

OFFSHORE MARINE

A newsletter of Keppel Offshore & Marine

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DIGITAL SOLUTIONS WITH ASSETCARE

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As part of efforts to create a sustainable impact for beneficiaries, Keppel O&M has committed to participate in volunteer sessions with Food From the Heart on a monthly basis.

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Seizing opportunities

Mr Loh Chin Hua, CEO of Keppel Corporation and Chairman of Keppel Offshore & Marine outlined the Group's performance and strategic developments at the Company's 1Q 2019 results webcast on 18 April 2019. Below are extracts from his speech.

Keppel Offshore & Marine (Keppel O&M) continued to seek new opportunities and execute its projects well, while exercising cost discipline. It made a profit at both the operating and net levels in 1Q 2019, due to the improved contributions of associates and lower taxes.

In the year to date, we secured new contracts totalling about \$1 billion. Our net orderbook stood at \$4.7 billion as at end-March 2019, an increase of \$400 million compared to \$4.3 billion as at end-2018. As we prepare for the recovery of the O&M business and to handle the anticipated increase in workload from new projects, we are also increasing our workforce

in selected Singapore and overseas yards, with plans to recruit about 1,800 full-time staff over the course of 2019.

During the quarter, Keppel O&M won a repeat mid-water semisubmersible (semi) drilling rig order from Awilco Drilling (Awilco) worth about US\$425 million.

This is the first of three options exercised by Awilco, reflecting the demand for our mid-water, harsh environment rigs for deployment in Northwestern Europe. Work on the first rig for Awilco is progressing well and we expect to benefit from economies of scale and cost efficiencies as we undertake the second project.

Keppel O&M has also secured integration and upgrading contracts worth a combined value of about \$160 million which includes fabrication and integration work on a Floating Production Storage and Offloading (FPSO) vessel. In addition, we have received the Final Notice to Proceed from Golar LNG to commence full conversion works with enhanced work scope worth US\$242 million, bringing the total value to US\$947 million for the Gimi FLNG project.

Sete Brasil recently called for a tender for the sale of four drilling units, two of which are for semis which were being built by BrasFELS before we stopped work in 2015. A bid has been submitted by Magni Partners for the four rigs. We have discussed with Magni Partners on the cost of completing the rigs if they win the bid. In addition, Keppel O&M also submitted a bid to purchase the two rigs that were being built at BrasFELS. A decision on the award of the tender will be announced at a later date by Sete Brasil, after they have evaluated the bids.

In Singapore, we have handed over the jackup rig, Cantarell IV, to Grupo R. Cantarell IV is the first rig equipped with Keppel O&M's



Keppel's second FLNGV conversion contract for Golar LNG comes on the back of the successful performance of the Hilli Episeyo, the world's first converted FLNG vessel, in offshore Kribi, Cameroon

Continues on page 4...

Continued from page 3.



Keppel O&M secured new contracts totalling about \$1 billion and will be increasing its workforce to handle the anticipated increase in workload from new projects

RigCare Solution, which will significantly transform the efficiency, safety and operability of the rig. As part of the deal, Grupo R has entered into a sale and leaseback agreement with a wholly-owned subsidiary of Keppel O&M. In early-May, Cantarell IV will be deployed to work in offshore Mexico. This is an example of a win-win solution we have achieved with our stakeholders, despite the challenges facing the offshore sector.

Testament to our newbuild capabilities and technological expertise, Keppel Singmarine has delivered the world's first European Union (EU) Stage V

dredger to Jan De Nul, further strengthening our presence in the non-oil and gas segment. Keppel O&M is scheduled to deliver another four state-of-the-art dredgers to Jan De Nul over the next two years (2019-2020).

The maritime industry is transforming rapidly and we are collaborating with Maritime and Port Authority of Singapore (MPA) and the Technology Centre for Offshore and Marine, Singapore on initiatives to improve the industry. Keppel O&M has embarked on the development of an autonomous tug, to be operated by Keppel Smit Towage, and has secured a grant of up to \$2 million from MPA for the development of the vessel. It is

expected to be one of Singapore's first autonomous vessels when the project is completed.

Harnessing the strengths of the multi-business group, Keppel O&M is also collaborating with M1 for the test bedding of Maritime Autonomous Surface Ships in Singapore's waters. The trial will utilise autonomous vessel technology and leverage M1's ultra-low latency 4.5G network connectivity to establish standards and data transfer links in terms of latency and reliability for the ship to shore communication, and support mission-critical Internet of Things (IoT) maritime applications.

IN CONVERSATION

OffshoreMarine shares highlights of Keppel management's responses to questions from the media and investment community at the Company's 1Q 2019 results webcast.

Q: Can you comment on the contracting terms and margins outlook for the newbuild market? Are you seeing some improvements?

CO: Over the years, we have diversified into various segments of the newbuild markets such as dredgers, amongst others. The margins and contract terms will depend on the geography, customer and type of vessel. In the drilling rig space, although the market remains quite challenging due to the supply overhang, there are opportunistic niches in the market and we will continue to evaluate the opportunities. We are also seeing more enquiries and opportunities in the production space.

Q: Is this the first time Keppel is adding to its O&M staff since the recent downturn?

LCH: With the expected increase in workflow as well as preparing for the upturn, we are looking to add about 1,800 staff to our workforce this year. This would be the first time we are doing it since we started rightsizing Keppel Offshore & Marine in late 2014.

Q: Keppel has been named as one of the two bidders for Sete Brasil's rigs, why are you bidding for your own rigs?

CO: The bid reflects our confidence in the Brazil market. Moreover, the rigs come with a long-term charter, 10 years, at a charter rate of \$299,000 per day. So we see that as an opportunistic bid and also a show of our confidence.



Keppel O&M is seeing more enquiries and opportunities in the production space, such as FPSO conversions

Q: What is the status of the third FLNG conversion with Golar, the Gandria?

CO: We still have a valid contract for the conversion of Gandria. The owner is marketing the prospect with different customers. We will await updates from the customer for further development.

Q: What is your outlook in the oil & gas business going forward? Any plans to get involved in the US Permian Basin for shale oil exploration?

CO: We are cautiously optimistic about the market. There is an increase of activities in tendering and bidding, as can be seen from FIDs of a lot of projects in the different segments of oil & gas. Our strategy in this area will be to stay close to the customers, provide the relevant solutions and work with them.

Any plans to get involved in shale oil exploration? The answer is not at the moment. We are not involved in this part of the sector.

**LCH – Mr Loh Chin Hua,
CEO of Keppel Corporation**

**CO – Mr Chris Ong,
CEO of Keppel Offshore & Marine**

Gimi FLNG gets go-ahead

Keppel Offshore & Marine (Keppel O&M) announced 17 April 2019 that its wholly-owned subsidiary, Keppel Shipyard has received the Final Notice to Proceed (FNTP) from Gimi MS Corporation, a subsidiary of Golar LNG Limited, to commence full conversion works for the Gimi Floating Liquefaction Vessel (FLNG) project. The total contract is worth US\$947million and builds on the issuance of the Limited Notice to Proceed (LNTP) on 17 December 2018.

Keppel Shipyard's scope of work in the conversion of a Moss Liquefied Natural Gas (LNG) carrier into an FLNG vessel includes the design, detailed engineering and procurement of the marine systems as well as conversion-related construction services. It will be similar to the work done on the first FLNG vessel, Hilli Episeyo, which Keppel undertook for Golar, but will be customised for the 20-year BP Greater Tortue Ahmeyim contract offshore West Africa. Delivery of the vessel is expected in 1H 2022.

Mr Chris Ong, CEO of Keppel O&M, said, "We are glad to continue this strong partnership with Golar on such a successful FLNG solution. The success of the Hilli Episeyo has provided the industry with strong proof of the attractiveness of Golar and Keppel's conversion solution. This has further strengthened our offerings along the gas value chain. Leveraging our engineering as well as execution expertise and LNG capabilities, we are able to



The Gimi is already in Keppel Shipyard which has completed the early works relating to design verification, engineering and some physical assessment works on the vessel

partner customers in developing innovative and fit-for-purpose solutions to meet the needs of the market."

Keppel's conversion solution has proven to be cost-efficient and quick-to-market. Hilli Episeyo, the world's first converted FLNG vessel, was delivered in record time and on budget to Golar LNG for work offshore Kribi, Cameroon.

Mr Iain Ross, CEO of Golar LNG, said, "Golar looks forward to working closely with Keppel on another Mark I FLNG and has a high degree of confidence in Keppel's ability to safely deliver FLNG Gimi on time and within budget."

Keppel Shipyard will once again engage Black & Veatch, its trusted partner for the conversion of the Hilli Episeyo, to provide design, procurement and commissioning

support services for the topsides, as well as the liquefaction process, utilising its established PRICO® technology.

When completed, the Gimi FLNG will be stationed at a nearshore hub located on the Mauritania and Senegal maritime border. The Gimi FLNG is designed to produce an average of approximately 2.5 million tonnes of LNG per annum.

Reflecting Keppel's confidence in the prospects of the FLNG sector, Keppel Capital Holdings has through an indirect wholly-owned subsidiary, First FLNG Holdings, subscribed for 30% of the total issued ordinary share capital of Gimi MS Corporation. The investment is in line with Keppel's business model and harnesses the diverse capabilities of the Group.

Contracts from repeat customers

Keppel Offshore & Marine (Keppel O&M) has through its wholly-owned subsidiaries, Keppel Shipyard and Keppel FELS, extended its contract wins with the securing of integration and upgrading projects.

Mr Chris Ong, CEO, Keppel O&M, said, "These contracts from repeat customers are testament to Keppel O&M's strong customer service in delivering on time, within budget and safely as well as our extensive track record in modification and upgrading projects for a wide variety of products such as FPSOs and drilling rigs."

"With strong engineering expertise and project management capabilities, we work closely with our clients to understand their requirements and provide customised, reliable, cost-efficient and value-added solutions."

The first contract is between Keppel Shipyard and a leading operator of oil and gas production vessels for fabrication and integration work on a Floating Production Storage and Offloading (FPSO) vessel. The shipyard's work scope includes the fabrication of several topside modules, the riser balcony, the spread-mooring and the umbilical support structures as well as installation and integration of associated equipment and all topside modules onto the FPSO.

Work is expected to commence in 3Q 2019, and delivery is scheduled for 2021.

The second contract is between Keppel FELS and Diamond Offshore for the upgrade of the drilling semisubmersible rig Ocean Onyx. Keppel FELS' scope of work includes the engineering, fabrication and installation of new

pontoons, columns, bracings and a wing deck. The Ocean Onyx was first upgraded in 2012 by Keppel AmFELS, Keppel O&M's yard in the US, from an old semisubmersible rig.

Scheduled for delivery in 2H 2019, Ocean Onyx will initially be deployed offshore Australia. Diamond Offshore is Keppel FELS' long-standing customer; the two companies have collaborated on more than 12 projects since 2005.

Mr Karl Sellers, Senior Vice President – Technical Services of Diamond Offshore said, "Keppel FELS has proven to be a reliable partner for our rig repairs and upgrades over the years and we are pleased to work with them again on the upgrade of Ocean Onyx."

Keppel O&M has proven to be a reliable partner for conversions and upgrades on a variety of products including FPSOs and rigs





Afonso de Albuquerque, the first of three dredgers delivered on time, within budget and with a perfect safety record

World's first EU Stage V dredgers

Keppel Offshore & Marine (Keppel O&M) strengthened its presence in the non-oil and gas segment with the delivery of three dredgers in April 2019. They are the world's first European Union (EU) Stage V dredgers and were completed on time, within budget and with a perfect safety record.

Built for Jan De Nul, the ultra-low emission Trailing Suction Hopper Dredgers (TSHD), named Afonso de Albuquerque, Diogo Cão and Tristão Da Cunha, comply with the requirements of the EU Stage V standards, which set stricter limits on emissions such as hydrocarbons and particulate matter.

Mr Abu Bakar, Managing Director (Gas & Specialised Vessels), Keppel O&M, said, "We are pleased to work with Jan De Nul in their pursuit of greener operations with the delivery of the world's

first EU Stage V dredgers. It is testament to Keppel's newbuild capabilities and technological expertise, and we look forward to extending this track record with the additional two state-of-the-art dredgers that we are building for Jan De Nul."

Mr Robby De Backer, Director of Newbuilding Department of Jan De Nul Group, said, "We are delighted to be at the forefront of the industry's push for more environmental-friendly solutions with this ultra-low emission vessel that will enable dredging at the lowest levels of emissions to date. The Keppel team has demonstrated the capability to provide value-added engineering solutions and excellent execution, which is why we ordered five dredgers from them. We look forward to the smooth delivery of the upcoming dredgers."

The first-of-its-kind dredgers were built in Keppel's shipyard in Nantong, China, to the requirements of classification society Bureau Veritas. They are able to dredge to a maximum depth of 27.6m and has a hopper capacity of 3,500 m³.

The dredgers will be used for dredging loose and soft soils such as sand, gravel, silt or clay. The dredged material can be deposited on the seabed through bottom doors or discharged through a floating pipeline to shore and used for land reclamation.

Keppel is currently building another four dredgers of various hopper capacities ranging from 6,000m³ to 10,500m³, including two for Jan De Nul.

First autonomous vessel



The autonomous tug to be developed by Keppel O&M is expected to be one of Singapore's first autonomous vessels when completed in 4Q 2020

Keppel Offshore & Marine (Keppel O&M) in April 2019 embarked on the development of an autonomous tug to be operated by Keppel Smit Towage. It is expected to be one of Singapore's first autonomous vessels when the project is completed in 4Q 2020.

To develop the autonomous tug, Keppel O&M has secured a grant of up to S\$2 million from the Maritime and Port Authority of Singapore (MPA) under its Maritime Innovation and Technology Fund (MINT FUND).

This follows the Memorandum of Understanding signed by Keppel O&M, MPA and the Technology Centre for Offshore and Marine, Singapore (TCOMS) in April 2018 to jointly develop autonomous vessels for a variety of applications including undertaking harbour operations such as channelling, berthing, mooring and towing operations.

Mr Chris Ong, CEO of Keppel O&M, said, "We are proud to be at the forefront of innovation with the development of autonomous tugs that are commercially viable. The maritime industry is transforming and we are glad to be able to partner MPA and TCOMS in exploring how to improve the industry with new technologies."

The project will involve modifying a 65 MT tug by retrofitting advanced systems such as position manoeuvring, digital pilot vision, as well as collision detection and avoidance. An onshore command centre will also be set up to remotely control the tug.

Ms Quah Ley Hoon, Chief Executive of MPA, said, "Autonomous vessels are the next exciting phase of development in the maritime industry and in Maritime Singapore. Here, we are constantly looking out for the next new technology to

pilot and testbed in an effort to develop Maritime Singapore to be more efficient, productive and technologically advanced. We are pleased to support Keppel in their autonomous vessel project. This is one of five autonomous vessel projects that MPA is supporting as part of our Marine Autonomous Surface Ship (MASS) test bedding programme."

As part of the project, Keppel O&M, through its technology arm, Keppel Marine and Deepwater Technology (KMDTech), will work with MPA and TCOMS to develop various technologies and be the system integrator for the autonomous solutions. These technologies include a Digital Twin of the tug to simulate vessel behavior in multiple scenarios and optimise vessel operations, as well as data analytics tools to improve the control and response of the tug. ABS (American Bureau of Shipping) will provide the Approval in Principle for the novel features such as Remote Navigation Control and Autonomous Control System.

Keppel O&M is also partnering M1, another member of the Keppel Group, to leverage M1's ultra-low latency 4.5G network connectivity to establish standards & data transfer links in terms of latency and reliability for the ship to shore communication, and support mission-critical Internet-of-Things (IoT) maritime applications.

Fourth Super A for EnscoRowan

Keppel Offshore & Marine (Keppel O&M) has delivered ENSCO 123, an enhanced version of Keppel's state-of-the-art KFELS Super A Class design, to Ensco Rowan plc (EnscoRowan) on schedule and with zero lost-time incidents.

ENSCO 123 is the ninth harsh environment jackup and the fourth enhanced KFELS Super A Class unit built and successfully delivered by Keppel to EnscoRowan. It has been chartered for operations in the UK North Sea ahead of its delivery.

Mr Tan Leong Peng, Executive Director (New Builds) of Keppel O&M, said, "Keppel has had a long and successful partnership with EnscoRowan. Combining our expertise and experience, we have brought a number of next generation offshore rigs to market that have set industry benchmarks for safety, efficiency and versatility. ENSCO 123 is Keppel's fourth enhanced KFELS Super A Class unit for EnscoRowan, and we are delighted to see the rig join its three predecessors that are performing offshore operations for customers in the challenging environments of the North Sea."

Featuring Keppel's proprietary and superior jacking and fixation system, the KFELS Super A Class jackup design can operate in a variety of environments in water depths up to 400 feet. The rig is designed to drill to total depths of 40,000 feet for the most demanding large multi-well platform programmes, ultra-deep gas programmes and ultra-long reach wells.



ENSCO 123 is built to an enhanced version of Keppel's state-of-the-art KFELS Super A Class design

It features a 2.5 million pound quad derrick, fully-automated hands-free offline pipe handling systems, ultra-high capacity jacking and fixation systems, 145 person quarters, and strict noise and ergonomic standards

Mr Gilles Luca, Senior Vice President of Operations Support for EnscoRowan, said, "The delivery of ENSCO 123 is the culmination of the efforts of EnscoRowan and Keppel FELS personnel over many years to design and construct our four

ENSCO 120 Series rigs. These harsh environment jackups are amongst the most capable shallow-water assets globally, and offer technical capabilities that help us deliver increased efficiencies to customers as they execute their offshore projects. The completion of ENSCO 123 without a lost time incident speaks to the unwavering safety focus of the team during this project, and is indicative of the consistent professionalism that Keppel FELS has displayed towards EnscoRowan over the course of our long-standing relationship."



The P-66 has a production capacity of 150,000 barrels of oil/day and 6 million m³ of gas/day

Top performer

Delivered by BrasFELS, Keppel Offshore & Marine's shipyard in Angra dos Reis, Brazil, the Floating Storage Production Offloading (FPSO) vessel P-66 has emerged as one of the most productive production platforms in Brazil in 2018, its first full year of operation. This was according to a calculation based on data released by the National Petroleum Agency (ANP) in its oil & gas production monthly reports from January to December 2018.

The unit placed 5th position on a ranking that took into account the annual average oil production of operating platforms in Brazil. P-66 recorded an annual average production of 129,283 bbl of oil/day in 2018.

Five other projects delivered by BrasFELS emerged in the list of top 10 most productive production platforms in Brazil in 2018. They are namely, FPSO Cidade de Itaguaí (6th), FPSO Cidade de Mangaratiba (7th), FPSO Cidade de Paraty (8th), FPSO Cidade de São Paulo (9th) and Petrobras 52 (10th).

Marlin Khiew, CEO of Keppel FELS Brasil, said: "P-66's production track record demonstrates its operation readiness, which in turn reflects BrasFELS' commitment to the provision of safe, prompt and high-quality services. We are confident that P-69 will also perform just as well as it continues ramping up its production. BrasFELS has a strong track record in construction, integration,

upgrading and repair of a wide range of offshore and marine projects. Through good teamwork with our customers, we have delivered a number of milestone projects for Brazil. We are glad that our projects are operating successfully, and so be able to contribute to the nation's energy needs."

BrasFELS was responsible for the final integration and completion of the P-66, which belongs to the consortium Tupi BV (formed by Petrobras, BG E&P Brasil and Petrogal Brasil). The unit was the first platform of Petrobras' Replicantes FPSO series to be delivered.

Provider of choice

With detailed engineering expertise and extensive project management experience, Keppel Offshore & Marine (Keppel O&M) is well-equipped to undertake complex upgrade and newbuild projects.

RIG UPGRADES

In March 2019, the newly completed Can Do Barge 2 performed her maiden heavy lift by docking Diamond Offshore's Enhanced Victory Class semisubmersible Ocean Apex for the rig's Special Periodic Survey and works relating to environmental regulations in preparations for its new drilling contract in Australian waters. Before the docking, the semi had undergone major works including the installation of a new offline standbuilding system, LQ refurbishment works and the fabrication and installation of almost 600 tonnes of new steel.

Ocean Apex sailed away in April 2019 and Can Do Barge 2 performed its second heavy lift by docking Ocean Onyx, another Diamond Offshore Victory Class semisubmersible which is currently undergoing upgrade at Keppel O&M. The Can Do Barge 2, which further adds to the yard's dry docking capability, has a lifting capacity of 65,000MT with the ability to dock ships and oil rigs without having to remove under hull thrusters.

In January 2019, Borr Drilling's KFELS Super B Class jackup



The semisubmersible Ocean Apex was the first vessel to be docked onto the newly completed Can Do Barge 2



Keppel O&M's quick turnaround of scrubber retrofit projects reduces downtime and maximises savings for ship owners

rig Borr Odin sailed away after upgrading works were performed on the CTU platform and the setback area to accommodate a larger Blow Out Preventer. In addition, Keppel O&M also designed, fabricated and installed a second drilling slot at the CTU platform. These works were done in preparation for a drilling contract in Mexico.

A key challenge of the project was the timeline for engineering, including procurement, fabrication and installation of 50 tons of steel. This had to be completed within a month of the upgrade job being awarded prior to rig departure.

SCRUBBER RETROFIT

In March 2019, Keppel O&M completed the scrubber installation for the Delta Maria Very Large

Crude Carrier (VLCC). This is the first in a series of scrubber installations for Greek owner Delta Tankers.

To achieve quicker turnaround of scrubber retrofit projects, Keppel O&M embarks on design development with 3D scanning and detailed engineering, and fits the complete scrubber and supporting systems in one prefabricated module, before the vessel comes into the yard for retrofitting.

CONTAINERSHIP STRIKE STEEL

In April 2019, Keppel AmFELS in Texas, USA, marked construction milestones for the LNG-fuelled Ohana Class containerships being built for Pasha Hawaii. The keel was laid for M/V George III and the first steel plates were cut for M/V Janet Marie. Upon

completion, both 774-foot U.S. Jones Act vessels will join Pasha Hawaii's fleet, serving the Hawaii/Mainland trade lane.

FIRST FSRU JOB FOR N-KOM

In March 2019, Nakilat-Keppel Offshore & Marine (N-KOM) successfully completed its first floating storage regasification unit (FSRU) project for the 138,000m³ FSRU Excelebrate owned by Excelebrate Energy (USA).

During its period at the Erhama Bin Jaber Al Jalahma Shipyard, the FSRU underwent routine drydocking and repairs, in addition to modifications and retrofitting of several new systems, including the installation of a ballast water treatment system (BWTS).



The 138,000m³ Excelebrate is the first FSRU project for N-KOM

Trailblazing rig solutions



Cantarell IV will be deployed directly to work in offshore Mexico under an integrated contract

In February 2019, Keppel Offshore & Marine (Keppel O&M) delivered the Cantarell IV, a proprietary KFELS B Class jackup, to Grupo R with a perfect safety record. The rig is the first to be equipped

with Keppel's proprietary RigCare solution – a suite of digital services to support the rig's lifecycle needs, significantly increasing uptime and safety while reducing maintenance costs.

As part of the deal, Grupo R has entered into a sale and leaseback agreement with FELS Asset Co Pte. Ltd. (FELS Asset), a wholly-owned subsidiary of Keppel O&M. FELS Asset will purchase the rig from Grupo R to the balance contract value of the rig. Cantarell IV will be leased back to Grupo R on a bareboat charter at competitive day rates over five years.

Under the bareboat charter, Grupo R has the right to purchase the rig at pre-agreed prices during the term of the bareboat charter. After the fifth year, FELS Asset may, at its discretion, put the rig to Grupo R at a pre-agreed price.

Mr Chris Ong, CEO of Keppel O&M said, "This transaction demonstrates how we are able to leverage the strengths of Keppel O&M to achieve win-win solutions for all stakeholders. Keppel FELS will be able to deliver the rig at full value; Grupo R will be able to lease the rig to begin operations in Mexico; and Keppel O&M will benefit from acquiring a quality rig at attractive commercial terms while generating regular and predictable cash flows from the charter at a good rate of return."

"As Mexico develops its oil and gas reserves, more high specification rigs such as the KFELS B Class rigs will be needed. We have previously delivered 10 such rigs to Mexico which have delivered robust, efficient and economical performances."

Grupo R is well-established as a driller in Mexico, with excellent uptimes and a strong track record of success with difficult wells. The two jackup rigs Keppel FELS delivered to Grupo R in 2016, Cantarell I and Cantarell II, have been drilling for Pemex in Mexico since August 2016 under a seven-year charter.

Mr Jose Ramiro Garza, CEO of Grupo R added, "We are pleased to be able to partner Keppel to bring this rig to work for Pemex in Mexico. The fields where the rig will operate is expected to produce up to 210,000 bpd of crude and 350 million mmcf of natural gas by 2020, resulting in more opportunities for the rig to be deployed in future. As a leading rig operator in Mexico, we are well positioned to meet the country's drilling demands."

"Our two jackups from Keppel FELS, Cantarell I and II have been achieving exceptional performances ever since they started working for Pemex in Mexico. In the last two years, they recorded uptimes of 99% and have clocked the best drilling times for both a JSO well and Cenozoic well. This is a result of having the right rig design, the choice yard to deliver a quality rig and our unmatched operating expertise. I am confident Cantarell IV will break new records in Mexico as well."

The Cantarell IV is designed to operate in water depths of up

to 400 feet and drill to depths of 30,000 feet. It is equipped with an advanced and fully-automated high capacity rack, pinion

jacking system, Self-Positioning Fixation System, and also has accommodation with full amenities for 150 persons.

RigCare

Cantarell IV is the first rig equipped with Keppel's proprietary RigCare Solution, which features the use of:

- Industrial Internet of Things (IIOT) to enhance automation and mobile operations;
- Smart sensors to drive towards condition based class surveys in a joint development project (JDP) with Classification

society ABS to lower down time and reduce maintenance costs;

- Digital Twin-based analytics to predict machine failure and enhance overall efficiency and robustness with real-time data; and
- Real-time optimisation of the rig's operations



Racing ahead with LNG

Keppel O&M is at the forefront of promoting LNG as marine fuel and has achieved several milestones in the month of April.



FueLNG marked its 100th bunkering operation in Singapore with no loss-time incidents

100TH LNG BUNKERING MILESTONE

FueLNG, a joint venture between Keppel Offshore & Marine (Keppel O&M) and Shell Eastern Petroleum (Pte) Ltd, in April 2019 set a new industry milestone for Singapore with the completion of its 100th LNG bunkering operation. This was achieved with no loss-time incidents, and in accordance with the Technical reference 56 standard for LNG bunkering in Singapore.

FueLNG has been providing truck-to-ship LNG bunkering for two dual-fuel tugs operated by Keppel Smit Towage since May 2018.

Mr Chris Ong, Chairman, FueLNG and CEO, Keppel O&M, said, "This milestone is testament to

FueLNG's ability to provide safe, cost-efficient and reliable LNG bunkering for our clients. We are optimistic that the industry will increasingly adopt LNG as a marine fuel and look forward to furthering our partnership with industry stakeholders to build a world-class LNG bunkering network in Singapore."

Mr Tahir Faruqui, Director, FueLNG and Head, Shell Global Downstream LNG, added, "By leveraging the strengths of its parent companies, FueLNG is able to provide comprehensive solutions for a range of activities such as LNG bunkering and distribution to industrial and consumer customers. The delivery of our LNG bunkering vessel in 2020 is an important step for growing a robust and reliable

global LNG fuel supply chain in the years to come as we will be able to increase the availability of LNG with ship-to-ship services for our end clients."

Ms Quah Ley Hoon, Chief Executive of the Maritime and Port Authority of Singapore (MPA), said, "We are pleased to see good progress in LNG bunkering in Singapore. We hope that this would strengthen Singapore's offering as a global maritime hub and bunkering port. We will continue to work through local and international partnerships to increase the viability of LNG as a marine fuel for the future."

The benefits of LNG as fuel have been tracked by Keppel Smit Towage, which has observed that when running on LNG, the tugs perform as efficiently as when using diesel, but consume 5% less fuel in tonnes.

Mr Romi Kaushal, Managing Director of Keppel Smit Towage, said, "We are glad to be one of the leaders in the adoption of LNG as a marine fuel, which has enabled us to not only reduce sulphur oxide emissions but increase our cost-efficiency. This milestone proves the commercial and operational viability of LNG, and we look forward to continuing the partnership with FueLNG to enhance bunkering standards and operations."

PROMOTING LNG AS MARINE FUEL

Keppel O&M's technology arm, Keppel Marine and Deepwater Technology (KMDTech), signed a framework agreement with classification society DNV GL to boost the uptake of LNG as a marine fuel.

The agreement covers potential newbuilding projects including LNG bunker vessels, small-scale LNG carriers and floating storage regasification units (FSRUs), as well as LNG related assets employing battery and hybrid technologies.

Mr Abu Bakar Mohd Nor, MD (Gas and Specialised Vessels), Keppel O&M, said: "We are pleased to partner with DNV GL in developing a suite of LNG related vessels that are ready to meet the needs of the market as the adoption of LNG as ship fuel increases. Working with

DNV GL enables us to demonstrate the strength of our vessel designs and the viability of LNG for ship owners. We have a strong track record in delivering LNG solutions including the first FLNGV conversion as well as LNG fuelled vessels."

Ms Cristina Saenz de Santa Maria, DNV GL's Regional Manager for South East Asia, Pacific and India, said, "The signing of this agreement signifies another milestone in the close partnership between DNV GL as the leading classification society for LNG ships and offshore assets, and Keppel Offshore & Marine, a world leader in conversion projects for Floating Storage Regasification Units (FSRU) and floating liquefied natural gas vessels (FLNGV) as well as for newbuilding of small-scale LNG carriers and LNG bunker vessels."

As the first delivery in the agreement, DNV GL will issue Approval in Principle certificates for two LNG bunker vessel designs from KMDTech. Both parties will also work together to establish roundtable discussions involving all stakeholders in the LNG-as-fuel value chain, including gas and LNG bunker suppliers, designers, shipbuilders, shipowners and operators, in an effort to increase the uptake in demand for LNG bunkering in Singapore and beyond.

The design and engineering collaborative office will be located at KMDTech Singapore, with Keppel O&M's yards to undertake the project execution.

Continues on page 18...



DNV GL will issue Approval in Principle certificates for two 7,500m³ LNG bunker vessel designs from KMDTech

Continued from page 17.



Built to Keppel's award-winning proprietary design, KST Liberty is South East Asia's first dual-fuel tug

BENEFITS OF LNG ADOPTION

Ms Andrea Gay, General Manager of Keppel O&M's Gas Business Development Department, shared updates on Southeast Asia's first two dual-fuel tugs with *Singapore Nautilus*, a magazine published by the Maritime Port Authority of Singapore (MPA). *OffshoreMarine* reproduces excerpts of the article.

A major milestone for Liquefied Natural Gas (LNG) bunkering in Singapore was achieved in May 2018 with the delivery of KST Liberty, Singapore's first dual-fuel vessel built by Keppel O&M through its specialised shipbuilding arm, Keppel Singmarine. Just four months later, Keppel O&M delivered its second dual-fuel tug, Maju Loyalty.

Built to Keppel's award-winning proprietary design, the two 65-tonne bollard pull tugs are equipped with LNG vaporisers, as well as containerised Type-C ISO-certified LNG tanks on deck, which can be easily replaced or replenished through truck-to-ship LNG bunkering.

"With the International Maritime Organisation (IMO) implementing the global sulphur cap of 0.5% on marine fuel from 2020, the industry is increasingly looking to adopt cleaner forms of energy, such as LNG," shares Ms Gay.

LNG burns more cleanly compared to traditional marine fuel, Ms Gay explains. The use of LNG is believed to completely remove SOx

and particulates, and reduce NOx emissions by 85%.

In addition, the tugs were found to consume 5% less fuel in tonnes when running on LNG. "The dual-fuel technology enables more sustainable and economical operations, with more efficient fuel consumption. Compared to diesel, these tugs run as efficiently on LNG, refuting industry hearsay that gas-powered vessels risk poorer performance, such as reduced power and slower speeds," Ms Gay shares.

With bollard pull used as a key performance indicator for the chartering of tugs, she notes that Keppel's dual-fuel tugs have outperformed its originally designed bollard pull in both gas and diesel modes. "The dual-fuel tugs are now certified for a bollard pull of more than 70 tonnes," she adds.

The tugs were also found to be more silent when operating on LNG. "Along with Keppel's innovative design for cabin layout and selection of insulation material, we have quieter cabins onboard the tugs, improving overall comfort levels for the crew."

Sea Asia 2019



Singapore's Senior Minister of State for Transport, and Communications and Information, Dr Janil Puthuchery (second from right), was warmly welcomed at the Keppel O&M exhibition booth by Mr Chow How Jat (first from right), MD (Conversions & Repairs) of Keppel O&M, and Mr Abu Bakar Mohd Nor (third from right), MD (Gas & Specialised Vessels) of Keppel O&M

Keppel Offshore & Marine (Keppel O&M) was one of the major exhibitors at the biennial Sea Asia, which took place from 9 to 11 April this year at Marina Bay Sands Expo and Convention Centre.

Showcasing its capabilities, designs and strong track record, the group hosted at its booth visitors from government, industry and academic institutions.

Singapore's Senior Minister of State for Transport, and

Communications and Information, Dr Janil Puthuchery, was guest of honour at the opening ceremony for the event. In his speech, Dr Puthuchery noted that the maritime sector remained more relevant than ever before with 90% of global trade carried by sea and demand continuing to grow each year, with Asia one of the strongest growing regions for the next few years.

He cautioned however that many challenges also lie ahead and that pertinent issues the industry would

need to address included digital connectivity, tighter environmental regulations and manpower crunch.

Held in conjunction with Singapore Maritime Week, Sea Asia serves as a focal point for both the global and local maritime communities to network, explore new businesses and showcase the latest maritime innovations, equipment and services.

Strong safety culture

Safety is a top priority and continuous efforts are made to strengthen safety culture at Keppel Offshore & Marine (Keppel O&M).

COMMITMENT TO HSE

In February 2019, Keppel Subic Shipyard in the Philippines launched its annual safety campaign to reiterate its commitment to Health, Safety and Environment (HSE). Themed "My Commitment to HSE", the campaign saw employees and subcontractors renew their personal commitment to building a strong safety culture.

This further reinforces one of Keppel's Five Key Safety Principles, HSE is a line responsibility, which encourages all personnel to do their part and take charge of health and safety.

The next month, Keppel Subic Shipyard participated in the nation-wide Fire Prevention

Month and spearheaded a fire and evacuation drill jointly conducted with the Subic Public Order and Safety Office.

The month of March was declared Fire Prevention Month in 1986 to raise awareness about the hazards of fire. According to data by the Bureau of Fire Protection, March is one of the hottest months of the year and marks the beginning of summer in the Philippines.



During Fire Prevention Month in March, Keppel Subic Shipyard participated in a fire and evacuation drill jointly conducted with the Subic Public Order and Safety Office

PERFECT SAFETY PERFORMANCE

In March 2019, Keppel Nantong Shipyard received safety performance bonuses for achieving zero loss-time incidents in the delivery of three Trailing Suction Hopper Dredgers each with a hopper capacity of 3,500m³. Built for Jan De Nul and to the requirements of classification society Bureau Veritas, the dredgers were delivered on time, within budget, and with a perfect safety record.



Keppel Nantong Shipyard received safety performance bonuses for delivering three dredgers to Jan De Nul with a perfect safety record

Renewing bench strength



Mr Paul Tan

A stalwart of Keppel, Mr Paul Tan will retire from his role as CFO of Keppel Offshore & Marine (Keppel O&M) with effect from 1 January 2020. He will then take up the appointment as Consultant to Keppel O&M.



Mr Kevin Chng

Mr Tan has been the CFO of Keppel O&M since 2017 and first joined the Keppel Group in 1980, having held various management positions within the Group. He was responsible for the Group Accounts for Keppel Corporation

since 1988 and was the Group Controller.

Mr Kevin Chng, General Manager of Group Risk and Compliance (GRC), Keppel Corporation will relinquish his GRC portfolio and take on the role of Chief Financial Officer (Designate), Keppel O&M with effect from 1 August 2019 until 1 January 2020 when he will be redesignated as CFO. Mr Chng joined Keppel in 2016 and had been with the Credit Suisse Group in Singapore and Hong Kong for 16 years where he last served as their Regional Head of Internal Audit (Asia Pacific). He is a Chartered Accountant with the Institute of Chartered Accountants Australia.

Driving Innovation

To maintain its competitive edge, Keppel Offshore & Marine (Keppel O&M) continually leverages technology and innovation to improve processes such as product design and yard operations.

Through the Keppel-NUS Corporate Laboratory, an industry-university partnership between Keppel Corporation and the National University of Singapore (NUS), Keppel O&M utilises the Aspire 1 supercomputer to digitally test and improve rig and ship designs.

The Aspire 1 is set for an upgrade with a capacity boost of up to 20 times, which would enable Keppel to further leverage High Performance Computing capabilities to develop more innovative products in a shorter time.

Keppel O&M also holds annual competitions which encourage employees to innovate and improve safety and efficiency on the ground. On 15 February 2019, BrasFELS, Keppel O&M's shipyard in Angra Dos Reis, Brazil, concluded its INOVE programme by recognising the innovation contributions of 11 teams.

Awarded the most prestigious Star Award, the Beveller for small bores project reduced time spent and reused discarded materials in the preparation of bores.



The Beveller for small bores project won the Star Award at BrasFELS' INOVE programme

Skills development

Leveraging its strong partnership with the Singapore University of Technical Design (SUTD) Academy, Keppel Offshore & Marine (Keppel O&M) on 26 February 2019 invited esteemed professors Dr Richard de Neufville, Professor

of Engineering Systems at the Institute for Data, Systems, and Society, Massachusetts Institute of Technology (MIT), and Dr Michel-Alexandre Cardin, Associate Professor at the Dyson School of Design Engineering,

Imperial College London, to conduct a workshop on flexibility in engineering design. The workshop was attended by over 100 participants from Keppel O&M.

In the face of a rapidly changing world, participants of the workshop gleaned valuable insights on how value-enhancing flexibility in design can be created to adapt to evolving market needs and technological developments. For example, good system design needs to incorporate factors such as economics, as well as the timing of expenses and revenues.

The workshop was well received by participants who found the sharing insightful and relevant.



The workshop was well received by the over 100 participants who gleaned insights on incorporating value-enhancing flexibility in the designing of products and services

Inclusion at the workplace

At the start of 2019, BrasFELS, Keppel Offshore & Marine's (Keppel O&M) shipyard in Angra dos Reis, Brazil, embarked on a project to promote inclusion amongst employees and in the work environment. A series of talks was organised as part of this project.

The first initiative of this project was held on 17 January 2019, with Ms Claudia Weneck, founder of the Non-Governmental Organisation (NGO) Escola de Gente, speaking

about the importance of inclusion at the workplace.

BrasFELS employees also participated in other talks to understand the challenges and stigmas of disabilities such as autism and physical disabilities.

Held throughout the first quarter of 2019, the series of lectures was organised as part of a partnership with Escola de Gente to promote inclusion at the workplace.



Ms Claudia Weneck, founder of Escola de Gente, spoke about the importance of inclusion at the workplace

Pioneering spirit



Mr Ma Zhen Nan (first from right), at Potala Palace, Lhasa, Tibet, during a road trip with his colleagues

In August 2008, to much fanfare, Asia's first icebreaker vessel was delivered by Keppel. Many were astonished that a specialised vessel such as an icebreaker meant for the Arctic region, could be built in the tropics. Mr Ma Zhen Nan, Vice President (Projects) at Keppel Nantong Shipyard (KNT), was then the project engineer at Keppel Singmarine in charge of this milestone project and to this day, remembers the jubilation at the vessel's naming ceremony.

Having successfully delivered that milestone project as well as several hull projects previously, Mr Ma was next offered the project manager role in KNT in China, which he readily accepted.

One of his first assignments in

KNT was to lead the project management of five Anchor Handling Tug Supply (AHTS) vessels and 13 tug boats. "At the time, the yard was still under development and we had just started to build vessels. Everything was new – the environment, systems, and people. It was the first time I felt like I was thrown outside my comfort zone", he shared.

Looking back fondly on those challenging times, Mr Ma is proud of what the shipyard has achieved since. In 2013 when the industry was booming, KNT was tasked to build offshore modules. One such project that KNT undertook was Shell's ice-class drilling rig, Shell Kulluk, which had come into Keppel FELS for repair. Through that project, KNT became the first

shipyard in China to successfully pass Shell's stringent audit and qualify as approved partner.

When the industry suffered a downturn in 2016, Mr Ma was tasked to support the business development team. He took the opportunity to pick up costing skills and learn more about the needs of potential owners.

Mr Ma, who is turning 36 this year, is excited about the opportunities in the coming years. "Keppel Nantong has built its first ice-class vessel, its first dredger, and is currently building its first LNG carrier and bunkering vessel. The learning curve may be steep, but I strongly believe we are well-equipped to meet any challenges along the way!"

Making a difference

Business units across Keppel Offshore & Marine (Keppel O&M) play active roles and regularly organise different types of initiatives to contribute back to the communities that they operate in.

FOOD FROM THE HEART

As part of efforts to create a sustainable impact for beneficiaries, Keppel O&M has committed to participate in volunteer sessions with Food From the Heart on a monthly basis. Held at Food From the Heart warehouse, volunteers sort and pack donated food items, which will then be distributed to the low-income families to help lighten their financial burden.

On 25 March 2019, 17 volunteers from Keppel O&M sorted and packed food items for 168 low-income families. Through this programme, Keppel O&M hopes do its part for the community, as well as create awareness on food wastage and instill amongst volunteers the virtue of sharing with the less fortunate.

BEACH CLEAN UP

Keppel O&M also believes in doing its part for the environment, and on 23 April 2019 organised a beach clean up at East Coast Park. Together, the 81 volunteers from across Keppel O&M cleared 28 bags of rubbish. Through this activity, Keppel O&M hopes to promote the importance of taking ownership in keeping parks and beaches clean for users and wildlife.



Keppel O&M has committed to participate in volunteer sessions with Food From the Heart on a monthly basis



Through combined efforts, over 80 volunteers from Keppel O&M cleared 28 bags of rubbish



Volunteers from Keppel Bantagas and Keppel Subic shipyards continued to support the nationwide blood donation campaign

BLOOD DONATION DRIVE

Keppel Volunteers in the Philippines continued its support of the nationwide blood donation campaign during the first quarter of 2019.

Keppel Batangas Shipyards and Keppel Subic Shipyards partnered with Mary Mediatrix Medical Center and the Philippine Red Cross respectively to organise blood donation drives for its employees. Their combined efforts produced 154 bags of blood, which has the potential to impact over 400 lives.

In recent years, both Philippine shipyards have received recognition and appreciation from the Philippine Red Cross and local medical partners for their continued efforts to promote blood donation in their respective communities.



(Top) Earth Hour at Keppel Batangas Shipyard in the Philippines
 (Bottom) As part of Earth Hour, Keppelites in Keppel Subic Shipyard also wrote pledges on personal contributions to conserve the environment

Earth hour

As a symbol of commitment to environmental conservation, businesses, communities, households and individuals around the world participate in Earth Hour and turn off non-essential lights for one hour. This year, Earth Hour was held on 30 March 2019 from 8.30pm to 9.30pm.

Keppel Offshore & Marine is committed to raising awareness for

environmental conservation and various yards and offices around the world such as Keppel Subic Shipyard and Keppel Batangas Shipyard in the Philippines and Keppel Nantong Shipyard in China participated in Earth Hour to show support for the initiative as well as encourage employees to take an active role in conserving the planet's resources.

In addition to observing Earth Hour, yards and offices also encouraged participation in this event by screening films on environmental awareness and circulating educational materials on conservation.

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Repeat semi order



When completed, the mid-water semisubmersible rig will have a low environmental footprint

In March 2019, Keppel Offshore & Marine (Keppel O&M) entered into a rig construction contract with Awilco Drilling (Awilco) for the construction of a repeat mid-water semisubmersible (semi) drilling rig for harsh environment use.

This follows the exercise of an option by Awilco based on a contract signed by Keppel O&M and Awilco for a similar rig earlier in 2018. As part of that transaction, Awilco has independent options to order up to another two similar rigs to be exercised in 2020 and 2021 respectively.

The rig will be built to Moss Maritime's CS60 ECO MW design and is scheduled for completion in 1Q 2022. Similar to the first rig, it is specially designed, configured and outfitted for mid-water operations in water depths up to 1,500m and able to work in the harshest environments of North West Europe, including the Barents Sea.

Mr Tan Leong Peng, Executive Director (New Builds) of Keppel O&M, said, "We are pleased that Awilco has decided to exercise its first option. It demonstrates the confidence in the solutions that

Keppel provides, the strength of our partnership, and the growing confidence in the market.

"Work on the first rig is progressing well and we will be able to benefit from economies of scale and cost efficiencies from undertaking a repeat project. For this second rig, we will be able to leverage the engineering and construction process of the first rig to further improve productivity."

Equipped with a hydraulic hoisting system capable of two million pounds of lifting capacity, the mid-water semi also features an optimised 12 point thruster assisted mooring system for vessel station keeping, complete with hybrid power supply and energy saving features.

Mr Sigurd E. Thorvildsen, Chairman of the Board of Awilco Drilling PLC, said, "We have exercised the first of our three options because we see growing demand for such mid-water, harsh environments rigs in North West Europe. Our partnership with the world's leading rig builder, Keppel, enables us to offer our customers confidence in receiving a high specification rig that is purpose-designed, setting a new environmental standard and equipped with the latest technology."

Keppel O&M has a strong track record of having delivered 25 semisubmersible rigs since 2000.