What's the future for Floating LNG

BY **DANNY CONSTANTINIS (EXECUTIVE CHAIRMAN) EM&I GROUP, MALTA.**

FLOATING LNG will probably become one of the fastest growth sectors in the offshore oil and gas industry over the next few years, particularly as climate change has become one of the dominant issues for most countries and companies. LNG is a relatively 'clean' fuel and the technology for gas fired power stations is well proven.

Providing low cost and reliable electrical power is fundamental for many emerging economies with little or no infrastructure.

Floating gas assets are the answer in many cases...

Existing and emerging markets are realizing that the environmental and economic value of natural gas, both in the transition to a decarbonized energy sector and as a long-term complement to sustainable energy sources is here to stay for the foreseeable future.

In this context floating gas has many advantages; FLNG assets can capitalise on 'stranded' gas fields and FSRU's can operate almost anywhere in the world as a quickly established fuel source for gas fired power stations.

Despite the pandemic and the consequential reduced energy demand, floating gas still remains a strong contender for current and mid-term energy provision, providing clean, economical fuel supply using proven technology

Most renewables suffer from 'intermittency' and cannot provide 24/7 power so need a baseload back up, as batteries can only currently provide peak power for a few hours at the most. When used to generate electricity, gas emits 50% less carbon dioxide than coal, and cuts nitrogen oxide and other particles by more than three-quarters, making it comparatively cleaner than other fossil fuels.

When it comes to balancing vast seasonal changes in energy demand, fuels like natural gas can be brought online quickly to overcome intermittency issues. Greater global access to natural gas, combined with continued low prices and the falling costs of renewable energy, means that the future energy landscape will look very different in future.

Asset integrity challenges

One challenge is to assure the integrity of the floating assets.

FLNG units carry significant quantities of volatile cargo and FSRUs are often located near population concentrations creating a need for higher levels of asset integrity management.

Integrity assurance requires accurate information on asset condition and trends particularly with respect to the hull, containment, pressure systems and Ex equipment.

Whereas FSRUs have generally been converted from LNG carriers and are often deployed on short term contracts which allowed them the opportunity of a conventional 5-year drydock, the situation is now changing whereby such assets may be on station for far longer.

This creates the need for on-station inspection and maintenance of components that would normally be performed in drydock, for example underwater hull inspections, moorings, hull structural and cargo storage systems surveys.

Typical FSRU integrity challenges include inspection and maintenance of hull and mooring systems locations where water clarity, strong currents and environmental concerns from leaks or removal of hull marine growth for inspection purposes, are present. Using divers can lead to safety risks and increased costs, so ROV based solutions or remote inspections from within the hull can be a better choice.

Similar needs apply to FLNG assets though the inspection challenges can be different, for example they will usually be on station for many years in heavier sea states, with deep water moorings similar to the existing F(P)SO units deployed worldwide.

For example, the underwater periodic inspections required by class societies have to be carried out using the UWILD (Under

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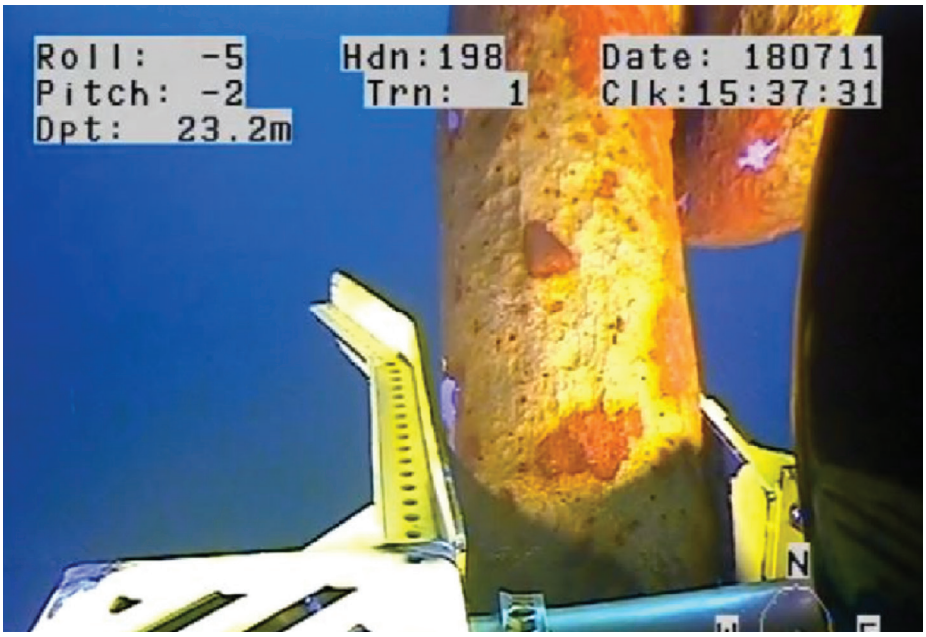

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For example, the underwater periodic inspections required by class societies have to be carried out using the UWILD (Under Water Inspection in Lieu of Drydocking) alternative. This has traditionally been carried out by divers which incurs significant weather dependence and again carries safety risk, cost and the environmental and health risks caused by high numbers of personnel on site.

Industry has encouraged development of robotic and digital technologies to help solve these problems…

The JIP (Joint Industry project) for HITS (Hull Inspection Techniques & Strategies) which we lead on behalf of the Global FPSO Research Forum for the past 8 years, includes most of the oil majors, operators, and class societies. The HITS organisation defines the challenges, specifies requirements, and encourages and evaluates solutions provided by the industry.

A new JIP for floating gas assets called 'FloGas' is being set up…

A new JIP for floating gas assets called 'FloGas' has been set up within the Global FPSO Research Forum, which has been operating successfully for over 20 years. The first 'kick off' meeting for 'FloGas' was held in Houston in 2019 to establish the scope of the JIP which includes tank inspections without man entry, diverless inspection and maintenance, diverless hull underwater protection, topsides piping integrity and repairs and integrity interactions between FSRUs and jetty arrangements

HITS sets out the challenge of seeking diverless solutions offshore and, following a number of years of development and refinement, there are now widely used methods for diverless hull and mooring system inspections that meet class requirements.

One such method, ODIN technology uses a number of tools to inspect, maintain and repair hulls and sea valves.

For diverless inspections and some maintenance operations, ODIN uses deck launched Integrity Class II ROVs equipped with vector thrusters, cavitation cleaning tools, laser measuring devices, NDT and other tools that allows these highly manoeuvrable machines to carry out the full hull and mooring system surveys to class requirements.

Isolation valves are traditionally inspected using divers to peer through openings in the hull or seachests or by blanking off the hull openings and removing the valves inboard for inspection or maintenance.

Valve inspections are now carried out by using an ODIN type inspection port hot-tapped into the adjacent piping through which a high-performance camera can be inserted. The valve can be inspected in full operation ensuring reliable function till the next scheduled inspection.

Valve repairs have also been carried out diverlessly using inflatable plugs inserted into discharge lines or through ODIN ports to double block the pipe and temporarily seal it.

Data from projects in West Africa, Brasil and other regions now demonstrates that this class of ROV has almost double the productive

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uptime than divers, based on IMCA guidelines, while using only a 3-person team, making it safer, lower cost and more efficient than divers.

One of the most difficult repairs to undertake on floating assets are diverless hull repairs…

This type of repair had often required drydocking or extensive and risky use of dive operations to attach cofferdams to the hull.

A new approach has now successfully carried out nine side shell replacements on FPSOs in Brazil and SE Asia using 'Diverless Cofferdams' to the satisfaction of both the clients and class society.

The use of ODIN access ports adjacent to the repair area…

Specialised ODIN access ports are welded on the inside of the hull through which 'cable guides' are inserted and attached to the deck launched cofferdams.

The 'cable guides' are controlled by winches operated by specialist equipment attached to the ODIN access ports from inside the hull. The operators can monitor and guide the progress of the cofferdam through a video link with the ROV which is focussed on the cofferdam until it is safely in position.

The cofferdams have highly specialised seals to cope with variations In the hull surface. The cofferdams themselves are tailor made using laser images of the hull area to be repaired. Once in position the repairs can take place from inside the hull.

Options for Deploying ROVs

ROVs can be deck launched or as an option from suitable support vessels so that POB (People on Board) can be reduced.

The latter launch method requires specialised launch and retrieve facilities and specialised skills for mooring the support vessel to avoid effects of thruster wash for example.

Remote Inspection of LNG storage tanks

LNG storage tanks also require close up inspection, be they spherical, SPB or membrane designs.

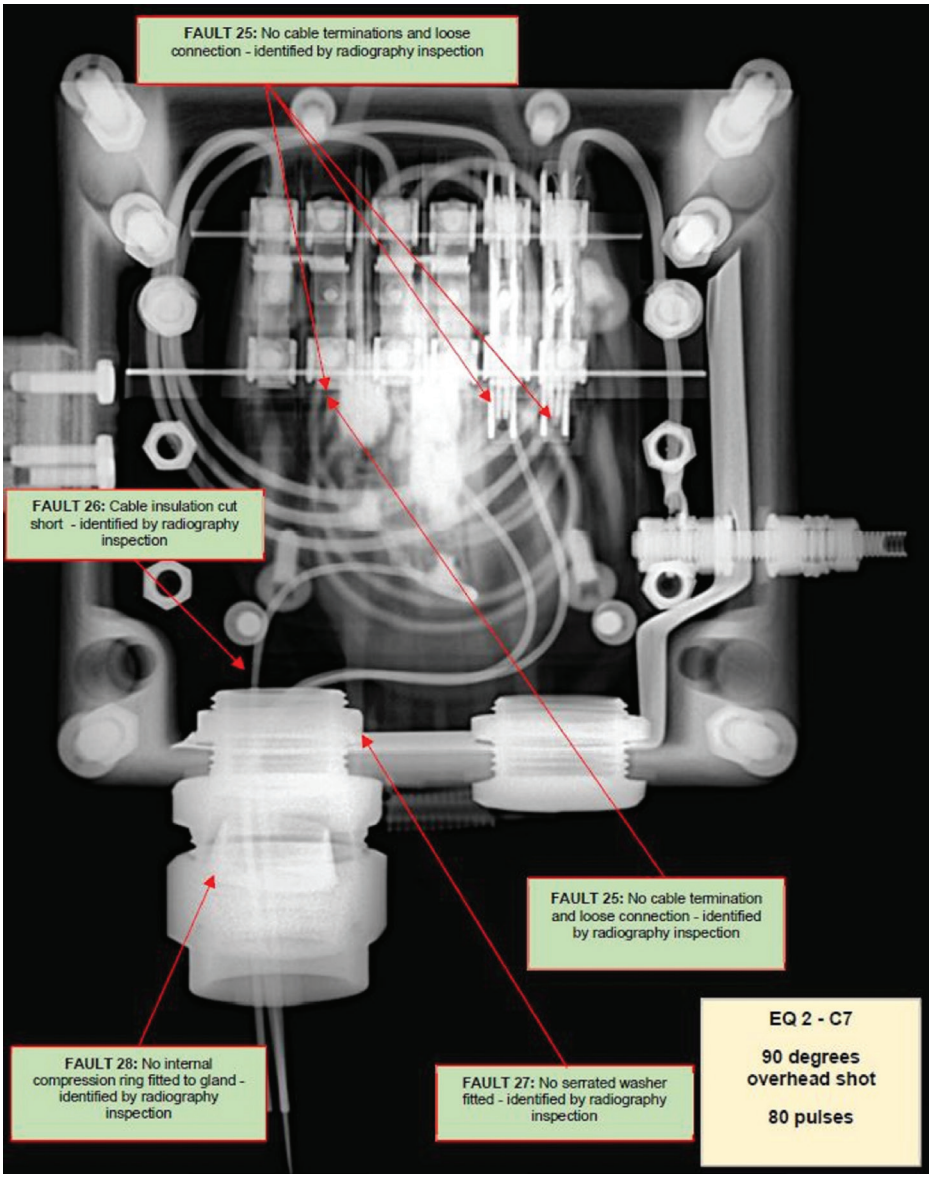
The time taken to enable human access and then bringing the tanks back into services, is considerable. New remotely operated techniques using NoMan® laser 'synchronous' scanning and remote optical scanners are now being validated by the industry, which will reduce the amount of time the tanks are unavailable for storage.

Other advanced integrity methods

Other diverless technologies include diverless ICCP (Impressed Current Cathodic Protection) systems have proved to be successful on floating assets in the North Sea, and LORIS™ systems for inspecting deep water anchor chains are planned for deployment in the next few months.

Other developments such as…

Other developments such as ANALYSE™ which is a statistical programme jointly developed with the leading London University for Science & Technology helps to safely reduce inspection workscopes based on analytical



studies of inspection data and 35 years of experience mined from hundreds of offshore assets.

And ExPert non-intrusive inspection of Ex equipment

One of the most exciting new developments is ExPert™ which is a technology borrowed from the medical profession. This allows us to 'see inside' electrical equipment without dismantling it. All the electrical items on floating assets need to be inspected regularly, and there are thousands of them. Traditional methods involve isolating systems so that electrical equipment can be dismantled, inspected, and reassembled.

This is both time consuming, expensive, and inconvenient, with anomalies sometimes introduced when reassembling the items. ExPert enables the inspection to be carried out in a fraction of the time without isolating or dismantling the electrical equipment.

All these activities can be carried out while the vessels are on station, on hire and in operation.

Robotic and remote integrity assurance methods are much less weather dependent and offer typical savings of 50% and POB reductions of 70% while allowing Operators to continue to produce or avoid unnecessary downtime.

The future is floating

The future is floating as far as economic & efficient LNG energy is concerned, as power generation can be available in a fraction of the time and cost required for land-based terminals, and do not require a sophisticated infrastructure.

FLNGs & FSRUs can be brought onstream or relocated relatively easily, can provide power to previously inaccessible locations, and are highly flexible for developing countries and remote regions.

CONCLUSION

The primary goal of replacing human interface with ROV's or alternative electronic equipment is to minimise the risk on behalf of the industry.

Even up to the very recent past, lives have been lost when the using divers offshore. Our intent is to take the knowledge in the F(P) SO world and transfer that knowledge to the FLNG world so that this work can be done more safely using ROVs and other remote inspection equipment.