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Offshore

World Trends and Technology for Offshore Oil and Gas

FRANCE SUPPLEMENT

Courtesy TOTAL

Eiffage Métal expanding offshore wind construction capability

WIND FARM INVESTMENTS in Europe remain heavily focused on the North Sea, but more projects are starting to emerge off France's shorelines. Engineering and construction group Eiffage Métal is one of the more active players in both sectors.

The company's Belgian subsidiary Smulders has an EPCI contract, under a consortium with DEME, to supply 55 jackets for EDPR/ENGIE's Moray East wind farm off northeast Scotland. All are three-legged structures, 85 m (279 ft) tall, and each weighing 1,000 metric tons (1,102 tons). Most of Eiffage Métal's factories across Europe have been involved in the production process, including workshops and yards at Balen, Hoboken and Eilhems in Belgium; Lauterborg in France; and Zary in Poland. Fabrication of the consignment has entered the final phase, with the Wallsend yard on the River Tyne in northeast England handling assembly.

According to Arnaud de Villepin, Industrial Division Director at Eiffage Métal, the main challenges have been the scale of the program, due to the large quantity of jackets involved; managing the logistics; the timeframe for delivery; and the industrial approach. Serial production of the jackets is completely different from a conventional offshore platform construction project.

"Some specialist oil and gas fabricators are still entering this market, while others have tried but are now exiting because they have not succeeded. Although still relatively new, offshore wind is a more fiercely contested market than oil and gas because the price of the energy, which has to be competitive. The capex is having to be constantly reduced, because the revenue from wind farms compared with oil and gas - at least until the latest oil price crash - is lower, and government subsidies for these projects are also going down. So, this is not an open market: to compete, you need to have a big yard, a large installation capacity, and a well-developed supply chain."

ABOVE: The Wallsend yard is completing assembly of the Moray East wind farm jackets. **BELOW:** The yard in Senegal is supporting construction of the Greater Tortue Ahmeyim LNG jetty. *(Images courtesy Eiffage Métal)*

Eiffage Métal is also collaborating with DEME on France's first offshore wind farm, a 480-MW complex located between 12 and 20 km (7.5 and 12 mi) from the port of St. Nazaire on the Guérande peninsula on the west coast. The scope of the EPCI contract, awarded last year, covers the design, fabrication, transportation, and installation of 80 monopiles and transition piece foundations. Construction of the transition pieces is taking place at Smulders' yard in Antwerp and of the monopiles at SIF in Roermond, the Netherlands. The completed structures will be transported to La Rochelle, south

of St. Nazaire, then installed by DEME between spring 2021 and summer 2022.

"The variable seabed soil conditions at the offshore location oblige us to use different installation methods for the monopiles," de Villepin explained, with a specially-fabricated subsea waves protection device deployed from DEME Offshore's installation vessel *Innovation*. "Some of the monopiles can be driven conventionally, while others have to be drilled, or in some cases drilled and driven. The dimensions of the monopiles will be strong enough for each case, this having been taken into account in the engineering phase."

A floating offshore wind farm market is also starting to emerge in Europe, led by Equinor's Hywind projects offshore Scotland and in the Norwegian North Sea. Eiffage Métal is the EPCI contractor for a pilot floating wind farm project in the French Mediterranean Sea, which involves assembly of a floater designed by Principle Power Inc.

Assuming contracts are awarded this year as originally planned, Eiffage Métal would fabricate three floater structures between 2021 and 2022. Each would weigh 2,000 metric tons (2,204 tons) and would operate in water depths of up to 70 m (229 ft), over an area of 3.5 sq km (1.35 sq mi). According to de Villepin, PPI's concept is based on dynamic ballasting. Eiffage Métal would manufacture parts of the columns and bracings, then assemble these at its yard in Fos-sur-Mer. In addition, the company aims to submit bids for other planned conventional and floating wind farms off Le Tréport and Dunkerque in northern France; another close to the island of Noirmoutier off the west coast; and three offshore floating wind farms, one located off the coast of Britanny and the other two in the Mediterranean Sea.

Before the sudden oil price collapse, the company had been monitoring potential oil and gas projects offshore Nigeria suited to its local living-quarter fabrication capability. These included Shell's shallow-water Block H development and the quarters module for SNEPCO's deepwater Bonga SW project. Another development of interest was the proposed Phase 2 of BP/Kosmos Energy's Greater Tortue Ahmeyim project off Mauritania and Senegal. This could involve an extension to the 1.2-km (0.75-mi) long Phase 1 LNG terminal breakwater jetty that Eiffage GC Marine is currently working on, possibly also a living quarter platform. For Phase 1, the company is using a yard in Senegal and the local supply chain to build the jetty's 25 supporting concrete caissons, each weighing 16,000 metric tons (17,637 tons). The yard, part of a major development at the Port of Dakar, could also be used to bid for future local offshore projects.

Transfer of LNG ship to ship.
(Image courtesy Excelerate Energy)

GTT membranes safeguard LNG on Prelude, Coral South

MOST OF THE NEWBUILD FSRU and FLNG vessels either in operation or under construction worldwide employ GTT's membrane containment systems for their LNG/LPG cargoes.

GTT (Gaztransport & Technigaz) was formed in 1994 following the merger between two French companies Gaztransport and Technigaz, both focused on the LNG shipping business. The company originally developed its membrane technologies to reduce the cost of LNG maritime transport by loading it in bulk in the LNG carrier's holds. The holds are equipped with cryogenic coatings, or membranes, which contain the LNG at a temperature of -163°C (-261°F) and are sealed with an impermeable layer between the liquid cargo and the vessel's hull. The design also limits cargo loss through evaporation, or boil-off.

GTT's sustained research and development efforts have led to it designing new solutions for the LNG offshore industry, especially for LNG floating storage and regasification units (FSRU) and floating liquefied natural gas vessels (FLNG).

It is important for GTT to develop its technology to meet their customer's requirements which are changing and evolving quickly. More resistant insulation systems are necessary to enable operations offshore (FLNG, FSRU, etc.), in order to obtain more operational flexibility or even to transport gases which are heavier than LNG.

In recent years the company introduced its Mark III Flex+ system, engineered to provide improved thermal performance. The design evolution involved the increase of the total thickness of the insulation by 20% compared to the established Mark III Flex system.

Another on-going development, which received initial approval from Class in late 2018, is GTT NEXT1, which is designed to achieve a thermal performance equivalent to Mark III Flex while using proven materials and components of NO96 system (the other GTT's technology).

According to the company, over 30 FSRU vessels currently operate globally, with countries new to LNG imports generally favoring the concept as more economic than construction of

full-scale onshore storage. The company claims that all units currently being built will also feature its technologies. As for FLNG (floating LNG) vessels, only a few are in service: GTT equipped 10 Mark III tanks to Shell's ***Prelude***, the world's largest FLNG vessel, and delivered systems for Petronas' two smaller FLNG vessels operating offshore Malaysia. In addition, GTT technologies will be fitted to the first ultra-deepwater FLNG, under construction by Samsung in South Korea for Eni's Coral South gas field in 2,000 m (6,562 ft) water depth in Area 4 of Mozambique's offshore Rovuma basin. The facility is due to start operations from mid-2022, producing 3.4 MM metric tons/yr (3.75 MM tons/yr) of LNG over a designed lifespan of 25 years.

GTT has licensed its membrane technology to leading Far East shipyards including Samsung, Hyundai Heavy Industries, DSME, Hudong Zonghua, and Jiangnan. Last December, it also signed a technical assistance and license agreement with Wison Offshore & Marine in China to equip FLNGs, FSRUS, floating storage, regasification and power generation units and other vessels with its membrane containment systems. Teams of the licensed partners are then trained by GTT in the principles of membrane installation.

According to GTT's Commercial Vice President David Colson, the company undertakes most of its R&D at its headquarters in St Rémy-lès-Chevreuse south of Paris. "We study the materials that go into the containment system: all selected materials and developed sub-assemblies then have to be qualified and tested at room and cryogenic temperatures. We then approve suppliers and shipyards for the fabrication process.

"Our facilities include a liquid motion/sloshing laboratory with four machines designed to simulate all the different movements of the LNG vessel, with 6 degrees of freedom. We use a 1/40 scale tank, equipped with pressure sensors, to measure at laboratory scale how the liquid in the tank would behave on an offshore vessel or platform. We can then optimize the membrane system design through reinforcements or to propose modifications to the design of the platform itself through changes in the dimensions or adding stability. GTT also works with universities in Europe if we do not have the necessary equipment in-house.

"Offshore ship-owners are less concerned about improving thermal performance to reduce the boil-off rate (a prime concern for LNG carriers; matching the boil off to the engine requirements). However, the thermal performance of tanks can be an issue for offshore re-gas applications as a resultant boil-off situation could halt a send-out of an FSRU."

A different approach is required for modeling sloshing on offshore re-gas/FLNG vessels, Colson explained. "With an LNG carrier, you typically operate it up to 10% of tank height when on ballast, and not below 70% on laden voyages. But for offshore vessels, you must be able to maintain the filling height in all conditions. So we must demonstrate to the client that our system can perform sufficiently well to meet all sloshing requirements under the offshore environment."

"At the start of FLNG development, some years ago", he continued "GTT's technology was not viewed as optimal for for such a platform, particularly for withstanding sloshing in FLNG units, and the company had to demonstrate to Shell, amongst others that its membrane containment systems could be adapted to work on the Prelude project offshore northwest Australia. Instead of the conventional arrangement of one row of four to five LNG storage tanks, the design of a central cofferdam solution between two rows of five tanks extending the length of the platform was adopted. This solution reduces the risk of sloshing loads as well as acting as structural support for the platform's very heavy topside. Other tank solutions, such as spherical tanks, would not afford enough flat deck space to accommodate the topsides." Other alternative solutions which do feature a flat deck, have been, according to Colson, considered to be more expensive.

"In a scenario of two banks of normally dimensioned 50-m (164-ft) wide tanks, there would be a potential for quite an important amount of liquid motion at certain filling levels. But if the tank breadths are halved, it reduces the sloshing effect significantly. In addition, FLNG vessels are massive, stable structures that do not move excessively in water compared to normal vessels."

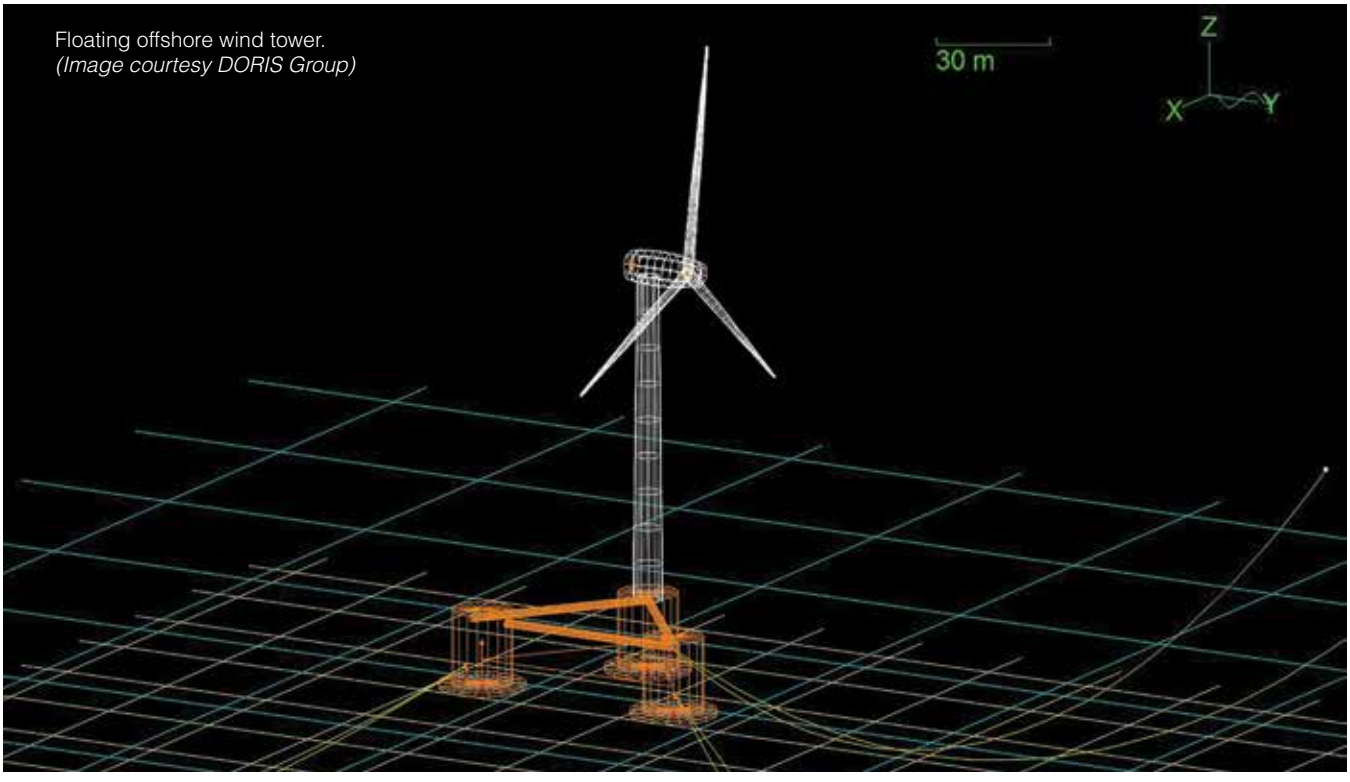
The redundancy built into the design means that nine of the tanks can continue to operate normally while the other tank is taken off line to be emptied of gas. The process entails visual inspections and checks for tightness, with maintenance and repairs, if required, performed on site. "If there is an issue at the higher part of the tank," Colson said, "our team may have to erect scaffolding in the tank on site, because the vessel cannot be brought ashore at any time for dry-docking."

"Our membrane systems on all our clients' vessels are constantly monitored for any potential leak in the tank or barrier. We also conduct visual checks to verify that there are no objects in the tank which could become loose. A bolt which has become unbolted may lead to damage under sloshing in operation."

GTT has also been awarded a contract with Shell to maintain the tanks on Prelude on a five-yearly basis.

For LNGC's, FSRUs and FLNGs, GTT subsidiary Cryovision provides different types of membrane test services such TAMI (Thermal Assessment of Membrane Integrity) for testing the tightness of tank secondary barrier as well as other tightness tests (Primary barrier, Global tank test). The company may also use in-tank equipment to facilitate testing such as: MOON (Motorized BalloON) operates in similar fashion to a drone. In this case, a balloon is dispatched to inspect a tank's primary membrane. TIBIA (Tank Inspection by Integrated Arm) is an arm-like tool developed by GTT that can roam around tanks on FSRUs and FLNGs and perform maintenance of the primary membranes.

GTT continues to offer innovative services for monitoring and maintaining the membrane tanks offshore. Recently GTT North America signed a five-year global technical services agreement with Excelerate Energy to support maintenance of nine FSRUs equipped with NO96 membrane technology.



Floating offshore wind tower.
(Image courtesy DORIS Group)

DORIS maintaining focus on renewables, lower-cost production

FRANÇOIS THIÉBAUD, *DORIS GROUP*

AGAIN, ANOTHER CRISIS for the offshore industry, or rather, two crises, with COVID-19 and the oil price slump. However, DORIS is confident it can adjust to these unexpected market conditions, as it has done over the past 55 years, thanks to its diversified activity and R&D investments.

Despite the recent developments, climate change remains a worldwide concern, and the reduction of greenhouse gases (GHG) in oil and gas production is now part of the group's design remit, from conceptual to detailed design stages. One current project involves reducing GHG generation onboard four FPSOs off West Africa: DORIS is preparing recommendations to that effect.

Another global priority is the replacement of hydrocarbons with other sources of energy. The group is participating in various initiatives, including carbon-free generation of hydrogen. Its UK subsidiary ODE is collaborating in the DOLPHYN project (Deepwater Offshore Local Production of HYdrogeN) to design the process equipment, electrical system, and overall technical safety requirements for the production of hydrogen from seawater.

The facilities will be installed on a semisubmersible, supporting a wind turbine to provide carbon-free energy, with the hydrogen piped to shore. Preliminary studies are complete and in February, the UK government launched the project's next phase which involves developing a 2-MW prototype. Later, with a full-scale unit, a single offshore 10-MW floating wind turbine should be able to produce sufficient low-carbon hydrogen to heat around 2,500 homes, fuel over 120-240 buses, or run eight to 12 trains.

OFFSHORE WIND FARMS

Renewables are also part of the solution. DORIS has developed two innovative concepts for floating wind, with the Nerewind semisubmersible suitable for deeper water, and the Articulated Wind Column (AWC) for intermediate depths. The group's first project in this field dates back to 2002 with a pre-front-end engineering design (pre-FEED) study for a wind farm offshore Zeebrugge, Belgium.

Since then, the group has provided engineering and associated services to developers for projects such as Ormonde, Scroby Sands, and Wikinger. The experience led the group to expand this service to Asia, with an office in Taiwan in 2016, followed by activities in Japan, Korea, Vietnam, and Boston, and prospects for further developments.

FACILITY LIFE EXTENSIONS

At the same time, the group remains active in more traditional oil and gas activities. One of the industry's main challenges today is extending the lives of existing facilities that have reached their originally designed lifespan of 20-25 years, but which can still produce available reserves. DORIS is assisting several initiatives in Africa and the Middle East to assess the remaining life of equipment and structures and to recommend life extension modifications.

Cost reduction remains the primary driver of most operators, and much more so in periods of depressed oil prices. One significant lever is the reduction of opex by converting facilities that were designed only a few years ago to operate manned to unmanned service. Through ODE, the group held operation and maintenance contracts for several platforms in the southern North Sea for over 15 years. It is now Duty Holder of two greenfield developments, and has expanded its Aberdeen office to target central North Sea operations. One idea is to design facilities with a once-yearly visit specification, such as the 2018 design the group produced for a wellhead platform offshore Argentina.

New facilities can also be designed with disrupting technology and commercial choices, such as small-scale FLNG development in which DORIS is presently involved for various West Africa prospects.

DIGITALIZATION

Finally, and most importantly, the industry is finally catching up on the digitalization journey several years after the automobile, aerospace, and other sectors. Digitalization leverages huge amounts of data that oil and gas operators have compiled over the years in their operations through sophisticated instrumentation packages and control systems. Yet much of this data is either used 'live' or more often, not at all. It is rarely used through statistical analyses because the data is stored in multiple databases (PI, SAP, SharePoint, EMDS, etc.) with no linkage between them. But when assembled in a single location, the data can be mined to reduce opex and capex by decreasing design margins and potentially increasing revenues though production improvements.

DORIS is developing solutions for digital twins with a view to producing prescriptive analytics for operators. This initiative started several years ago with 'intelligent 3D-models,' and is now moving into the pilot phase for actual greenfield and brownfield facilities. The group has also provided several digitalization proof of concepts to oil and gas clients from California to Africa to the North Sea.

The present crises will change many industry activities to a new 'normal,' but DORIS aims to prepared for the next wave of upheavals via continued R&D initiatives and the contributions of its worldwide subsidiaries.

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iXblue develops second Gaps USBL system for shallower-water subsea tasks

NAVIGATION/POSITIONING specialist iXblue has expanded its Gaps range of ultra-short baseline (USBL) systems for subsea operations support.

The newly developed Gaps M5 is an omni-directional, medium-frequency USBL acoustic positioning system which like the established Gaps M7 does not require on-the-field calibration. It is designed for positioning and vertical/horizontal tracking of subsea infrastructure, from shallow-water to medium water depths (down to 1,000 m/3,281 ft), with a claimed accuracy of better than 0.5% of the slant range up to 995 m (3,264 ft).

The motion sensor embedded within the system is a free-of-export Octans Nano attitude and heading reference system, and is based on the company's FOG (Fiber Optic Gyroscope) technology, said to ensure stable heading roll and pitch compensation and a true north reference. Gaps M5, with a weight of 14 kg, is smaller and more compact than Gaps M7 (17 kg), features that are said to further facilitate installation and operation. As with Gaps M7, after installing and turning on the system, it is ready for the user to operate.

According to iXblue, when positioning a vessel at a distance of 500 m (1,640 ft), Gaps M5 is accurate up to a maximum of 2.5 m (8.2 ft), and the maximum operating range can be achieved even in noisy conditions. The export-free capability is said to be particularly advantageous for operations in strictly regulated offshore locations. Subsea applications range from tracking of divers, AUVs, ROVs and tow fish tracking to dynamic positioning, long baseline transponder 'box-in', subsea structure installation and pipelaying.

Gaps M5 retains the main design features of the M7, but with shorter legs and an overall height around 12 cm (4.7 in.) lower. Its 3D four-hydrophone antenna has different leg lengths to enhance horizontal tracking and the acoustic capability is said to provide maximum aperture, allowing up to 200° omni-directional coverage without the need to tilt the antenna. This is claimed to be a major advantage in shallow water and horizontal tracking conditions, especially when multiple vehicles must be simultaneously located at 360°. The system can also be used for dynamic positioning as an acoustic transceiver, with one beacon in USBL mode or three or more beacons in LBL mode.

Since iXblue introduced Gaps M7 as the first pre-calibrated USBL system in 2005, over 300 have been deployed worldwide. Gaps M7 remains the best option for more complex survey requirements such as subsea multi-beam and laser scan positioning, as it provides an accuracy that can reach 0.06% of the slant range up to 4,000 m (13,123 ft). According to Gary Bagot, iXblue's Business Developer, Subsea Navigation & Energy Market, many of the company's clients have confirmed this accuracy at a distance of

Gaps M5 under deployment. *(Images courtesy iXblue)*

thousands of meters from the target. One application that benefits from this capability, he explained, is laying a pipeline in a field congested by structures and geohazards. "If the USBL is sufficiently accurate, it can be used to narrow down the optimum corridor for the pipeline. And therefore, unlock shorter safe pipeline routings and decrease sleepers dimensions."

Gaps M7's USBL antenna and Phins Fiber-Optic-based inertial navigation system (the latter pre-calibrated at the company's factory) are combined within the same housing. Its acoustic capabilities, which include wideband signals, are said to maximize performance even in the most problematic conditions, and the 3D acoustic array allows for tracking even at angles above horizontal. Offshore applications range from structure placement to ROV navigation, AUV operations, towfish tracking, cable/pipelay support, touchdown positioning, mattress placement, plough/trenching positioning, rig and anchor moves, riser positioning and OBC node placements for 4D seismic surveys.

Both Gaps M7 and Gaps M5 are based on an open architecture with serial and Ethernet connectivity and Web control command, and according to iXblue both are also compatible with third-party equipment. Even if they operate on the same medium-frequency bandwidth, the two systems can be deployed simultaneously, Bagot added, typically as permanent and temporary subsea positioning systems.

Application wise, the new Gaps M5 is perfectly suited for inshore applications, while Gaps M7 can cover all applications, from inshore to offshore, with ultimate performance.

Among recent applications was a pipelay project where the lay barge already had a permanent USBL system onboard. "However, when the laying operation started, this could not provide the client's requested accuracy. In this case, the situation was resolved by installing a Gaps on the vessel's stinger.

"For another project, in shallow water depths, the client wanted to install pipes in 20-m [65.6-ft] sections, one after the other. The operation, involving three divers, and an inspection ROV, was quite challenging in terms of providing an overview of the situation - but the Gaps M7 was able to do it in such noisy environment. In addition, two transponders were installed on each pipe section allowing complete monitoring through iXblue's Delph Roadmap Software's 3D view, delivered with every product in the Gaps Series.

"Another client used a Gaps M7 in combination with our 2D/3D visualization software on an offshore construction vessel to ensure safe placement of the structure on the seafloor."

Class survey plays its part in the conversion process. *(All images courtesy Bureau Veritas)*

Re-purposing gas carriers for offshore re-gas, storage roles

JULIEN BOULLAND, *BUREAU VERITAS*

CONVERSION IS OFFERING a second life to gas carriers, but repurposing these vessels as floating storage and regasification units (FSRUs) and floating storage units (FSUs) comes with technical and operational challenges for owners.

The liquefied natural gas (LNG) market is growing as more countries turn to gas to meet their rising energy needs. In parallel, there has been an increase in the number of gas carriers providing LNG transportation and distribution. In recent years, numerous laid-up ships have become available for varying reasons: they may be nearing the end of their design lives, or may be outside of modern specifications, phased out, or off-charter for the market. Owners are seeking to repurpose their vessels and extend their lifecycle by converting them to FSRUs and FSUs as more countries see the capex and opex-reducing potential these units bring compared to onshore LNG terminals.

Furthermore, because they offer greater flexibility and are less infrastructure intensive, FSRUs can provide an intermediate solution (the time charter can be less than five years), during the length of time it takes to develop a permanent onshore solution. As the FSRU sector is still relatively new and developing, relationships between countries that require LNG and the FSRU providers can be complex. There are several key points that FSRU and FSU developers should consider to ensure their vessels are safe, fully compliant with environmental regulations, and appropriate for market demands.

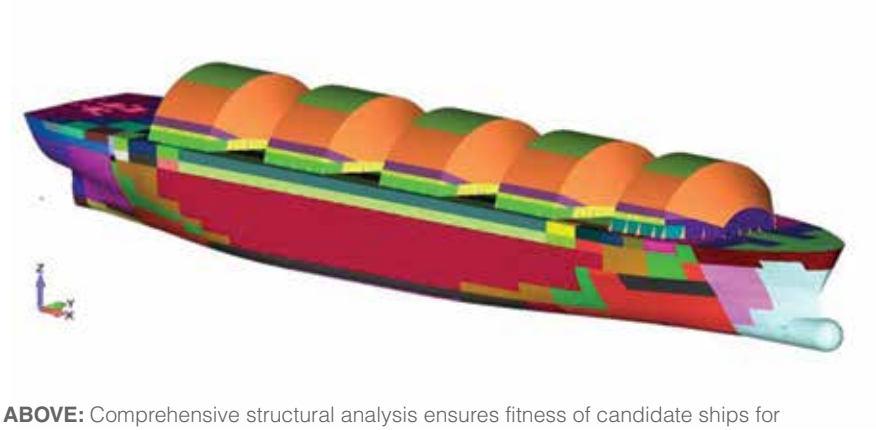
Regulatory questions at both flag state and class levels are a

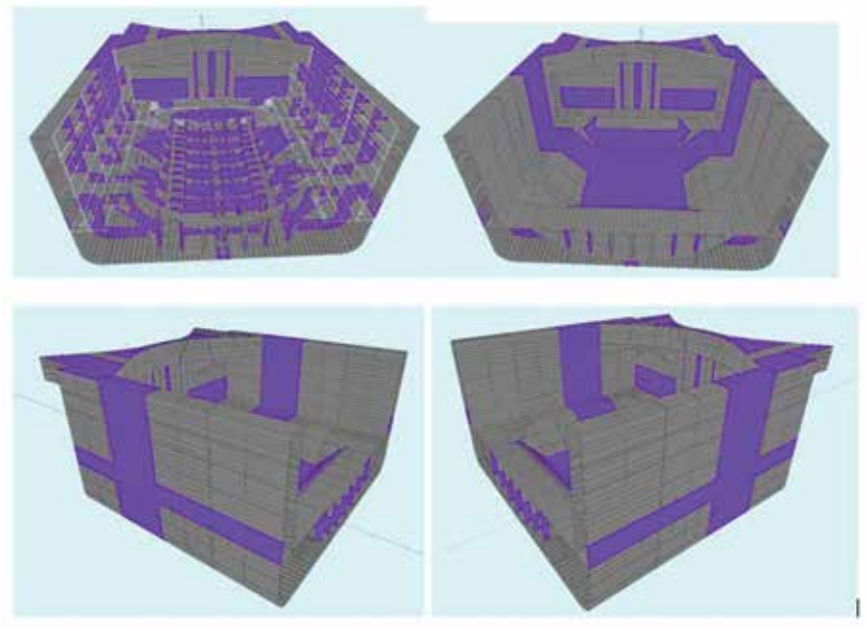
major consideration for FSRU/FSU conversions. Depending on the intended modifications, project specifications and conversion work, different systems may be decommissioned, removed, modified, or added. Project developers must account for all statutory and classification concerns, including International Marine Organization regulations such as the International Convention for the Safety of Life at Sea (SOLAS), the International Convention for the Prevention of Pollution from Ships (MARPOL) and the IGC Code, which ensure that vessels comply with safety and environmental requirements. Coastal state and local port authorities may also need to be consulted, and their requirements taken into consideration.

Technical challenges abound. Gas carriers may need to undergo modifications to their power generation systems (e.g. boilers, generators), power distribution, propulsion, LNG cargo tanks, systems for cargo, cargo control, mooring, handling cranes and others. Owners looking to remove certain equipment must assess how this can be done safely, and under what conditions. From reviewing structural elements, to upgrading cargo containment systems, to adding new equipment, the list of technical challenges is considerable for conversion to FSRUs and FSUs.

Compliance with local environmental regulations also needs to be considered. In many cases, an FSRU or FSU will be in a stationary position close to shore and potentially near to other marine users such as fishing vessels. FSRUs use considerable amounts of seawater to heat up the LNG during regasification and the change in temperature of the discharged water is considerable. Therefore, it is essential that the vessel operators are fully aware of and compliant with local regulations on water emissions as well as others relating to environmental issues such as air quality and noise.

Another key question is how to keep a vessel on location for an extended period, potentially exceeding the typical five-year dry-docking regime. Project developers frequently seek a 'no-dry dock' approach,





ABOVE: Comprehensive structural analysis ensures fitness of candidate ships for conversion. **BELOW:** Thorough thickness measurement of the hull.

which has implications for conversion work on hull structure and equipment. Finally, there is the issue of cost, as owners seek to limit the price of on-site maintenance and minimize opex for their vessel's extended lifecycle.

HOW CLASSIFICATION SOCIETIES CAN HELP

Classification societies can perform a range of analyses for gas carrier hull structures, cargo tanks, machinery, mooring systems, and more. Evaluation of hydrodynamics, design loads and scantling data, as well as structural assessments, offer owners a clear picture of their vessel's condition, and allow classification societies to assist in developing a full inspection program. However, it is important that the product developer engages and involves a classification society at the earliest opportunity in a project, and that the relationship is maintained throughout the design and build process.

The classification society will be able to provide counsel and guidance from a regulatory perspective from the outset, to highlight potential challenges and how these may be overcome. By helping the product developer to avoid costly errors in regulation compliance and design early on, and by providing advice and expertise support along the way, the classification society can be seen as an enabler for the development of a safe, environmentally responsible, and cost-effective asset.

Les “Habitués” de OTC