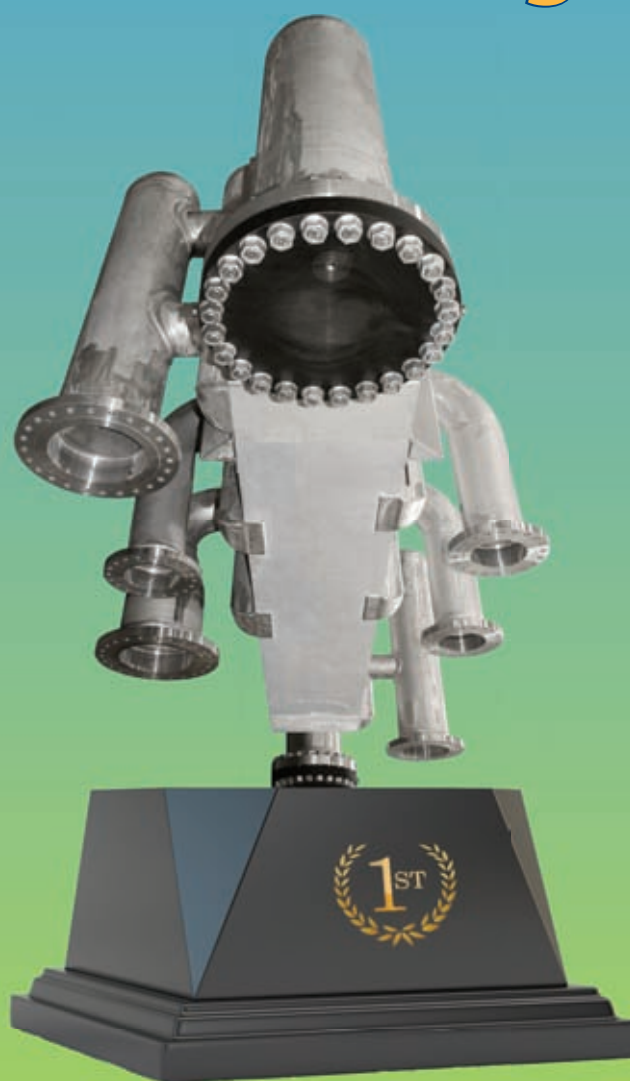
reflecting Egypt's tight currency reserves. EGAS tendered for 45 LNG cargoes in October 2015 and received competitive bidding from seven international suppliers. The same companies will be involved again with others and will likely include Royal Dutch Shell, BP of the UK, France's EDF Trading, Spain's Gas Natural, PetroChina and international commodities companies Vitol and Trafigura. The cargoes will be directed to the Egyptian LNG import terminal port of Ain Sokhna, located in the Gulf of Suez, where cargoes from as far away as Australia have been received. Egypt has two Floating Storage and Regasification Units deployed at Ain Sokhna to handle imports to satisfy its demand. The Egyptians began importing LNG in April 2015 to satisfy natural gas consumption, which increased by an annual average of 7 percent over the previous 10 years. One of the FSRUs is at Ain Sokhna under a five-year charter from Hoegh LNG of Norway and the other import facility was supplied by Singapore-based BW Gas. While issuing the LNG cargo tender, EGAS 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. Eni was given the go-ahead in February 2016 by the Egyptian Ministry of Petroleum and Mineral Resources to develop the Zohr field, discovered in its Shorouk block licence area. The Eni discovery will go some way to satisfying Egypt's domestic natural gas needs, while possibly helping to revitalize its two LNG gas export plants and ending the need for so much

LNG as imports. Italian LNG and energy engineering company Saipem was awarded contracts worth \$1.7 billion for developing the Zohr field that will form

the Arab nation's East Med Gas Hub. Eni said the Zohr development plan envisages the start of production by the end of 2017, just two years after the discovery and

with the LNG tenders well into their second year as regards delivery dates. Eni holds 100 percent of the Shorouk licence and operations are also being conducted

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by Petrobel, a joint venture between Eni and Egyptian state energy company Egyptian General Petroleum Corp. Petrobel awarded Saipem an engineering, procurement, construction and installation contract for the accelerated start-up of the Zohr gas field. Saipem's contract scope entails work on six gas wells and the installation of the umbilical systems. It includes the installation of a 26-inch gas export trunkline and 14-inch and 8-inch service trunklines, as well as EPCI work for the field development in deep water of up to 1,700 metres. The Egyptians stopped producing LNG on a commercial scale about three years ago as natural gas supplies were diverted by EGAS to satisfy pipeline demand. Even the existing gas resources were not sufficient and the Egyptians began importing LNG shortly before the Eni discovery was made.

ENAGAS, the Spanish liquefied natural gas terminal owner and gas network operator, said industrial demand extended its positive trend during the first nine months of 2016, rising by 2.2

percent as its own net profits increased. Enagas, which operates 10,314 kilometres of natural gas pipelines, posted a 1.5 percent rise in net profits for the nine months through September of 317.4 million euros (\$349M) compared with 312.7M euros in the same nine months of 2015. Total revenues fell 2.3 percent to 899.7M euros from 920.7M in the same nine-month period a year ago. The company noted that in July 2016 it purchased a majority stake in the Sagunto LNG import terminal in eastern Spain, giving it control of six regasification facilities. Through its subsidiary Enagas Transporte it agreed to buy an additional 42.5 percent of the Sagunto terminal from the holding company, Union Fenosa Gas Plant Sagunto Regasification (Saggas), for 106M euros. Enagas is already a stakeholder or has operatorship in the import and regasification facilities at Barcelona, Cartagena, Huelva, Bilbao and El Musel. The Enagas LNG terminals have a total of 16 storage tanks around the country with capacity for 1.95 million cubic metres. The Spanish

terminals have a total of nominal regasification capacity of 4.65 million cubic metres per hour. Enagas said that while domestic natural gas demand totalled 226.5 terawatt hours, down 1.7 percent compared with the same period last year as hydroelectric generation took market share, industrial natural gas demand extended its rise by more than 2 percent. Investments in the nine-month period totalled 598.4M of which 175M was invested in Spain, including the acquisition of 42.5 percent of Saggas and 423.4M euros overseas. The overseas acquisitions included buying an additional 1.64 percent stake in the Peru pipeline company, Transportadora de Gas del Peru (TgP), for a total of 28.3M euros, increasing Enagas's stake to 25.98 percent. There was also an investment to acquire an additional 20 percent of the LNG Quintero regasification terminal for 175.5M euros from Endesa Chile. Enagas added net financial debt at the end of the third quarter stood at 4.43 billion euros.

ENGIE, French energy company, has signed an accord to promote liquefied

natural gas as a marine fuel with France's largest shipping group CMA CGM, operator of a fleet of more than 400 container vessels. CMA CGM, led by Lebanon-born Chief Executive Jacques Saadé, is the third-largest container shipping company in the world. The Marseille-based group combines Compagnie Maritime d'Affretement (CMA) and Compagnie Generale Maritime (CGM), which at one time carried passengers on Transatlantic liners such as the "Normandy" and the "France". The LNG fuel memorandum of understanding was signed in Marseille by Farid Salem, Executive Officer of the CMA CGM Group, and Isabelle Kocher, Chief Executive of Engie. The agreement will focus on a joint CMA CGM-Engie technical and economic study on LNG as a fuel for tomorrow's container shipping market. Actions include setting up a study to develop engineering specifications for a bunkering vessel fully adapted to re-fuel LNG-powered container ships. "We are most pleased with this cooperation with CMA CGM, which is a leader of maritime transport

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at the international level,” said Engie CEO Kocher. “For Engie, natural gas is a key element in the energy transition. The Group is actively engaged in the development of the diverse uses of retail LNG. Ultimately, LNG as marine fuel could lead to a massive reduction in pollutant emissions,” she added. According to CMA CGM Group’s Salem LNG has all the environmental and propulsion advantages. “It is undoubtedly the fuel of the future of the shipping industry that will progressively substitute heavy fuel oil over the next few decades. CMA CGM wishes to be a pioneer in this area and with the agreement with Engie this allows the company to move one step closer,” Salem said. Engie has a large portfolio of LNG interests in the production and import markets to sustain the long-term supply of fuel to customers. The French utility and energy company has already initiated a partnership with Mitsubishi Corp. and NYK Line of Japan for LNG marine fuel development projects. Part of that agreement was the ordering of the first purpose-built LNG bunkering vessel to be delivered in early 2017 to operate out of the Belgian LNG import terminal at Zeebrugge. LNG is gathering ground in the shipping industry as the future fuel of choice as stricter pollution rules are applied in Emissions Control Areas (ECAs) in Northwest Europe, North America and the Caribbean and eventually the rest of the world. “The two groups consider that the use of LNG as a marine fuel is destined to expand in the near future and intend to be active

players in this development,” the Engie-CMA CGM statement added. LNG use offers clear environmental advantages compared with heavy fuel oil, for example,

such as significantly reduced carbon-dioxide emissions, lower nitrogen oxides and the elimination of sulfur oxide. “This agreement rounds out the research

program undertaken since 2011 by CMA CGM to design ever more environment-friendly large capacity container ships,” the statement added.

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OLT Offshore LNG Toscana S.p.A, which shares are divided among two important operators in the energy sector, Uniper Global Commodities (formerly E.ON Global Commodities) and Iren, is the company which manages the floating storage and regasification unit “FSRU Toscana”. The Terminal is technologically innovative and well-advanced. It guarantees the maximum standards in terms of environmental sustainability and safety. “FSRU Toscana” is permanently moored off the Italian coast - between Livorno and Pisa - in the heart of the Mediterranean Sea. The Terminal has a regasification capacity of 3.75 billion cubic meters per year and an LNG storage capacity of 137.500 cubic meters. The operational flexibility and the design of the Terminal allow future LNG bunkering activities.

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EXMAR, the Belgian shipping line and LNG fleet owner, said it was still currently discussing several deployment opportunities for the floating LNG production vessel that has just undergone extensive testing at the Chinese shipyard where it was built. “This performance test completion is a major milestone in our company’s floating LNG liquefaction program to help meet the growing demand for energy,” said Nicolas Saverys, Exmar Chief Executive. “It demonstrates our leadership in FLNG solutions, allowing owners of stranded gas reserves to monetize their reserves on a very fast track basis under a build, own, operate basis with Exmar,” Saverys added. The Antwerp-based company’s vessel is a non-propelled barge capable of producing 72 million cubic feet a day of LNG, the equivalent of 500,000 tonnes per annum. The LNG is temporarily stored in onboard tanks and can be subsequently offloaded to LNG carriers. The ship uses liquefaction technology from Overland, Kansas-based Black & Veatch called the PRICO SMR process and successfully completed the performance testing at the Nantong yard of Wison Offshore & Marine. Black & Veatch said that during the 72-hour testing phase carried out in Nantong the average liquefaction process load exceeded 100 percent and the “flawless performance” of the FLNG hull ensured all design requirements and production capacities were achieved. “The results from the in-depth performance testing further confirms the leadership in FLNG project delivery that we are bringing to the industry through our floating LNG solutions program,” said Bob Germinder, Senior Vice President of Black & Veatch’s Oil & Gas business. “Our PRICO technology is being applied in more than 30 LNG operations worldwide, and with the completion of this performance testing, the first of five Black & Veatch designed FLNG trains are now proven in the marketplace, demonstrating how we are helping to meet the growing demand for energy,” Germinder stated. The hull was originally built for the cancelled Caribbean FLNG project and comprises a single processing Train. “Black & Veatch delivered engineering and procurement for the top side liquefaction unit, along with construction support, onsite commissioning and start-up services,” the US company said. In addition to the design and production capacity of the liquefaction unit, the tests

also confirmed the other systems designed by Black & Veatch, including gas treating, boil-off gas handling, and supporting utilities.

FINLAND’S natural gas and LNG company Gasum posted 16 percent lower net sales amounting to 589 million euros (\$648M) for the third quarter compared with 702M euros for the same three months of 2015. Gasum is mainly involved in the LNG business through its ownership of the Norwegian company Skangas and while it saw natural gas and LNG sales fall its Finland-based biogas sales rose. Subsidiary Skangas is a market leader in the Nordic region with LNG production plants in Risavika, Norway, and Porvoo, Finland, as well as LNG reception terminals in the Norwegian town of Ora, at Lysekil in Sweden and the newest at the port of Pori in Finland. “The downward trend in natural gas volumes seen over the past few years has levelled off, and this year’s natural gas consumption has been at the same level as last year,” Gasum said in its earnings statement. “During the period under review, Skangas accounted for 111M euros, or 19 percent of the Gasum Group’s revenue compared with 159M euros in the 2015 quarter,” Gasum added. “Gasum has taken strategic steps forward as planned during the period under review,” said Chief Executive Johanna Lamminen. “Finland’s first LNG terminal was opened in Pori and deliveries to customers began in September. The terminal enables LNG deliveries to industrial, maritime and heavy-duty road transport customers outside the gas pipeline network and diversifies the Finnish energy market,” CEO Lamminen added. Gasum stated that plans were also progressing on bringing on line another LNG import terminal in Finland. “The Pori LNG terminal strengthens the position of Skangas as a major player in the Nordic countries. Progress in the construction of the Tornio Manga LNG joint project is also being made as planned and the terminal will be completed in Tornio in early 2018,” Gasum said. Gasum pointed out that during the third quarter it also entered into a partnership with Finnish marine propulsion equipment maker Wartsila. “Our joint co-operation agreement aims to develop the utilization and distribution of natural energy gases in marine and onshore markets as well as to increase the availability of natural gas for marine use,” it added. In the

biogas business, Gasum said it invested in doubling the capacity at its Oulu biogas plant.

GAS LNG Europe, the industry business organization, has held a meeting at the Reganosa import terminal in the northwest Spanish port of El Ferrol attended by 16 directors of regional natural gas regasification facilities. They discussed challenges facing European natural gas companies as well as issues such as small-scale LNG distribution, market transparency and decarbonisation measures. The autumn meeting of GLE brought together LNG terminal operators representing 90 percent of the region’s regasification capacity. Participants took part in discussions covering the evolution of LNG terminals in such areas as providing marine bunkering facilities and other fuel distribution operations. “The transformation of regasification plants into distribution centres for LNG, especially for marine fuel, is expected to constitute a decisive factor in the provision of cleaner shipping and emission reductions,” GLE said. The choice of the Reganosa terminal’s facilities in El Ferrol port to hold the meeting reflected the interest shown by members of GLE in the development of small-scale services by its operators. The Reganosa import terminal, also known as the Mugardos plant, is noted for having received Europe’s second LNG shipment from the US. The cargo was delivered by the 138,000 cubic metres capacity vessel “Sestao Knutsen” on July 21, 2016, from the Sabine Pass liquefaction plant in Louisiana, operated by Cheniere Energy. The first US LNG cargo shipped to Europe had gone to Portugal’s Sines facility in April. The GLE meeting also discussed the transition towards “decarbonisation” with LNG regarded as a key fuel in the transition towards workable and economic renewable energy sources. “The meeting also agreed its criteria to give greater transparency to the natural gas market,” GLE added. President of GLE, Wim Groenindijk from Gasunie natural gas company in the Netherlands, said that the progress of the sector in the new environment has already begun because “our plants are becoming LNG distribution centres while retaining their conventional and vital roles in the gas system.” GLE is part of the European Union-wide Gas Infrastructure Europe, the association of the Transmission, Storage and LNG

terminal Operators. GLE is committed to promoting the development of a fully operational European internal market for LNG and the creation of a stable and predictable regulatory framework, conducive to investment and which ensures transparency and non discriminatory treatment. Spain is the country with the largest number of LNG terminals in Europe, with six operating and a seventh at El Musel in Gijón, also in the northwest, currently mothballed because of the economic slowdown. The shareholders in the Reganosa terminal include the Government of Spain’s Galicia region, Grupo Tojeiro and Algerian state energy company Sonatrach.

GAZTRANSPORT and Technigaz, the French maritime storage tank technology company, has received an order to provide tanks for two carriers being built in South Korea for Maran Gas as the Greek shipping operator continues to increase its LNG fleet. GTT said its orders came from Daewoo Shipbuilding & Marine Engineering for the Maran Gas newbuilds at the Geoje shipyard in Korea. The two ships will be equipped with GTT’s No. 96 cryogenic membrane containment system and are scheduled to be delivered by 2019. “This order reinforces our long-standing relationship with DSME who have already received 147 ship orders with the No. 96 technology,” said GTT Chairman and Chief Executive Philippe Berterottiere. “With a fleet of 20 vessels, entirely equipped with membrane solutions, Maran Gas is a major player of the maritime industry. This new contract reflects the level of confidence between Maran Gas, the Korean shipbuilding industry and GTT,” the GTT CEO added. GTT explained that with 143 vessels equipped in the world, and 59 on order, the No. 96 storage tank range is regarded as “sea proven.” The French company said that since the tank’s commercial launch in 1996, it has constantly been developed by GTT “on the basis of significant feedback from operational experience” at sea. “These evolutions allow, among other things, the matching of the requirements of the latest propulsion systems,” GTT added. The company last received an order on October 11 for two 180,000 cubic metres capacity LNG carriers being built at the Korean yard of Samsung Heavy Industries for Monaco-based shipping company GasLog. The ships being built

at SHI are being fitted with the more modern Mark V tanks. GTT is listed on the Euronext exchange and its stock was last trading at 30.35 euros per share on October 25, which is about 50 percent higher than the 2016 low of 20.62 euros hit on February 12 because of the malaise in the shipbuilding industry.

GLX, the Australian-run Global LNG Exchange, is progressing with its plans to facilitate spot cargo sales during Singapore and London business hours whereby parties will initiate an auction, set the commercial terms, including a reserve price and select the counterparties they wish to invite. GLX also plans to support the development of transparent regional price benchmarks for the commodity. The platform is open to all buyers and sellers of LNG to trade single cargoes and will commence operations in early 2017. GLX founder and Chief Executive Damien Criddle said the LNG market had grown substantially in recent years, with about 75 sellers and 75 buyers engaged in the worldwide trade. The Perth-based executive, a former Royal Dutch Shell lawyer, has launched the GLX platform with other energy executives, including Rob Cole, an ex-Woodside Petroleum director who is company Chairman. The exchange was conceived by Criddle who hopes the online auctions will replace the current system of buy and sell tenders that are issued and bid on by traders through e-mails, instant messages and phone calls. The parent company GLX Holdings is based and registered in Perth, while the online exchange would operate from Singapore. GLX was set up a year ago

and is formally registered as an Australian private company. "A global exchange for LNG means sellers can be satisfied they are securing fair market

prices for their spot cargoes, rather than relying on their own market intelligence and the strength of their relationships," Criddle said. "Equally, buyers of LNG can

now go to the exchange and secure a cargo from anywhere in the world by simply registering their interest and eliciting the best value bid from a range of suppliers.

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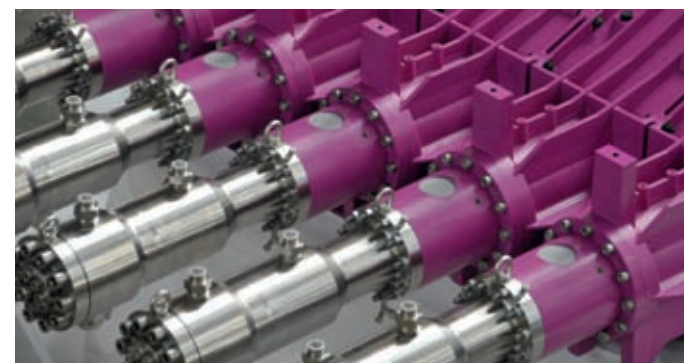


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GLX will provide a greater level of transparency for market participants and provide buyers and sellers of LNG with greater assurance that spot cargoes are being traded for their true market value. Importantly, GLX will also allow LNG sales to be conducted with speed and simplicity,” stated Criddle. The GLX platform was developed in Australia by LNG industry professionals who saw the opportunity for LNG trading to undergo a technological transformation. Development of the platform was undertaken in consultation with a number of sellers and buyers in the sector, with the feedback being incorporated into the final design. GLX will operate the platform in Singapore, with auctions being conducted based on either Singapore or London time. “Parties initiating an auction set the commercial terms, including a reserve price, and select the counterparties they wish to invite into the auction. Successful auctions result in binding sales contracts,” GLX explained. The company pointed out that short-term sales now represent nearly 30 percent of the global LNG trade, or about 1,200 cargoes per year. GLX Chairman Cole said the

company had consulted extensively with LNG sector participants, industry commentators and interested governments to create an exchange which was deliberately unaligned with any market or regional interests. “We have sought to create a truly independent platform which serves the interests of all participants, which is a market operating on demand and supply fundamentals and based on fair and transparent pricing,” Cole said. “The global LNG industry has matured sufficiently to move to a digital platform for spot sales which can support growth in supply and demand. Other globally traded commodities such as coal and iron ore have moved to online platforms and we believe the time has come for the LNG industry to embrace this technology,” said Cole. Approved LNG companies are undertaking trials of the platform to ensure they are familiar with its operation before live trading commences.

GOLAR LNG will provide a Floating Storage and Regasification Unit on a 25-year charter to supply a gas-fired electricity plant as part of a project in Sergipe, Brazil's smallest state located in

the northeast of the country on the Atlantic coast. Golar said its newest business, called Golar Power, will charter the FSRU to a Brazilian joint venture company following the signing of a construction contract with General Electric of the US for a 1.5 gigawatts combined-cycle gas-fired power plant in the region. Located near Aracaju, the state capital of Brazil's Sergipe state, the power station will be the largest thermal power plant in South America. The Sergipe project will supplement hydropower during dry seasons and help to meet growing demand for electricity in the region. “Capital expenditure for the power station and terminal including taxes and financing costs is estimated at around US\$1.3 billion at current exchange rates,” Golar said. The gas-to-power project is scheduled to deliver power to 26 committed off-takers for 25 years from 2020 in accordance with previously executed contracts. “In connection with the Sergipe project, Golar Power has entered into an agreement to charter the FSRU ‘Golar Nanook’ for 25 years,” Golar explained. “The annual earnings contribution for Golar Power from the FSRU charter is currently projected to be US\$39M with upside potential for Golar Power from FSRU capacity not utilised by the Sergipe power plant,” Golar said. Golar Power added that it had also increased its ownership in the Sergipe project from 25 percent to 50 percent. “The final price to be paid for the shares will depend on the performance of the project and the structure includes an option, which if exercised, limits the price to US\$50M,” it explained. Golar LNG has a 50 percent ownership interest in Golar Power. The remaining 50 percent is held by US equity fund, Stonepeak Infrastructure Partners. Golar Power will own 50 percent of the Sergipe project and 100 percent of the associated FSRU to be deployed in Brazil. In June 2016, Stonepeak made an initial commitment of \$290M in new funding for the venture with Golar Power that will focus FSRUs linked to gas-fired power projects like the one in Brazil. “We are very enthusiastic with the FID of Porto de Sergipe and fully committed to deliver the plant and terminal in accordance with the original budget and schedule,” said Golar Power Chief Executive Eduardo Antonello. “The project shows very solid economics and provides a strong financial foundation for Golar Power. Through this project, Golar Power is developing a very robust and

replicable structure to enable the most comprehensive, cost-efficient and flexible integrated gas-to-power solutions globally,” Antonella stated. The first major deal for Golar LNG's power joint venture comes after Brazilian state-run energy company Petrobras said in June 2016 it was looking to offload its two LNG import FSRU ventures. The sale of the LNG facilities is part of an asset restructuring as Petrobras adapts to falling oil and gas prices and revenues from its huge offshore resources as well as a home-grown economic crisis.

INDIAN imports of LNG surged 32.5 percent in September compared to the same month a year ago as additional shipments arrived from the US and Australia. India's import terminals received 2.37 million cubic metres of natural gas, the equivalent of 1.75 million tonnes of LNG, in September compared with 1.79 Bcm of natural gas, or 1.32MT of LNG, in the 2015 month, according to the Ministry of Petroleum and Natural Gas. The cumulative imports for the first-half of the fiscal year to the end of September amounted to 12.72 billion cubic metres, or 9.41MT of LNG, which was 26.9 percent higher than for the first half of fiscal 2015. Most shipments currently come from Qatar but several cargoes were received during the month from Australia and the US as new projects ramp up. If the current 2016 import levels are maintained India's terminals, all located on the West Coast, could bring in shipments of between 18MT and 19MT, given current infrastructure limitations in terms of the pipeline grid and geographical spread. India's net annual LNG imports amounted to 14.6MT in the 2015 calendar year. India's Minister of Petroleum and Natural Gas, Dharmendra Pradhan, said on October 13 that the country planned to increase its LNG capacity to 50 million tonnes per annum from the current 21 MTPA as new infrastructure comes on line on the East Coast and LNG fuel is marketed for transport. Once the country develops import capacity on the East Coast, where none currently exists, LNG shipments will be able to rise higher. The four West Coast terminals also have plans or potential to increase existing capacity. Petronet LNG said recently work was mostly completed for expanding its Dahej terminal from 10 MTPA to 15 MTPA in terms of capacity. Dahej, located north of Mumbai, is the most widely used

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terminal. The Shell-operated import terminal at Hazira, also on the West Coast near Mumbai, has 5 MTPA of capacity. The Dabhol facility, south of Mumbai, still only has the capacity to handle 1.7 MTPA of cargoes because of a lack of breakwater infrastructure. The fourth West Coast terminal at Kochi in the southwest state of Kerala is little used because of inadequate pipeline connections, though it can handle 5 MTPA of imports. Around half-a-dozen east coast LNG import ventures are planned, including the use of floating storage and regasification units.

IVORY COAST has signed an agreement to create a consortium headed by French energy company Total as it moves ahead with plans for a liquefied natural gas import facility that could begin receiving cargoes by mid-2018. The LNG facility will be part of the African nation's Songon gas-to-power project. "The arrival of LNG in the Ivory Coast will open a new era in the production of electricity," said Ivory Coast Energy Minister Adama Toungara at a Songon project signing ceremony in Abidjan. The French-speaking Ivory Coast has the region's largest economy after Nigeria and produces a surplus of gas-fired electricity from its own resources which it exports to its neighbours. However, a lack of new domestic natural gas discoveries has raised concerns about future supplies. The natural gas reserves of the Ivory Coast were estimated at around 1 trillion cubic feet in 2015. The Total-led project aims to deploy a floating storage and regasification unit and associated infrastructure costing an initial \$200 million. "We intend to bring

this project to fruition and have set ambitious targets," said Laurent Vivier, head of Total's natural gas division. A statement said Total would be the project

operator and the consortium would also include Royal Dutch Shell, Ivory Coast state oil company Petroci, Azerbaijan's Socar and Norwegian FSRU provider

Golar LNG. Also part of the Songon project is Houston, Texas-based Endeavor Energy, an independent power development and generation company



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focused on Africa. Songon is a greenfield development venture consisting of combined-cycle gas-fired power generation, featuring pipeline infrastructure and an FSRU. The project has already significantly advanced in terms of obtaining the coastal site and starting the environmental approvals process with the Ivory Coast government.

JAPANESE marine classification society Nippon Kaiji Kyokai, which has almost 60 liquefied natural gas carriers on its books, has issued an approval in principle for an LNG bunkering vessel to be built in South Korea. The society, known as ClassNK, issued the approval for a 7,500 cubic metres capacity LNG bunkering ship designed by Hanjin Heavy Industries and Construction Co., based at the South Korean port of Busan. The design is the result of joint research carried out by Hanjin Heavy and ClassNK to improve the efficiency of LNG bunkering vessels. “The choice of LNG as ship fuel has become increasingly prevalent in the industry and is expected to become one of a primary source of fuel in the near future,” the class society said. “However, LNG fueled vessels are currently largely dependent on existing infrastructure comprised mainly of fixed bunker locations at ports, potentially limiting their operations,” ClassNK pointed out. The Japan-South Korea project was set up because of the need for greater flexibility that LNG bunkering vessels could provide through ship-to-ship bunkering. Hanjin Heavy and ClassNK have, therefore, worked together to improve the viability of the ship technology. The shipbuilder is the fourth-largest in South Korea, which has led the world in recent vessel construction through Hyundai Heavy Industries, Daewoo Shipbuilding and Marine Engineering and Samsung Heavy Industries. The Hanjin Heavy design employs type-C bi-lobe tanks, improving on cargo capacity to allow for greater efficiency and productivity. The AIP was granted after confirming the design complies with ClassNK’s Rules and Guidance for the Survey and

Construction of Steel Ships. This approval also allows the design to be considered for further individual projects, whereby tests on the hull structure and direct stress analyses will be carried out to ensure it is in line with classification rules and the International Code for the construction and equipment of ships carrying liquefied gases in bulk (IGC Code). “Hanjin Heavy Industries and ClassNK have always enjoyed close cooperation and this design is just one of the fruits of our relationship,” said Takashi Nishibashi, ClassNK’s Manager for South Korea. “We hope this AIP will help pave the way for a new generation of highly efficient LNG bunkering vessels,” Nishibashi added. Cha-Soo Lee, Technical Director of Hanjin Heavy, said that the shipyard had been commissioned to develop an LNG bunkering vessel concept by clients. “We face a much wider array of challenges, such as compact ship’s dimensions, robust hull structure, more cargo capacity, simple operation and a lower ship price. We are happy to find the best compromise between economic and technical issues through this joint research with ClassNK,” he said.

KBR, the US energy construction company, was awarded an engineering study contract for an LNG hub terminal in the Indonesian province of East Java similar to European terminals and offering additional services such as truck-loading. The contract was awarded by a joint venture comprising PT Australasia LNG Indonesia and PT Petrogas Jatim Utama. The venture has Australian, Indonesian and Malaysian shareholders and plans to provide mid-scale LNG infrastructure in the Asia-Pacific region under long-term contracts. The President of Indonesian LNG Australasia is Setyaki Arya and he said the plans are for a floating storage and regasification facility with the construction of infrastructure such as mooring, a jetty and truck-loading bays for local distribution. European terminals import LNG from around the world and in addition to providing natural gas for national pipeline networks they also now load trucks for

retail and wholesale distribution. The developers said the Indonesian terminal would be located at Probolinggo, a port on the north coast of East Java, and could potentially be expanded by adding more LNG regasification equipment and storage to meet future demands for the fuel in the region. “Our feasibility study is expected to be completed this year so ground-breaking could be done by the end of 2017,” Arya said. Under the terms of the contract, Houston-based KBR will provide a pre-front-end engineering and design study for the LNG Hub. Despite being an LNG exporter, Indonesia has decided to build up a regasification network around the country where pipeline delivery is not available in many places to meet rising domestic natural gas needs. It already has two Floating Storage and Regasification Units to handling LNG deliveries, one at Lampung in south Sumatra and another in Jakarta Bay since 2012. The Indonesians have also transformed a former small-scale liquefaction plant into an import terminal at Arun in Aceh province in the northwest of Sumatra. KBR said the pre-FEED study for the new facility would be further developed for subsequent implementation phases to meet a throughput capacity of 3 million tonnes per annum of LNG. “KBR is pleased to be awarded this important project and we look forward to furthering our working relationship with AALNG and to supporting AALNG in their future projects,” said Greg Conlon, KBR President for the Asia-Pacific region. “This project demonstrates KBR’s ability to offer integrated solutions through a collaborative execution model to our customers in Asia Pacific by bringing together our global knowledge, experiences and expertise,” Conlon added. KBR said the work was expected to be performed over 10 weeks by an integrated team led by engineers from KBR’s London office with support from the company’s Jakarta office and its Granherne subsidiary.

KBR said it was chosen to carry out a feasibility study, including exploring the possible expansion of the Singapore LNG

Corp, import terminal at the city state’s Jurong Island. KBR pointed out that the Singapore terminal operator was formed by the state Energy Market Authority to develop, build, own and operate the terminal. This is KBR’s first contract with SLNG. Under the terms of the contract, KBR will provide feasible concepts and a long-term design option. KBR said the work was expected to be performed over five months with the Houston, Texas-based company using its engineering teams in London and Singapore offices, at its Granherne subsidiary and SLNG’s own development team. Singapore currently has one LNG import facility, located on Jurong Island, consisting of two jetties that handle the largest carriers, three storage tanks of 180,000 cubic metres capacity and regasification equipment. The city state has previously looked at using additional floating LNG import facilities as it builds up its infrastructure as a regional LNG trading and bunkering hub with its own pricing formula. Singapore’s government had singled out two sites where Floating Storage and Regasification Units could be berthed, either at a quayside or offshore. The Jurong Island terminal began operations in May 2013 and was scheduled to be expanded from the current capacity to import 6 million tonnes per annum to 11 MTPA by 2018. Plans for a second onshore terminal have also been examined. “Singapore’s first LNG Terminal in Jurong Island is a strategic and critical national infrastructure,” said Greg Conlon, KBR President for the Asia-Pacific region. “Together with SLNG, KBR is excited to help advance the growth of the energy market and LNG hub in Singapore and support SLNG’s vision of being a world-class terminal operator,” added Conlon. “KBR is pleased to be awarded this important project and we look forward to working with SLNG to meet the future gas needs for Singapore. This strategic win allows KBR to demonstrate our capabilities and develop a long-term working relationship with SLNG on future projects,” he said. “The project also exhibits KBR’s ability to offer integrated solutions through a collaborative execution model to our customers in Asia Pacific by bringing together our global knowledge, experiences and expertise,” Conlon stated.

MALAYSIA International Shipping Corp., the Asian nation’s liquefied natural gas and energy fleet owner, has

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Cannes, France
<http://lngsummit.org>

Flame Natural Gas & LNG Conference
May 2017 (dates to be confirmed)
Hotel Okura, Amsterdam,
the Netherlands
<https://energy.knect365.com/flame-conference>

named a new LNG carrier as it progresses with floating and onshore expansion. The 150,200 cubic metres capacity ship was named “Seri Camellia” in a ceremony at the South Korean shipyard of Hyundai Heavy Industries Co. The vessel has Moss-type storage tanks and will be chartered by state energy company Petronas for 15 years. MISC is majority-owned by Petronas and when the ship enters into service the shipping line will have 22 of its 26 LNG vessels on long-term charter. The “Seri Camellia” is the first of five newbuild contracts previously agreed between Petronas and HHI and taken over by MISC. All five ships will have Moss-type tanks and the other four are due for delivery in 2017 and 2018. MISC has chosen to power all five ships with a reheated steam main engine. Many believe this to be old technology and most new carriers are fitted with dual-fuel diesel engines or the new low-speed diesel engine. The shipping company is looking to boost business and benefit in the medium term from Petronas being at the forefront of FLNG projects being developed for stranded gas fields in Malaysian waters. The Asian country will soon be deploying an FLNG hull named “PFLNG Satu” over the Kanowit gas field, located 180 kilometres offshore Sarawak, Malaysia, to produce 1.2 million tonnes of LNG per annum. A second FLNG project planned by Petronas, the Rotan FLNG facility for offshore Sabah, has been postponed. Petronas is also expanding its Bintulu onshore LNG production plant in Sarawak and the regasification capabilities of the Malaysia peninsula. The Malaysian shipping

line is additionally being helped by lifting cargoes from the Australian Gladstone coal-seam-gas-to-LNG plant in Queensland, where Petronas is a

shareholder. Petronas has also been given conditional permits to develop the Pacific Northwest project in the Canadian province of British Columbia, which if it

went ahead would open new LNG delivery routes from Canada to Asia. The new “Seri Camellia” LNG ship will be part of the new generation of the Seri C

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Class LNG fleet. “MISC strives to fulfil our role in moving energy to build a better world and in this sense, we will continue to contribute significantly towards developing Maritime Malaysia as well as the global shipping industry,” said Yee Yang Chien, President and Chief Executive of MISC. “Capacity building is our primary focus to support this agenda, from fostering the dynamic talent of our seafaring professionals to modernizing and expanding our fleet of vessels that is aligned with global standards in technology, safety and reliability,” Yee stated. Petronas Chairman Sidek Hassan said the naming of the ship celebrated his company’s long collaborative partnership with MISC. “As one of the world’s leading players in the production and manufacturing of LNG, it is imperative for Petronas to ensure that we are able to deliver safe and reliable supply of energy to power millions of homes around the world,” Hassan added.

MALTA in the Mediterranean has seen the arrival of a floating storage unit that will serve as a liquefied natural gas import facility moored next to a gas-fired power station. The vessel “Armada LNG Mediterrana”, a former Japanese-built conventional LNG carrier, was converted at the Keppel Shipyard in Singapore. The FSU is moored in Malta’s Marsaxlokk Bay and will deliver regasified LNG to the new Delimara Power Station. The vessel, which was converted at the Singapore yard over a 17-month period, will store LNG until it is ready to be regasified when required. The “Armada LNG Mediterrana” was previously named the “Wakaba Maru” and built in 1985. It is owned by Malaysian offshore energy services company Bumi Armada Navigation and has been taken on long-term charter by Electrogas Malta. The FSU has been converted so that it can be used on a continuous basis, without dry-docking interruption, during a period of up to 20 years feeding LNG for regasification and use by the 400-megawatt Delimara power plant. The conversion project of the Moss-type LNG carrier was part of a charter agreement signed by Bumi Armada and ElectroGas in April 2015. Malta will also allow the FSU “Armada LNG Mediterrana” to fly the Maltese flag as an exception to that rule that makes ships older than 25 years ineligible. This followed a full inspection and testing of the ship by Transport Malta. While LNG will be imported for the Maltese gas-fired power plant, the

long-term aim of Malta, the smallest member of the European Union, is to have a pipeline link with Italy, one of EU’s largest pipeline gas importers.

MARSHALL ISLANDS, the republic whose ship registry has many liquefied natural gas carriers on its books, has hit a significant landmark by attaining the status as the world’s largest tanker fleet. This status was achieved recently with additional tonnage joining the RMI Registry from markets in Greece, the United States and Asia. Marshall Islands flags fly on the world’s largest LNG carriers such as the 261,700 cubic metres capacity Q-Max “Al Ghuwairiya” and the 210,000 cubic metres capacity Q-Flex vessel “Al Aamriya”, which transport the fuel for Qatar. It also flies on many of the most modern LNG average-sized carriers owned by European shipping lines such as Greece’s Dynagas and its ships like the 160,000 cubic metres capacity “Clean Ocean”. The RMI-flagged tanker fleet now stands at 44.6 million gross tons, putting it ahead of Liberia with 40.6MGT, Panama 36.1MGT, Singapore 20MGT and Hong Kong 18.9MGT. International Registries Inc. (IRI), which provide administrative and technical support to the RMI Maritime and Corporate Registries, is committed to the continued decentralization of services to better support the Registry’s owners and operators in every aspect of their business. This principle has led the RMI Registry to an average year-on-year growth of 15 percent since 2001. Overall, the RMI Registry now stands at 137.3 million GT, with an average age of 8.7 years. The 3,937 vessels flying the RMI flag are afforded the excellent safety record of the flag that has been on the US Coast Guard’s Qualship 21 program for 12 consecutive years and continues its status on the White Lists of the Paris and Tokyo Memorandums of Understanding. “Qualship 21 is a particularly difficult standard to meet,” said Bill Gallagher, President of IRI. “As mentioned at the Connecticut Maritime Association’s (CMA’s) Shipping 2016 Conference, 13 of the 26 eligible flag States from 2015 fell off Qualship,” he remarked. “This dramatic development in the spring led directly to the increased tonnage for the Registry in the summer,” stated Gallagher. “The RMI is the only flag State of the three largest that holds Qualship 21 status. Where others have faltered,

RMI has remained steadfast for more than a decade,” said Gallagher. The RMI said it continued to be proactive at the International Maritime Organization (IMO) and in September established a dedicated team of experts to guide shipowners through the complications of complying with the recently ratified Ballast Water Management Convention.

MITSUI OSK Lines, the Japanese shipping company with a liquefied natural gas fleet operation of 70 vessels, said the global shipping industry will face a harsh situation at least until the end of 2017, though LNG prospects are brighter in the medium term. “Many marine shipping companies are struggling to stay afloat as the global market remains stuck in the doldrums,” said Junichiro Ikeda, President of the shipping company, in an interview with the Japanese financial daily “Nikkei”. Ikeda said that with South Korea’s Hanjin Shipping, one of the world’s largest container companies, collapsing at the end of August the industry was forced to consider more options to emerge from the slump in better shape. MOL is becoming involved in managing more LNG carriers in supplying Asia as more liquefaction projects come on stream in the Asia-Pacific region, the US and Russia. It will also play a key role in operating ice-class LNG carriers from Arctic Ocean routes to transport LNG from Russia’s Yamal project from 2018. Ikeda said that the LNG shipping was being helped by the crude oil tanker segment being firmer and in the medium term by the expansion of the Panama Canal. He also cited the Russian Yamal project as having additional benefits for MOL. “Demand for oil tankers has been lifted by China’s efforts to boost its strategic petroleum reserves,” Ikeda said. “The Panama expansion has made it possible for liquefied natural gas carriers to pass through there. I expect Japan and other countries will be able to procure energy more efficiently. Our company is also developing a shipping route to transport LNG to Japan and Europe from Russia’s Yamal Peninsula. We want to take measures to achieve further growth despite the tough business environment,” the MOL President said. Ikeda said that problems in the container market also affected other shipping businesses such as LNG carriers as it was a sort of industry benchmark. “The benchmark freight rate for container traffic from Asia to the US West Coast is hovering around

\$1,700 per 40-foot container,” said Ikeda. “Concerns over a glut in the supply of ships have receded following the bankruptcy of Hanjin, resulting in the freight rate recovering somewhat. But the freight rate is still about half the peak level seen before the global financial crisis of 2008. It is also still below the break-even point,” the MOL President explained. “The annual transportation volume of container ships usually grew at a pace three to five times faster than the world’s gross domestic product from around 1990, when the Chinese economy started growing rapidly. But there has been no big difference in growth rates since the banking crisis. Growth in maritime trade has lost its momentum, while the fleet has swollen due to the debut of many newly built vessels, resulting in a wider supply-demand gap,” he added. “Shipping companies must push ahead with restructuring efforts, such as reducing surplus vessels, even if they are painful. A.P. Moller-Maersk, the world’s largest container shipping company (based in Denmark), has declared it will press ahead with reorganization and integration to adjust supplies. But it is unlikely the situation will improve rapidly. I think the harsh conditions will continue at least until the end of next year,” Ikeda stated.

MOZAMBIQUE, the southeast African nation, said it had signed a 20-year liquefied natural gas sales agreement with BP of the UK, with its project partner Italian energy company Eni, opening the way for progress on a floating LNG project. Executives of the Mozambican state National Hydrocarbons Company (ENH) said the sales accord with BP was “an important step” in moving towards a final investment decision. “Eni and Mozambique should by the end of this year reach a final investment decision on a project to build a floating offshore platform with a capacity to produce 3.3 million tonnes per annum of LNG,” ENH said. The Coral natural gas field is part of the huge reserves discovered six years ago in the Area 4 concession off the Rovuma Basin offshore Mozambique. The field gives its name to the Eni-led Coral FLNG venture. Eni’s Coral FLNG project will be located in waters more than 2,000 metres deep and about 80 kilometres offshore the northern Mozambican province of Cabo Delgado. The Eni plan of development, the very first one to be approved in the Rovuma

Basin, foresees the drilling and completion of six subsea wells and the construction and installation of a floating production facility. In February 2016, the Mozambique authorities sanctioned the development of the first phase of the Coral FLNG project and targeting fields with 5 trillion cubic feet of natural gas. However, Eni had been reluctant to move forward because of economic uncertainty in Mozambique following a state loans scandal. Eni is the operator of Area 4 with a 50 percent interest owned through Eni East Africa, which holds a 70 percent stake of Area 4. The other Area 4 concessionaires are Portugal's Galp Energia, Korea Gas Corp. and ENH. China National Petroleum Corp.'s PetroChina affiliate owns a 20 percent indirect interest in Area 4 through Eni East Africa. Huge natural gas reserves have also been discovered in the Area 1 licence block operated by US company Anadarko Petroleum, which expects to eventually proceed with an onshore LNG project. The shareholders in the Anadarko-led Area 1 licence include three Indian companies, ONGC Videsh, Oil India and Bharat PetroResources as well as Japan's Mitsui & Co. and Thailand's state-owned energy company PTT. Omar Mitha, the Chairman of state energy company ENH, said recently that his country was heartened by the rising clean-energy profile of LNG as a fuel. "The positive aspect that underlies the opportunities for Mozambique is that there are large reserves and the country offers security of energy supply to premium markets of East Asia, including new LNG importers," he said. "Mozambique has a

strategic location, has economic advantages and a broad base of stakeholders from India, Thailand, South Korea, China and Japan," Mitha added.

OIL SEARCH, the Australia-listed company that lost a takeover battle for the Papua New Guinea LNG asset holder InterOil to ExxonMobil, has explained its

preference for three new production Trains centred on the existing liquefaction plant near the capital Port Moresby. Its explanation was contained in

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third-quarter earnings as it reported a 16 percent rise in revenues to US\$309.5 from US\$267.7M in the year-ago period. Oil Search is a shareholder in the PNG LNG plant near Port Moresby, operated by ExxonMobil. ExxonMobil's bidding move was in opposition to plans by French energy company Total in PNG to back the Oil Search offer for InterOil because of InterOil's control of the Elk-Antelope gas field that will underpin the Total-led Papua LNG project. Oil Search in explaining the outcome of the takeover of PNG LNG and Papua LNG stakeholder InterOil by ExxonMobil also issued its own views on the way forward for LNG in the small Oceania state. "Once ExxonMobil's entry into the PRL 15 joint venture (Papua LNG) has been confirmed, we anticipate that talks will commence with the operator, Total, about possible cooperation and integration of the next phase of LNG development," Oil Search explained. "Oil Search believes that there is sufficient gas resource in the Elk-Antelope and P'nyang gas fields to underpin at least two PNG LNG-sized expansion Trains, and possibly three Trains if planned appraisal and exploration drilling is successful. Building these Trains on the PNG LNG plant site and sharing downstream facilities would result in considerable capital savings and would materially improve operating efficiencies, generating superior returns for Oil Search shareholders, as well as for other stakeholders, including the PNG Government and local landowners," Oil Search stated. "Under all anticipated scenarios involving cooperation, two highly credentialed operators of LNG developments, ExxonMobil and Total, will be maintained in PNG for the next phase of development," it added. On its own earnings, Oil Search said the average realised oil and condensate price of US\$47.24 per barrel was slightly lower than in the second quarter, but the average realised LNG and gas price was 23 percent higher, at US\$6.44 per MMBtu, due to the three-month lag between oil and LNG pricing. It said in its earnings that production net to Oil Search from the PNG LNG project was 5.94 million barrels of oil equivalent in the quarter. "The PNG LNG plant produced at an annualised rate of approximately 8.1 million tonnes per annum, 10 percent higher than in the second quarter and the highest quarterly rate achieved since it came on stream in 2014," Oil Search said.

PACIFIC NORTHWEST LNG

Chief Executive Michael Culbert, who lined up more than 60 trillion cubic feet of resources for the project, is stepping down from his roles with Petronas, including his post as CEO of Progress Energy, the Canadian company acquired by the Malaysians five years ago for its shale-gas assets. The Petronas CEO of Upstream, Anuar Taib, said Culbert was stepping down from his day-to-day responsibilities as President and CEO from October 31 as he prepares for retirement. The Malaysian company said Culbert would continue to serve as a director on the boards of both Progress and Pacific Northwest. His replacement at Progress was named as Mark Fitzgerald. Petronas is still considering its next move on the Pacific Northwest LNG joint venture after it was given regulatory approval by the Canadian federal government. However, the approval includes 190 mitigation measures and for the first time in a Canadian energy venture the imposition of a maximum cap on greenhouse gas emissions. These will add extra costs. Petronas has said it would conduct a total project review along with other shareholders over the coming months before announcing the next steps for the venture aimed at building a liquefaction plant at Lelu Island, near the port of Prince Rupert. The other partners are India Oil Corp., Japan Petroleum Exploration Co., China's Sinopec and Petroleum Brunei. Petronas paid US\$1.7 billion for its Progress Energy stake back in June 2011 to develop its British Columbia shale-gas holdings in the Montney region. Culbert was President and CEO at the time and stayed on as his company became a Petronas subsidiary. "On behalf of Petronas I want to thank Mr Culbert for his years of leadership with Progress," said Taib. "He was instrumental in developing the joint venture partnership with Petronas and the subsequent acquisition, while also significantly growing the company's production of natural gas in British Columbia," Taib added. "Mr Culbert has also led and supported Pacific NorthWest LNG through the federal regulatory process, which recently culminated in the project receiving its environmental certificate," the Petronas executive said. Culbert stated that he was confident he was leaving Progress in a solid position as a leading natural gas development company, which is well positioned. "Over the last few years we have achieved

several key milestones, including the establishment of 25 trillion cubic feet of proven and probable reserves and 62 Tcf of total resources in the North Montney in support of the LNG project," Culbert said. "With this high quality natural gas asset, I am confident that Mr Fitzgerald and the entire management team will maintain Progress Energy's positive trajectory," he added.

QATARGAS

the world's largest liquefied natural gas producing company, has signed a firm 20-year agreement to supply Pakistan with LNG cargoes as the Asian nation continues to develop import infrastructure around the port of Karachi. Executives of the owner of the sole Pakistani import facility at Port Qasim, near Karachi, Global Energy Infrastructure Ltd (GEIL), signed the Sale and Purchase Agreement at a ceremony in Islamabad hosted by Pakistani Prime Minister Nawaz Sharif. The Qatari delegation was led by Saad Sherida Al Kaabi, the President and Chief Executive of Qatar Petroleum, which is the main shareholder of Qatargas as well as the other Qatari production company RasGas. The Islamabad event was also attended by the Chairman and CEO of Qatargas, Khalid bin Khalifa Al Thani, and other company officials. Pakistan's first LNG import facility, the floating storage and regasification unit "Exquisite", began operations in April 2015 at Port Qasim, located on a channel of the Indus River east of Karachi. The regasified LNG is delivered directly to a pipeline of the Pakistani regional utility, Sui Southern Gas Co. The single LNG facility has helped alleviate some of the huge energy shortages in the south of the country since being commissioned, though officials have said more import terminals are planned. The Qatari delegation was welcomed by Prime Minister Sharif, along with federal ministers and senior Pakistani officials. Under the terms of the agreement, Qatargas will supply 1.3 million tonnes per annum of LNG to Pakistan, with provisions allowing the volume to increase to 2.3 MTPA once Pakistan expands its import infrastructure. The LNG will be supplied from the Qatargas 2 operation at Ras Laffan, where two Trains each produce 7.8 MTPA. Qatargas said the first cargo was expected to be delivered to Pakistan in 2018 by a Qatargas-chartered Q-Flex vessel. Qatar Petroleum CEO Al Kaabi thanked the Pakistani PM for hosting the signing of

the long-term LNG supply deal with GEIL. "The agreement with GEIL reinforces our confidence in Pakistan as a promising energy market. It also enables us to meet Pakistan's energy needs from the world's most reliable LNG producer, thus enhancing our long and historic brotherly relations," Al Kaabi added. Qatargas CEO Al Thani stated: "I am particularly pleased to strengthen our relationship with Pakistan, which continues to grow as an important LNG market. I have great confidence in this deal, and I look forward to our respective teams working together as we safely and reliably supply LNG to Pakistan."

QATAR PETROLEUM

the main shareholder in the Gulf state's two liquefied natural gas production companies Qatargas and RasGas, reflected on its close relationship with Japan and its delivery of more than 2,500 LNG cargoes to the Asian nation in 20 years of long-term contracts. The point was made in a speech to end a Qatari LNG delegation's three-day working visit to Japan led by QP President and Chief Executive Saad Sherida Al-Kaabi, who is also Chairman of Qatargas. "For us in Qatar, we have watched the volatility that has characterized the energy market in the past two years," the QP CEO said. "And, throughout this time, we have never lost sight of the need to maintain and enhance our long-standing relationships with our valued customers and partners," Al Kaabi said. "The year 1997 was the beginning of our historic journey in Japan with Chubu Electric. The friendship and commitment of Qatar Petroleum and Qatargas towards our partners remain just as strong as it was then, if not stronger. I am proud to announce that we have successfully delivered more than 2,500 cargoes to our esteemed Japanese LNG buyers. This achievement could not have been possible without the confidence of our customers and the cooperation of all our partners in Japan. Qatar places great value on its relationship with its clients in Japan, and we will work towards better and stronger relations," Al Kaabi stated. Al Kaabi's speech before the diplomatic corps, the Mayor of Tokyo and the Japanese energy industry comes at a time of active lobbying by the Japanese government to gain more control over cargo prices. The largest LNG importing nation is seeking to end destination clauses, renegotiate long-term contracts with producers linked to the oil price and to develop LNG financial derivatives on

the commodities market to allow more hedging against price movements. Qatar and other LNG producers point to the need for cargo prices to be at a level that reflects the high costs of exploration and production of oil and gas and constructing high-technology liquefaction plants and fleets of vessels to transport the fuel. LNG deliveries to Japan from the Middle East amount to around 2 million tonnes per month, or 24MT a year. The QP CEO was accompanied by senior executives of the Qatari LNG industry and substantive talks were held with the major Japanese energy companies. Meetings during the visit discussions also took place with Chairmen, Presidents, and senior executives of Chubu Electric, Jera Co Inc., Mitsui, Chiyoda Corporation, Idemitsu, Cosmo Oil Co., LNG Japan, Mitsui & Co. and Marubeni Corporation. The Qatari delegation additionally held meetings with Japanese financial institutions, including the nation's largest bank, Bank of Tokyo-Mitsubishi UFJ, as well as the Japan Bank for International Cooperation, the import-export institution that lends to energy projects that supply Japan.

SANTOS, the Australian energy company, said its liquefied natural gas sales volumes more than doubled to 755,500 tonnes, reflecting the ramp-up of the Gladstone LNG plant in Queensland and a strong performance from Papua New Guinea LNG. Santos said the GLNG plant on Curtis Island, whose shareholders also include Malaysia's Petronas, French energy group Total and Korea Gas Corp. produced 1.3 million tonnes of LNG in the quarter and shipped 21 cargoes. The

Adelaide-based company, which also has a stake in the Darwin LNG plant in the Northern Territory operated by ConocoPhillips, said its share of LNG

sales income amounted to US\$227 million compared with US\$148M in the same quarter of 2015 when volumes were less than half what they are now. In 2016 so

far, Santos has received US\$617M from sales of 2.05 million tonnes of LNG. Santos said the average LNG price received for its volumes was US\$5.72 per

Isolation valves for Gas Combustion Units

When the Boil Off Gas cannot be used to cover a vessel's energy needs, Gas Combustion Units (GCU) are mandatory on board Diesel Electric LNG carriers.

The same applies to future LNG fueled vessels such as container carriers, cruise ships or ROPAX, as identified in the "LNG Fueled Vessel Gas Code" (which is presently in preparation by the industry), if the selected LNG fuel tank technology, such as membrane or prismatic, is not compatible with a 15 day pressure build up.

Compared to LNGCs, the main identified differences for LNG fueled vessels GCUs are that:

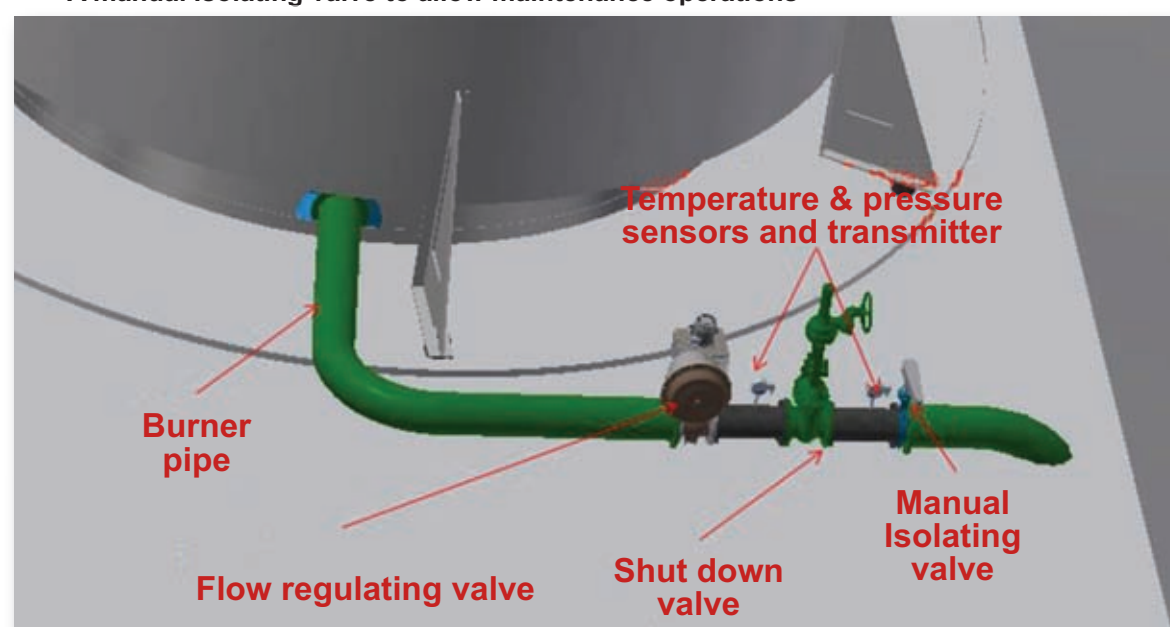
- ♦ The Boil Off Gas (BOG) flow to be disposed of will be significantly less : typically less than 1t/hour compared to 3 to 4, as the size of the LNG tanks are much smaller
- ♦ space available for the equipment will be scarce, while noise and exhaust temperature limits will be stricter.

To address this challenge, SNRI, together with the company NG3 proposes a brand new miniaturized ECOFLARE GCU which presents main design features:

- ✓ Very limited number of optimized components
- ✓ An innovative burner technology which provides a distribution of the combustion over the whole central section of the combustion chamber, reducing both gas and air feed pressure drops.
- ✓ An optimized reduced volume

This compact new design makes real sense for merchant vessels which will be revamped in order to operate with LNG fuel. To optimize the total volume of the skid, SNRI has developed:

- ♦ A gas flow regulating valve whose opening is driven directly by the ship automated system to dispose of the excess BOG which is not used by the ship engines;
- ♦ An automated shut down valve which blocks gas flow as soon as there is no more need to burn BOG;
- ♦ A manual Isolating valve to allow maintenance operations



The shut-down valve is compliant with the requirement of all Classification Societies which identify that the isolation of the GCU shall be performed by 2 Isolation valves + a draining valve.

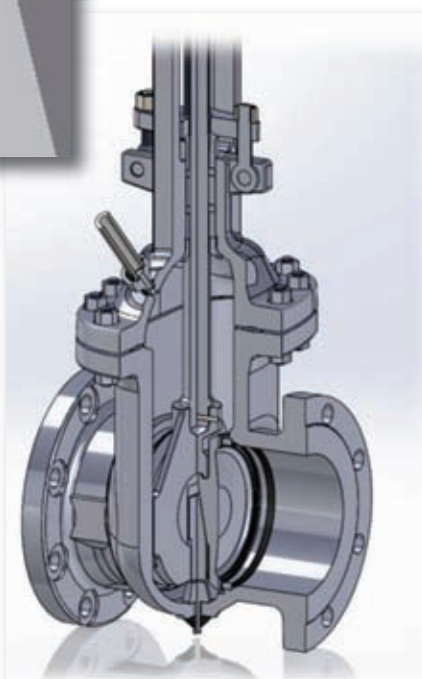
With an innovating design, SNRI is able to meet this requirement with only valve integration of:

- 2 internal isolation barriers
- 1 draining line + valve

Innovative Equipment for the Shipping Industry

For more information : Mr. Stanislas LONGUET

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million British thermal units compared with US\$8.47 per MMBtu in the year-ago quarter. Over the past year the GLNG has increased production and brought on stream its second liquefaction Train. Santos said that in its overall energy business third-quarter production rose 7 percent to 15.5 million barrels of oil equivalent. The company also said it had started transactions under a new oil price hedging policy Santos Managing Director and Chief Executive Kevin Gallagher said the company continued to focus on driving down costs and applying available cash flow to reduce debt. “We are taking the right steps to ensure Santos becomes a strong and sustainable business, and that mindset guides our decision making as we continue to reduce costs and maintain a strong capital discipline. Furthermore, our decision to commence oil price hedging reflects our desire to reduce the effect of commodity price volatility,” Gallagher said. In project reports, Santos explained that feed-gas delivered to the GLNG plant during the quarter was 80.1 petajoules of indigenous production, including from the Santos portfolio and third-party purchased quantities. The LNG plant has shipped a total of 60 LNG cargoes since it started up in September 2015. A planned three-week statutory inspection shutdown of LNG Train 1 commenced in early October. Santos added that the planned shutdowns of the Fairview feed-gas hubs 4 and 5 have been aligned with the Train 1 shutdown. As regards the PNG LNG plant operated by ExxonMobil and in which Santos has a stake, the facility produced 2 million tonnes of LNG in the quarter and shipped 27 LNG cargoes. The Darwin LNG plant produced 830,000 tonnes in the quarter and shipped 13 cargoes.

SHARJAH, the third largest of the seven United Arab Emirates after Dubai and Abu Dhabi, has signed an accord with German utility and energy trading company Uniper for liquefied natural gas deliveries. Sharjah National Oil Corp. (SNOC) and Uniper signed a memorandum of understanding for the shipments to be delivered from the first quarter of 2018. The cargoes will be unloaded at the Port of Hamriyah, a deep water Gulf seaport in the Sharjah emirate’s Hamriyah Free Trade Zone. “Gas will flow to the Sajaa gas field complex and further into the existing pipeline network throughout the Northern Emirates,” a SNOC statement

said. “The natural gas will be marketed to existing gas consumers in the region and new business seeking a reliable long-term supply of energy,” SNOC added. “We highly value this project which will add to the supply of gas in Sharjah and Northern Emirates to meet the growing demand for energy,” said Sheikh Sultan Bin Ahmed Al Qasimi, SNOC President. “The combination of SNOC and Uniper efforts with all their capabilities and experience in natural gas activities will achieve the planned targets,” Al Qasimi added. Uniper Global Commodities said that under the accord just signed the firm would assist SNOC in developing the Port of Hamriyah to receive LNG cargoes and obtain supplies of energy from LNG markets. “We are grateful that SNOC has selected Uniper to support the Emirate of Sharjah in their quest for uninterrupted supplies of natural gas,” said Klaus Schaefer, Chief Executive of Uniper. “Uniper has over 50 years of experience, through its legacy companies, in delivering sustainable competitively priced energy to customers,” added Schaefer. The Sharjah LNG accord is likely to lead to the chartering of a Floating Storage and Regasification Unit to handle the shipments. The Emirate of Abu Dhabi inaugurated an FLNG import facility in August 2016 at the port of Ruwais. The FSRU loaded LNG from the UAE’s own production plant on Das Island and delivered it to the port. The Abu Dhabi cargo was delivered by the FSRU “Excelerate”, chartered from Excelerate Energy of the US. The FSRU is considered a component of Abu Dhabi’s plan to provide the gas necessary to meet its development goals. The seasonal use of an FSRU means the cancellation of the UAE’s plans for its first land-based facility for importing LNG, originally planned at Fujairah, located outside the Persian Gulf on the Gulf of Oman. Arab nations have favoured floating LNG solutions. Previously the Gulf state of Kuwait started the port-side FSRU import terminal system in 2009 followed by Dubai’s use of its first FSRU for the UAE in late 2010.

SHELL has signed a supply agreement with US cruise line Carnival Corp. to supply liquefied natural gas to fuel two of the world’s largest passenger cruise ships. The Shell Western LNG BV subsidiary of the Anglo-Dutch company will supply the vessels when they start sailing in northwest Europe and the Mediterranean in 2019. Shell said this will be the first

time LNG in dual-fuel engines will be used in the cruise industry to power ships both in port and at sea. Under the terms of the agreement, one Carnival cruise ship will refuel from Shell’s special LNG bunker vessel that will load at the Gate LNG import terminal in Rotterdam. To serve marine customers, Shell is building an LNG bunkering vessel with a capacity of around 6,500 cubic metres to facilitate ship-to-ship transfer and deliver LNG fuel from the Gate facility. The second Carnival cruise ship is expected to refuel at one of the ports in the Western Mediterranean, possibly Gibraltar. The use of LNG as a fuel in the shipping industry is growing as ship operators meet stricter regulations on sulphur and nitrogen oxide emissions in Emission Control Areas set up in Northwest Europe and North America and set to bring in other regions. “We have been working closely with Carnival to get to this point in our commercial partnership,” said Laurant Wetemans, Shell’s General Manager Downstream LNG. “Working together from an early stage is critical in helping the transition to cleaner LNG cruising. This is a unique partnership that will contribute to a robust and reliable LNG fuel supply chain, along with opportunities for future growth,” Wetemans added. Tom Strang, senior vice president of maritime affairs for Carnival, said his company was committed to reducing air emissions and improving air quality through various means, including LNG. “We are proud to be on the forefront of advancing LNG as a fuel source for the cruise industry and creating a new model for powering next-generation cruise ships,” Strang added. Shell said the development of LNG-fuelled vessels and ships and the supporting infrastructure, enhances its position in Europe’s natural gas and LNG markets. The company is also one of the main global traders of LNG as its Shell Shipping & Maritime unit manages more than 40 large-scale LNG carriers delivering to import terminals around the world.

SKANGAS, the Norwegian liquefied natural gas company, said it carried out a successful bunkering operation near the Swedish port of Gothenburg as it forecast faster growth of the marine and industrial LNG fuel market in Northwest Europe. Skangas, a subsidiary of Finnish natural gas operator Gasum, said it was delivering LNG to customers such as North European Oil Trading using a chartered carrier until its new bunkering

vessel arrives. Skangas has hired the services of the small-scale carrier “Coral Energy”, with 15,600 cubic metres of capacity, owned by Dutch shipping line Anthony Veder. “By using the ‘Coral Energy’, Skangas provides LNG bunkering to ship owners throughout Northern Europe. The bunkering in Gothenburg was performed in close cooperation between Skangas, ship owners Terntank and Anthony Veder, the Port of Gothenburg and the company North European Oil Trading,” it added. Skangas said the Gothenburg bunkering operation had several historic firsts for the company. “Not only was it the first ship-to-ship LNG bunkering to the vessel ‘Ternsund’, it was the first ship-to-ship bunkering to be executed by companies Skangas and Anthony Veder and the first to take place in the Gothenburg area,” Skangas said. The company explained that the Gothenburg operation means the LNG bunkering market in Northern Europe has advanced as re-fueling had previously been done at ports using trucks or alongside onshore terminals. It noted that it will soon take delivery of its own LNG bunkering vessel in early 2017. The new Skangas bunker vessel is named “Coralus” and will have a capacity of 5,800 cubic metres. “We are very proud to be one of the first in the world to bunker LNG ship-to-ship,” said Tor Morten Osmundsen, Chief Executive of Skangas. “We strongly believe that LNG will rapidly become the fuel solution for forward-thinking ship owners,” he added. “We have developed an LNG infrastructure to serve the Nordic industrial and marine sectors, and make LNG available for customers who are willing to switch to a much cleaner fuel than traditionally used,” Osmundsen said. “The bunkering operation in Gothenburg clearly indicates that the market is developing and that our efforts to make LNG readily available are paying off,” he stated.

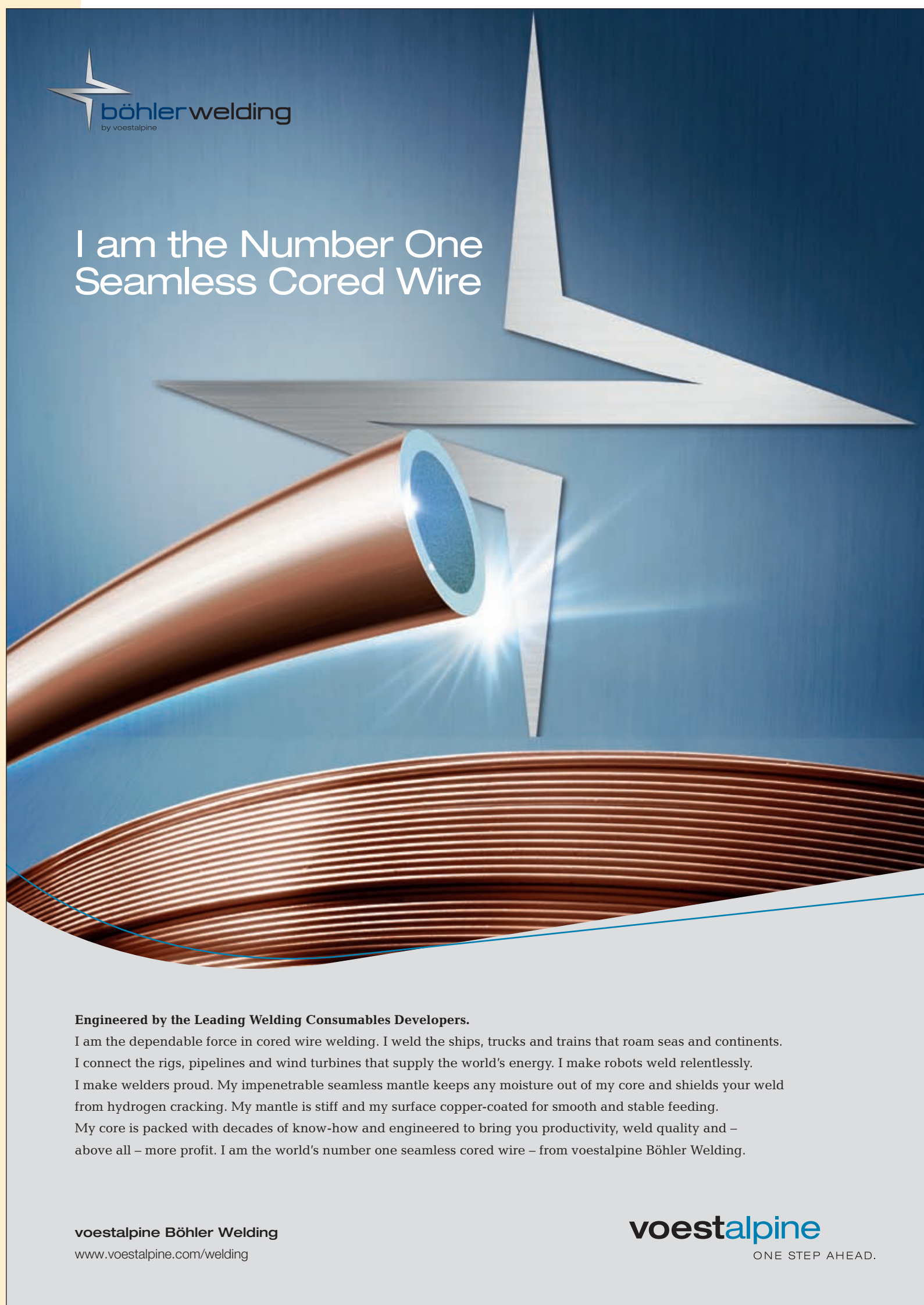
US REGULATORS at the Federal Energy Regulatory Commission have released an update of the environmental review of the export project of Washington-based Venture Global LNG involving a large-scale plant on the banks of the Mississippi River. The VG Plaquemines project will be located on 630 acres near river mile-marker 55 on the west side of the Mississippi, 30 miles south of New Orleans. The FERC said it was currently reviewing the draft resource reports and consulting with

interested stakeholders. The next step is for Plaquemines LNG and its affiliated Gator Express Pipeline project to submit their formal applications to the regulator after it will start its environmental analysis and issue recommendations for mitigation measures. The Mississippi river project will produce 20 million tonnes per annum of LNG and will include 20 small-scale liquefaction Trains, four LNG storage tanks and three marine loading berths for ocean-going vessels. "We are continuing to conduct our review of the planned project based on the information we have received from Plaquemines LNG and Gator Express Pipeline and the comments we have received from stakeholders," the FERC said. "The companies provided revised draft reports in August 2016 and we are currently reviewing these," the regulators added. "After they file their formal application, we will issue a Notice of Application and identify the CP Docket number for the Project. This Notice of Application will outline how interested parties can become intervenors and how persons can continue to comment on the project," the FERC explained. VG is also planning to produce 10 MTPA of LNG at another Louisiana project being developed at Calcasieu Pass. The company has acquired a 1,000-acre site for the Calcasieu Pass plant to be located at the intersection of the Calcasieu Ship Channel and the Gulf of Mexico. The VG development company was founded by a banker and a lawyer. The two are Michael Sabel, an equity fund manager and venture capitalist, and Robert Pender, a former partner at Hogan Lovells, a global law firm. Both are now joint

chief executives and co-chairmen of the VG LNG company. In February 2016, VG signed a sales and purchase agreement with Shell North America for 1 MTPA of

LNG from the Calcasieu Pass plant. The accord with Shell is for 20 years with the cargoes being supplied on a free-on-board basis, whereby the Anglo-Dutch

company supplies the ships, for a purchase price indexed to the monthly Henry Hub price plus a facility fee indexed to inflation. ■



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Experts consider their successful delivery of three Curtis Island LNG joint ventures

How multiple plants were built on an island using a centralized service strategy

In quick succession, three customers for the Queensland Curtis, Gladstone and Australia Pacific coal-seam-gas to LNG projects each hired Bechtel to design and execute their project on a lump-sum basis.

The three island projects are located side-by-side and are only accessible by water, presenting a unique set of challenges and opportunities. These simultaneous construction programs are part of the largest concentration of private-capital investment in Australia's history.

Experience

Bechtel's extensive experience in modular design of the ConocoPhillips Optimized Cascade® process technology and its innovative program for successfully delivering these projects by a direct-hire approach.

Each project optimized the extent of modularization through construction-led engineering and employed a unique execution approach in collaboration with fabrication yards. Each plant design is based on highly efficient aero-derivative gas turbines with power augmentation for refrigeration compressor drivers.

Highly efficient nitrogen rejection units minimize the environmental impact and safety hazards, while maximizing the performance, flexibility and ease of modularization.

"To effectively execute multiple projects on the island, a centralized service strategy has been adopted for standardization, knowledge sharing and alignment with customers, regulators and the community," Bechtel said.

Overlap

"The benefits to the Gladstone area economy, craft training and community development programs are also addressed," it added.

These three simultaneous construction programs are part of the largest concentration of private-capital investment in Australia's history.

Together, the three Curtis Island plants, when completed, will account for over 25 MTPA of LNG capacity, roughly eight percent of global production.

Due to overlapping schedules, close

proximity, and good cooperation, each project and all customers have benefited from economies of scale and efficiency orchestrated by Bechtel. Bechtel engineers in Houston and Shanghai geared their designs for the three Curtis Island plants to modular construction, enabling simultaneous construction at multiple sites, allowing for a fast-tracked schedule and access to skilled and experienced resources.

At Bechtel facilities in the Philippines, Indonesia, and Thailand, teams built 260 modules (125,000 metric tons) for use in all three complexes.

The range of modules selected varied from less than 100 metric tons to over 2,000 metric tons on each project. The Cryogenic Rack is among the largest of the modules, weighing 3,500 metric tons and measuring 77m long, 30m wide, and 25m high.

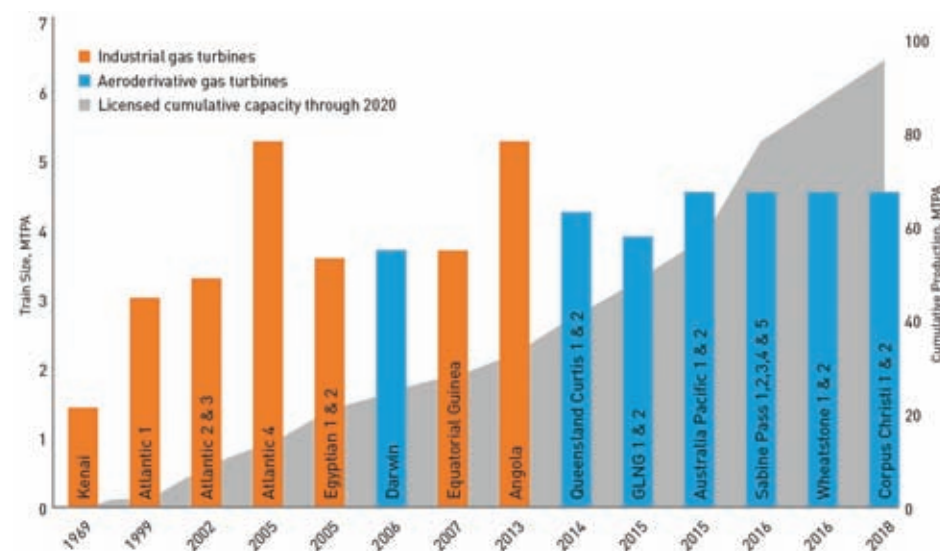
Extraordinary employee training and community development programs earned Bechtel the 2013 Employer of the Year Award from the Queensland Department of Education, Training and Employment. During construction on Curtis Island, 23,000 Bechtel employees completed accredited training programs, and 436 adult apprentices were employed, among the largest single hiring of apprentices in Australia's history.

Moreover, Bechtel boosted the Gladstone-area economy by awarding \$1 billion worth of local procurement and other contracts, employing more than 10,000 local personnel, and hiring 450 indigenous employees and subcontractors.

The three multi-train LNG projects are being executed on a lump sum basis for three different customers in one location, which is unprecedented for the industry.

Each project consists of two LNG trains, two LNG storage tanks, single jetty, utilities and balance of plant that support plant operation. The nominal plant capacities are:

- Queensland Curtis LNG project: 8.5 MTPA LNG
- Gladstone LNG project: 7.8 MTPA LNG
- Australia Pacific LNG project: 9.0 MTPA LNG



Bechtel LNG projects and cumulative capacity based on Optimized Cascade Process for liquefaction of natural gas at plants around the world

In December 2014, QCLNG became the world's first producer of LNG from natural gas sourced from coal seams.

The QCLNG project has both trains operating and performing at high levels. The project is complete and the custody of the plant has been transferred to the owner. The first trains of the GLNG and APLNG projects are running and loading cargoes.

The performance test for GLNG is complete, with excellent results. The second trains of the GLNG and APLNG projects are planned to be completed in 2016.

The start of LNG production from these projects is a result of nearly five years of development and construction on Curtis Island. As the EPC contractor, Bechtel designed the plants, procured monumental quantities of materials from more than 100 global suppliers, built modules at three yards in Asia, provided support services in Gladstone, as well as performed construction at Curtis Island sites.

The three projects together required over 14,000 personnel, with 6,600 living on Curtis Island.

These projects are the first application of converting gas from coal seams into LNG utilizing the ConocoPhillips Optimized Cascade process and highly efficient LM2500+G4 aero-derivative gas turbines as refrigeration compressor drivers with power augmentation by inlet air chilling.

The Curtis Island LNG projects are designed and developed under a global LNG collaboration between Bechtel and ConocoPhillips LNG Technology and Licensing.

Collaboration

The collaboration capitalizes on the highly differentiated ConocoPhillips Optimized Cascade process, ConocoPhillips' operations expertise, and Bechtel's extensive LNG engineering, procurement, construction, and commissioning and start-up project execution experience.

Uniquely, Bechtel delivered the projects under a direct hire methodology and executed through a lump sum turnkey commercial approach. By 2020, when the current projects in EPC will be in operation, the LNG collaboration is expected to have a total installed production capacity of approximately 100 MTPA.

QCLNG was the first of the three Curtis Island LNG projects to liquefy CSG.

A large number of CGS wells must be drilled in order to produce the volume of feed gas, mostly methane, necessary to support LNG facilities.

Upon dewatering a new well, the gas production will start when hydrostatic pressure is sufficiently reduced. The gas production stays constant over a long period of time, as long as a minimum capacity is maintained, which prevents the water from filling the well.

TABLE 1: COMBINED QUANTITIES ON CURTIS ISLAND LNG PROJECTS		
Item	Quantity	Unit
Pieces of equipment	2,300	EA
LNG tanks	6	EA
Cut and fill	18,600,00	CM
Concrete	375,000	CM
Structural steel	65,00	MT
Pipe	550,000	LM
Cable	5,000,000	LM
Pieces of instrument	6,000	EA
Number of modules	260	EA
Total LNG capacity	25	MTPA

An overview of the significant quantities required for the job

To maintain the CSG wells in operation, it is critical to process the feed gas in the LNG plant at all times, instead of shutting it in and restarting like conventional gas fields.

A flexible LNG technology such as ConocoPhillips Optimized Cascade process with high production efficiency and significant LNG plant turndown capabilities can improve overall integration of CSG production and LNG plant operation.

Some of the attributes of the process are summarized below:

- The process is configured in a proven ‘two trains-in-one’ arrangement to ensure superior reliability and availability. This provides highest plant turndown capability. The plant turndown can range from 0-100% while still maintaining good efficiencies. The LNG train is able to operate at reduced rates of 60-80% in the event that one refrigeration compressor is down. Even with half the train down, it can operate at 30-60% capacity.
- Easy to start up, shut down, operate and maintain, with fast startup cycles and wide operating range. The process lends itself to quick recovery time after trips/shut downs, allowing LNG production to be back to full rates for a cold restart within 2-4 hours, warm restart within 4-8 hours. Cold boxes retain cold temperatures during extended outages, which greatly facilitate faster startup cycles.
- Rebalancing between refrigeration circuits allows for quick response to changes in operating conditions.

Turbine drivers

The Curtis Island LNG projects are utilizing highly reliable and efficient LM2500+G4 aeroderivative gas turbines as compressor drivers, with low emissions and NOx abatement by Dry Low Emissions combustion.

Each train utilizes six LM2500+G4 drivers as this size meets the power requirements and ideally fit ‘two trains-in-one’ concept of the Optimized Cascade process LNG process

These engines are variable speed drivers, which aid the operational flexibility of the process and allow faster startup without the use of large variable frequency drive starter motors as are commonly used on single shaft gas turbines.

Higher thermal efficiency of these turbines, along with waste heat recovery, complement a higher efficiency of the Optimized Cascade process, which results in a greener train because of a significant reduction in greenhouse gas emissions.

Other benefits of LM2500+G4 gas turbines include higher power-to-weight ratio and modular construction, which reduces the plot space of the compressor deck and lowers installation time and cost. These drivers are easier to maintain with modular engine change outs, resulting in improved production efficiency of the plant.

Another first

All three Curtis Island LNG projects have inlet air chilling on each LM2500+G4 aeroderivative gas turbine to boost compressor driver power to closely match the power requirements for LNG production.

This is the first application of inlet air chilling in the LNG industry. Since Curtis Island has a warm climate, inlet air chilling is an attractive approach to keep gas turbine power steady at a higher level throughout the year, resulting in minimizing seasonal production swings and increasing annual LNG production capacity by as much as 8 percent.

On Curtis Island, Bechtel has employed a fully integrated, self-performed approach to engineering, procurement, and construction, which has provided better control and flexibility in

every element of project execution. This self-perform model integrates Bechtel’s engineering centers with the global supply chain, module yards, and project construction sites, across functions and services.

Bechtel’s own fabrication capabilities, coupled with its direct control over module assembly, was key to project success. Bechtel’s unique approach offers better control of costs and schedule, and allows for greater flexibility to account for customer priorities that are unique to each project.

Our team of trained professionals and supervisors on the construction sites and at module yards were mobilized from Bechtel’s global direct hire workforce, in addition to extensive local and national recruitment. Bechtel craft and safety training programs enabled maximum use of this local talent, ensuring long-term commitments to these projects.

Modular

Modularization of mega project components is common practice in the industry and has been utilized to varying degrees of success on other major projects. The extent of modularization on Bechtel’s current LNG projects has grown since the first Bechtel project utilizing the Optimized Cascade process.

On our past LNG projects, only the cold box for ethylene and methane refrigeration units, and nitrogen removal unit were modularized, while the rest of the plant was stick-built.

This growth was driven by the challenges of completing three adjacent projects simultaneously, the schedule expectations of our clients, and the labor environment in Gladstone.

The cold boxes are highly modularized, shop assembled units, containing cryogenic brazed aluminum heat exchangers, vessels and piping components within a totally enclosed structure.

The enclosure also includes support structures, equipment access hatches

with removable covers, vacuum and overpressure relief valves, and, enclosure access ports for the installation and removal of perlite insulation, and attachment points for handling and erection.

Single units

They are shipped as single units and filled with perlite insulation at site. The cold boxes are thoroughly inspected at regular intervals throughout the fabrication phase, along with other modularized units to avoid any delays when erected on site.

When conditions and requirements of a specific LNG project favor modularization, the Optimized Cascade process can readily comply.

For the Curtis Island LNG projects, the main process area, including the cold boxes, and offsites piperacks are modularized. In order to limit the size and weight of the largest module, the refrigeration compressor deck within the main process area is stick-built.

Bechtel’s unique execution approach to modular construction mirrors our successful EPC project delivery, which utilizes the same, seamless project execution tools at the plant construction site, in the module yard, and in the engineering office.

Our existing fabrication and procurement strengths were applied to sourcing the module constituents expeditiously. We were able to draw upon our South East Asia direct hire workforce - that has worked successfully for Bechtel for decades in the Middle East and Africa - to support our direct control approach to module assembly.

As a result, the same standards of safety, quality, and productivity are applied across all phases of the project.

Success

The key to the success of these projects has been continuous collaboration and alignment with the customer and

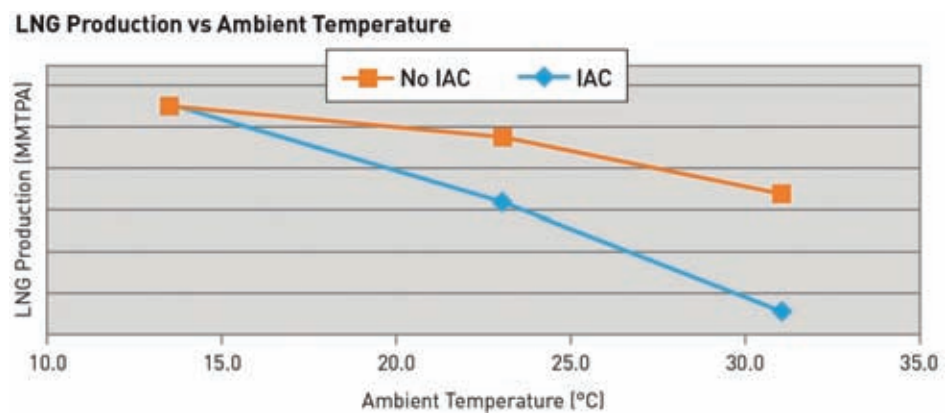


Illustration of higher production due to inlet air chilling

partners throughout the process. In the planning phase, the engineering team works with the customer to assess viability of modularization and determines the best approach to support a successful project delivery.

The LNG modules are pre-fabricated steel structures of different dimensions and weights.

Each piece, or module, is designed so that it can be built to fit precisely into a specific location and connected to other components to form the LNG plant layout structure. Construction personnel are involved very early during the design phase resulting in a highly developed construction plan.

This early construction scope analysis also allows projects to explore options for optimization of cost and schedule.

Asia yards

Module yards in the Philippines, Indonesia, and Thailand were selected for each Curtis Island LNG project through a competitive tender process.

Bechtel deployed experienced construction teams to these yards to incorporate work processes consistent with the design offices and to directly manage production and schedule to

ensure compliance with project safety and quality standards.

To manage risk and deliver certainty of outcome, each project leased the yard space, hired local experienced craft, mobilized experienced Bechtel supervision, supplied Bechtel equipment and tools, and directly controlled the entire work scope.

For early alignment, project personnel occupied the module yard three months before the first assembly and targeted to control productivity from the beginning.

These module yards produced 260 modules with a total weight of 125,000 metric tons. Bechtel's seasoned traffic and logistic teams worked with industry partners to deliver completed modules to the site safely, and on time.

Modules were shipped during the period of mid-2012 to mid-2014 and were delivered in 83 shipments traveling 350,000 nautical miles to Curtis Island. Each module was off loaded at specially designed Material Offloading Facilities (MOFs) at each site.

The modules were then transferred to their final position for assembly on the project.

The size and weight of the largest module were limited by the design

guidelines and shipping restrictions. Building three mega projects of this magnitude for three different customers, side by side and simultaneously, on an island offshore with no road access, is a challenging undertaking. The logistics involved in managing the construction of these three projects is unprecedented and bring challenges, not just on the job site, but also on the mainland and the city of Gladstone.

Highlighted below are some of the major challenges for the Curtis Island LNG projects:

- Geographic dispersion of sites and laydown facilities;
- Complexity of cross harbor operations in an already congested port;
- Apply common processes and best practice across all sites;
- Sourcing over 14,000 skilled workers at the same time in a community of 35,000;
- Managing the social and environmental impacts in an environmentally sensitive area;
- Building a strong reputation for the LNG industry in Queensland and locally to ensure the owners' have a 'social license to operate' post-construction; and

- Managing unique biosecurity challenges in one of the world's most regulated regions.

These challenges also offered unique opportunities for coordination and greater efficiency across the three projects.

Conclusion

Success of the Curtis Island LNG projects was a tribute to many organizations working collaboratively, namely the owners, Bechtel, ConocoPhillips, suppliers, and the Gladstone community.

In addition to successfully building these plants, the projects demonstrated their strong commitment to local environmental, community relations stewardship, and the development of local people and business.

As a consequence, these projects leave a positive legacy both for the owners and the community. ■

This article is based on extracts from the conference paper "Successfully delivering Curtis Island LNG projects" by Alasdair Cathcart General Manager - LNG & Senior Vice President, Himanshu Patel, Senior Project Manager and Manager of Gas Technologies Bechtel Oil, Gas and Chemicals, Inc. and Michael Harbeson, Director-Engineering and Product Development Center ConocoPhillips Co.

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Nakilat advances role in ship management and in the adoption of vessel technologies

Qatar holds leading position in LNG transport through growth and safety investment

Few shipping companies have managed to stay afloat in today's fluctuating oil and gas market, much less generate profits. Through prudent investments and adoption of new technologies, Qatar Gas Transport Company (Nakilat) has remained resilient and continued to uphold its industry leading position in the transportation of LNG around the globe.

Nakilat was established in 2004 to provide the critical transportation link in the State of Qatar's LNG supply chain.

Its LNG shipping fleet is the largest in the world, comprising of 63 LNG vessels. Nakilat also co-owns and operates four large LPG carriers through its in-house ship management arm, Nakilat Shipping Qatar Limited (NSQL).

Youngest

Nakilat's LNG carrier fleet is one of the youngest in the world, averaging seven years, and is among the most modern and advanced fleets around, incorporating the use of modern technology to ensure the safe, environmentally sound and cost-effective transportation of gas.

The Qatari shipping company's LNG carriers have a combined carrying capacity of over 9 million cubic metres capacity, which is about 15 percent of the world capacity.

Of Nakilat's 63 LNG carriers, 25 are wholly-owned while the remaining 38 are jointly-owned with other reputable shipping entities.

They are either operated by NSQL, STASCO (Shell International Trading and



Q-Flex vessel 'Al Kharaitiyat' is one of a fleet of 63 ships delivering to import terminals worldwide

or through our joint venture operators such as MOL, NYK, 'K'-Line, Maran Gas, Pronav and Shipping Corporation of India; and deliver LNG to 23 of the 26 LNG terminals worldwide.

Nakilat has long-term charter contracts in place with local gas producers Qatargas and RasGas, which gives it a solid ground for growth and development, and also with international oil and gas players such as Shell, ExxonMobil and Gunvor for LNG and LPG shipments.

Maritime services

The company's business portfolio extends beyond shipping to also include a comprehensive range of maritime services, complementing Nakilat's vision to be a global leader and provider of choice for energy transportation and maritime services.

In addition to its core shipping activities, Nakilat operates the ship repair and construction facilities at Erhama Bin Jaber Al Jalahma Shipyard in Ras Laffan Industrial City via two strategic joint ventures.

These ventures are named Nakilat-Keppel Offshore & Marine (N-KOM) and Nakilat Damen Shipyards Qatar (NDSQ).

It also provides shipping agency services through Nakilat Agency Company (NAC) for all Qatari Ports, as well as towage and other marine support services through its joint venture Nakilat SvitzerWijismuller (NSW) for vessels in Qatari waters.

Nakilat's diverse involvement across the maritime supply chain makes it a well-rounded maritime organization in Qatar.

Fleet expansion

Nakilat's fleet has progressively expanded since its inception. The company acquired three new LNG carriers in 2015 and one LNG carrier in 2016 through its joint-venture with Maran Ventures Inc., Maran Nakilat Company Limited.

All four LNG carriers are tri-fuel diesel

electric (TFDE) propulsion models with capacities between 159,800 cubic metres capacity to 174,000 cubic metres capacity.

The acquisition of these four LNG carriers brings Nakilat's total fleet size to 67 vessels.

The company first started its ship management operations through NSQL back in 2012, when it took over the ship management and operations of its four LPG carriers, which are jointly-owned with Milaha.

The success of this transition paved the way for further expansion in NSQL's ship management role and NSQL later took over management and operations of four Q-Flex LNG carriers jointly-owned with OSG in 2014.

NSQL has steadily built upon its experience in ship management over the years in preparation for the management takeover of Nakilat's wholly-owned vessels.

In October 2016, Nakilat signed an agreement with STASCO for the management transition of Nakilat's LNG fleet from STASCO to NSQL.

This will involve the phased management takeover of 25 Nakilat wholly-owned LNG carriers by NSQL.

Nakilat's LNG carrier fleet is one of the youngest in the world, averaging seven years, and is among the most modern and advanced fleets around....

Shipping Co.),

By consolidating its ship management and operations in-house, Nakilat will not only be able to better optimize its fleet operations but also, benefit from the established synergy with its local charterers and main customers, Qatargas and RasGas.

Technology

Green shipping and gas systems are the future of the maritime industry as Nakilat sees it.

As a global leader in LNG transportation, Nakilat has adopted the latest green technologies onboard to enhance operational efficiency and operate in an environmentally-responsible manner.

A large majority of the fleet conforms to stringent safety and environmental requirements, and have been certified with the Green Award as a testament to their clean and safe operating systems.

Nakilat has effectively capitalized on its vast expertise in handling gas carriers and completed the world’s first main engine gas injection (MEGI) retrofit for a Q-Max LNG vessel to run on LNG as an alternative fuel.

The modified vessel has the world’s



Besides the core LNG shipping activities, Nakilat operates the ship repair and construction facilities at Erhama Bin Jaber Al Jalahma Shipyard in Ras Laffan through two strategic joint ventures with Keppel and Damen

first low-speed marine diesel engines that can utilize forced LNG, reliquefied boil-off gas and HFO as fuel, depending on the requirements of the voyage.

Configuration

This is also the first ever MEGI conversion involving a twin-engine configuration along with the associated systems, piping and safety shut-down systems allowing for

redundant operations. The MEGI retrofit conversion project is the first of its kind, and out-measures similar system installations on newbuildings due to the complexities involved in integrating this new system with existing ones onboard the vessel.

Unlike most newbuildings, the technology utilizes liquid-LNG directly from the cargo tank, which has also proven to run reliably from reliquefaction condensate return, giving further flexibility in operation.

The use of MEGI allows a cleaner fuel technology with a significant reduction in environmental emissions, cleaner burning engines with potential to increase mean time between maintenance, provide flexibility of fuel supply to react to market changes and reduced bunkering activities which in turn will offer operations and marine risk reduction.

Not only will this pilot MEGI retrofit result in greatly reduced emissions, but also it will allow the converted vessel to operate with maximum flexibility in a safe and sustainable manner, enabling the vessel’s engines to meet current and future emissions standards set by the International Maritime Organization (IMO).

Options

In addition to pioneering the adoption of MEGI technology for a Q-Max LNG vessel, Nakilat has also carried out in-depth studies on options for the installation of Ballast Water Treatment System (BWTS) for its fleet.

The company carried out a pilot project for a BWTS installation on board one of its Q-Max LNG carriers to initiate and understand the reliability and

performance standard of the system.

Nakilat is also working with specialists, training its staff and having discussions with well-established BWTS manufacturers to ensure preparedness for the upcoming BWM Convention ratification.

These projects are excellent examples of Nakilat’s steadfast commitment and proactive approach towards the sustainable development of the maritime industry delivering clean energy worldwide in a safe and responsible manner.

As regards the handover to Nakilat of 25 vessels previously managed by STASCO, the process is continuing for the ships which have so far delivered more than 320 million cubic metres of Qatar’s LNG to over 20 countries.

The vessels are being transitioned in three phases with the process already under way.

“We are grateful to Shell for their professional management of our vessels over the last eight years and are confident of NSQL upholding the same excellent standards for our vessels, ensuring the safety and integrity of cargo from Qatar to the rest of the world,” said Nakilat Managing Director Abdullah Fadhalah Al Sulaiti.

Grahaeme Henderson, Vice President of Shell Shipping & Maritime, said he was proud to be a partner of Nakilat and to continue to support Qatar’s vision of building a world-class shipping business.

“This world-leading fleet includes some of the largest and most technically advanced vessels of their type and their cargoes help ensure energy security for millions of people around the world,” said Henderson.

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Improved modularized construction methods are refined for Australian liquefaction plants

Geoff Byfield, Technology Development Manager; and Eric Pegrum, Construction Manager; Woodside Energy, Perth, Western Australia

The construction of the then new Train 5 at the North West Shelf plant in Western Australia was the world's first base-load Train constructed using a modularised approach.

Although the construction method was different to NWS LNG Train 4, the layout of the earlier stick-built train was retained.

The modularised Pluto LNG train followed a similar approach. Since then Woodside has embarked upon a journey of continuously improving the state-of-the-art modularised LNG train design, to incorporate the lessons learnt from NWS LNG Train 5 and Pluto.

New Layout

In the front-end engineering design (FEED) phase for a proposed major onshore facility, Woodside pursued a completely new layout, purpose-designed to suit the modularised construction technique.

This was based around a central piperack incorporating all of the air coolers, with process modules and other major units (e.g. compression strings) on either side of the piperack/air cooler modules.

Recent design studies subsequent to that FEED have made further significant improvements in meeting the original modularisation objectives of minimising the inter-module piping, and allowing entire process systems to be wholly contained within a single module.

Woodside's preferred modularised LNG train design has now evolved to use modules in which air coolers, pipe-racks and process equipment are all completely integrated. Air coolers are not treated as mutually exclusive to other equipment.

There are no separate piperack/air cooler modules. By constructing modules partially covered by air coolers, whole systems can be included in a single module, whilst retaining the air coolers in a single contiguous bank.

Cost reduction

Modularisation is one approach to minimising the construction costs for LNG facilities in locations which have a high net labour cost. The high net labour

cost may be a result of a combination of factors.

- Labour rate in the country/region
- Depth of the labour market in the country/region, especially considering other projects
- Restrictions upon the use of foreign labour
- Labour productivity, possibly impacted by climate
- The need to build dedicated facilities to accommodate workers at a remote location

The goal of modularisation is simply to reduce overall project cost by reducing the manhours at site.

Modularisation will increase the total manhours for a project, but the intention is that the reduction in expensive site hours will more than cover both the additional hours in the less-expensive module fabrication yard and the associated cost of transporting the modules to site.

Woodside has completed the world's first and second modularised base-load LNG trains – the North West Shelf Project's LNG Train 5 (NWS Train 5), and Pluto LNG (Pluto).

In order to maximise the potential benefit of modularisation for future projects, Woodside has subsequently performed a series of design studies that have successively improved the LNG train layout, targeting a reduction in the work to be completed at site in order to reduce cost.

Confirmation

NWS Train 5 was built to replicate the layout of the earlier NWS Train 4 stick-built design, inclusive of the Acid Gas Removal Unit (AGRU).

This project also featured a new bespoke fractionation unit. Subsequently Pluto followed the example of NWS Train 5 and essentially repeated the same main liquefaction unit, but used new modularised designs for the remaining facilities, including the AGRU and fractionation units.

The experience confirmed that to get the most advantage from modularisation, designing with modularisation in mind right from the start was essential, rather



First: NWS Train 5 liquefaction module on the haul road in 2007

than restricting the layout to that of a previous stick-built design.

Whilst the Pluto LNG Plant was under construction, Woodside began the journey towards improved modularisation, based upon the feedback of the construction team from NWS Train 5. The basic objectives for efficient modularised construction were:

- Minimise the amount of interconnection work that needs to be performed on site.
- ♦ Use modules which are all close to the maximum allowable size, in order to minimise the total number of modules.
- ♦ Modularise entire systems where possible. Where practical, each process unit or sub-process should ideally be self-contained within a single module.
- Design the layout such that the modules may be installed in any order
- Achieve the right balance between modularised elements and stick-built elements.

The maximum modules size for NWS Train 5 was 1,800 tons. (See photo).

However there were many modules within the LNG train that weighed less than 500 tons. As a result the total number of modules within the LNG train was more than 80.

Subsequent modularised projects have

used Self Propelled Mobile Trailers (SPMTs) to transport modules weighing in excess of 5,000 tons.

Given such a maximum weight, installing a single module of 5,000 tons rather than ten modules of 500 tons each reduces the number of interconnections.

Entire systems

Consolidating ten modules into one transforms the site inter-module connections into intra-module connections that are performed in the low-cost fabrication yard rather than at site.

As a guiding principle, having determined the transportation limits relating to size and weight, the equipment should be distributed across the modules such that they are all of a similar size, just under the allowable limits, with appropriate margins for growth.

The second basic principle is to place related equipment items that have a large number of interconnections in the same module.

The layout objective is to make as many of these pipes intra-module rather than inter-module.

As a practical example, systems such as AGRU should be wholly-contained within a single module, such that the natural gas comes into the module and exits again, whilst the amine solvent

never has to move between modules. Ideally, the whole end-flash gas system should ideally be contained within a single module.

Sequence

The construction feedback from NWS Train 5 and Pluto was that modules should only ship from the fabrication yard once they have been truly completed, to the required standard. Transporting modules too early can lead to both carry-over work (work knowingly not completed at the fabrication yard) and also corrective work (defects that are not detected at the fabrication yard).

These have the potential to significantly erode the benefits of modularised construction.

In order to prevent being obliged to ship a module prematurely to maintain the overall project schedule, the construction sequence needs to be flexible. A delay of a single module should not affect the remainder of the modules.

Flexibility of installation sequence also helps to minimise amount of laydown space required at the site. Ideally modules should be moved from the offloading facility to their permanent position without having to be parked at site, or sent from the fabrication yard to an intermediate holding facility before being brought to site.

Stick-built issue

It is not always obvious when to modularise a piece of equipment and when to adopt a more conventional stick-built approach. Modularisation is a balance between transferring work from the high-cost site to the low-cost fabrication yard, versus adding to the total quantities required for the job, in particular the amount of structural steel required.

If the effort required to join up modules is almost the as much as simply stick-building that item, then modularisation may be of little benefit. By way of an

example from Pluto, the LNG rundown piping was modularised.

The feedback from construction was that this piperack could have been stick-built efficiently, by following the natural slope rather than stepping down the hill.

The effort to connect up these modules was significant, and therefore any savings in site labour were unlikely to have paid for the increase in structural steel, brought about by modularisation.

Where the amount of interconnection work between elements is only small in relation to the size of the equipment, then the ability to transfer manhours is limited.

For example, the Pluto Frame 6 gas turbine generators (GTGs) were fully modularised, which required a significant amount of additional structural steel.

These GTGs would normally be delivered in just a handful of elements. For example, fuel gas conditioning and lube oil systems would normally come as separate skids to be piped to the main turbine at site.

Hindsight

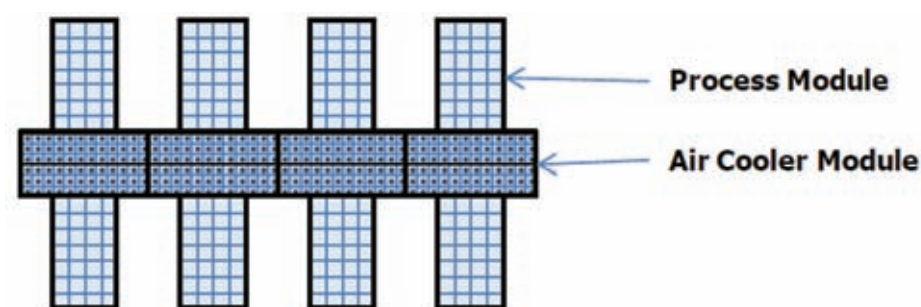
In hindsight, the connections such as fuel gas and lube oil were only relatively small diameter pipes compared to those within the LNG train.

The construction view was that eliminating the modest number of small connections probably did not cover the additional costs associated with modularising the Frame 6 GTGs.

The lesson is that modularisation is best applied to the areas where the amount of effort that would be required to stick-build is relatively high.

The blunt feedback received from construction team was, “don’t modularise air!”

The view was that a small number of pipes should not be used as a justification for modularisation. A certain minimum density was required to make it worthwhile.



A simplified diagram of the ‘fish-bone’ modularised layout

The inclusion of some stick-built sections was found to assist with resource distribution. Module deliveries are intermittent, and therefore create an uneven demand for labour. The stick-built sections of a project provide workfronts to keep all trades fully employed at all times, even when there are no modules arriving.

‘Stick’ checklist

There are a myriad of reasons that make it preferable to stick-build a specific piece of equipment rather than to include it inside a module, including:

- Long lead items that should not be double-shipped – e.g. MCHE
- Weight/height – e.g. amine absorber column
- Separation distances – e.g. thermal combustion unit, boilers and other fired equipment
- Elevation – e.g. amine drain drum
- Safety – e.g. large hydrocarbon inventories, refrigerant storage
- Fragile – e.g. large butted kettle exchangers with specialised gaskets

Generations

The NWS Train 5 and Pluto liquefaction units represented the first generation of modularised LNG train construction – the original design simply sliced into modules.

Prior to the completion of the Pluto LNG Plant, Woodside entered FEED for a major greenfields onshore development.

Given the feedback from NWS Train 5 and the changes to the process design

imposed by the gas composition, it was concluded that the LNG train should be a new design, with modularisation built in from the very start.

The philosophy was to take the conventional LNG train equipment and to arrange it into logical modules in order to meet the construction objectives and also apply good practices like minimising hydrocarbon inventory and providing good maintenance access.

The design concept was based around a “fish-bone” layout with a “spine” down the centre of the train formed by the air cooler modules.

The process modules and large stick-built elements such as the main Frame 7 compression strings radiated from the centre spine on both sides of the train.

Module gaps

Minimising the gaps between modules, the basic concept essentially followed the same arrangement (See fish-bone graphic).

In order to avoid any concerns with hot air recirculation, the air coolers were kept in a single bank, rather than scattered across the modules with gaps in between.

This air cooler bank was then divided up in to the fewest practical number of modules, by aligning the major axis of these modules with the overall train.

This was consistent with the objective of minimising interconnections for pipes traversing the length of the train.

The design concept changed little from the above diagram during the FEED studies.

However at the end of FEED, critical review and benchmarking of the results suggested that the fish-bone layout was not actually delivering in accordance with many of the original objectives. (Continued in January 2017 edition) ■



By way of example, Pluto LNG rundown piping was modularised

The second part of this article will appear in the January 2017 LNG Journal. This article is based on a paper by Geoff Byfield, Technology Development Manager; and Eric Pegrum, Construction Manager, Woodside Energy, Perth, Western Australia.

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World LNG Carrier Fleet

LNG carrier	Capacity m ³	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 Khatiya	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 Safliya	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
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

CARRIER FLEET

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
Galicia 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	174,0000	GasLog	Samsung	Sept-16	Bermuda	TFDE	TZ Mk. III	4	Shell charter
Gaslog Gibraltar	174,0000	GasLog	Samsung	Oct-16	Bermuda	TFDE	TZ Mk. III	4	Shell charter
Gaslog Glasgow	174,0000	GasLog	Samsung	Jun-16	Bermuda	TFDE	TZ Mk. III	4	Shell charter
Gaslog Greece	174,0000	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
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

CARRIER FLEET

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 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
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
Mesaimeer	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-Atl’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
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
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
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	4	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	Dunkergue	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

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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		
Finland	Yuedong LNG, Jieyang, Guangdong	CNOOC	2017	2	320,000
India	Tianjin North	Sinopec	2017	2	320,000
	Tornio	Gasum Skanga	2018	1	30,000
	Ennore	Indian Oil Corp	2017	2	320,000
	Mundra	Gujarat State Petroleum, Adani Group	2017	2	320,000
Indonesia	FSRU Andhra Pradesh	Engie, Andhra Pradesh Gas	2017	1	135,000
Japan	Pipovav LNG (FSRU), Gujarat	Swan Energy	2017	2	320,000
Malaysia	Labuhan Maringgai	Perusahaan Gas Negara	2017	1	135,000
Philippines	Soma, Fukushima	Japan Petroleum	2017	1	230,000
UK	Lahad Datu LNG, Sabah	Petronas	2017	studies	
Uruguay FSRU	Pagbilao LNG	Energy World Corp.	2017	1	130,000
	Port Meridian, Barrow-in-Furness	Port Meridian Energy Ltd.	2017	1	150,000
	Montevideo	Gas Sayago, Mitsui Osk Lines	2017	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, Golar	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	2018+	2	10.0
	Ichthys LNG	INPEX, Total	2017	2	8.4
	Prelude FLNG	Shell, Inpex, Kogas CPC	2017	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.	2021	4	24.0
	Bear Head LNG, Nova Scotia	LNG Ltd.	2021	4	8.0
	Cedar 1, 2, 3, Kitimat area	LNG Export Ltd (Haisla)	2021	studies	
	GNL Quebec, Saquenay	Freestone Capital and Breyer Capital	2021	4	10.0
	Goldboro LNG, Nova Scotia	Pieridae Energy	2021	2	10.0
	Grassy Point LNG	Woodside Petroleum	2021	studies	
	Kitimat LNG, BC	Woodside, Chevron	2021	2	10.0
	LNG Canada, BC	Shell, Mitsubishi, Kogas, PetroChina	2021	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
	Shell Prince Rupert LNG, BC	Shell	2021	3	21.0
	Steelhead LNG, Bamfield	Steelhead LNG Corp	2021	2	12.00
	Vancouver Tilbury	WesPac Midstream	2021	1	3.25
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	Bintulu Train 9	Petronas	2016	1	3.6
	Kanowit FLNG (Sarawak)	Petronas	2016	1	1.2
	Rotan FLNG (Sabah)	Petronas	2017	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	ExxonMobil, BP, ConocoPhillips, Alaska State	2021	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
	Freeport LNG, Texas	Freeport LNG	2018	4	20.4
	Golden Pass, Texas	Qatar Petroleum, ExxonMobil	2021	3	15.6
	Jordan Cove Energy	Veresen Inc.	2021	2	6.8
	Lake Charles, Louisiana	Shell, ETE	2021	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
	Southern LNG	Kinder Morgan	2019	4	2.0
	Texas LNG Brownsville	Chandra, Meyer, Samsung, others	2021	2	4.0
	VG LNG (Cameron Parish)	Venture Global	2019	10	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 m ³
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 Gladstone LNG Gorgon LNG Pluto LNG QCLNG	ConocoPhillips, Origin Energy, Sinopec	2016	2	7.5	2	320,000
		Santos, Petronas, Total, Kogas	2015	2	7.8	2	280,000
		Chevron, Shell, ExxonMobil	2016	3	15.6	2	360,000
		Woodside, Tokyo Gas, Kansei	2012	1	4.8	2	240,000
		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
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		
	RasGas II- T4	QP, ExxonMobil	2005	1	4.7	6	840,000
	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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