THE WINDS

The offshore energy industries face significant challenges in a period of transition from fossil fuels to renewable energy. It has taken over a century to master the fossil fuel industries, but the climate change objectives agreed by most nations now demand that the change to renewables will have to be much faster if global targets for reduced carbon emissions are to be reached.

Public awareness of human safety has also, rightly, come under scrutiny, with regulators in most countries insisting on higher safety standards, including in the energy producing industries.

Extreme weather events, which many believe are caused by climate change, have also become more frequent and this has cost the countries concerned thousands of lives, billions of dollars and countless problems in trying to cope with the after-effects of fires, floods and hurricanes, etc.

Fortunately, most of the major polluting nations have signed up to the basic principles of the climate change initiative and are taking steps to meet their commitments; as climate has no borders we will all have to work together to solve this problem.

Similar problems have been faced before, such as the so-called 'hole' in the ozone layer, which was caused by greenhouse gases such as chloroflurocarbons (CFCs), typically used in refrigerators. International action, such as the

OF CHANGE

Danny Constantinis, EM&I Group, Malta, outlines the asset integrity technologies being developed and deployed by the offshore industry during the energy transition to improve safety and reduce environmental impacts.

Montreal Protocol, helped to ban the use of such gases and the problem has almost been resolved, but it has taken over 30 years so there is little likelihood of a 'quick fix'.

The effects of the COVID-19 pandemic have given a glimpse of what life could be like with lower levels of pollution and encouraged the adoption of alternative methods of transport and working.

However, the world's energy demands continue to rise, so it is clear that efficient, low-cost and, above all, clean energy is key to solving the problem.

The challenge of achieving much more efficient and environmentally low impact methods of finding, producing and burning hydrocarbons is evident to all, including the major producers which are themselves moving swiftly to change their business models towards renewable energy.

The challenge is how to manage this transition to cleaner, safer and low-cost energy in the offshore industry.

Dealing with the challenges

With the amount of technology available and the speed of further development in all areas, meeting the challenge starts with a clear definition of aims and then gathering stakeholders together to solve the problem.

JIPs – defining and encouraging solutions

Joint industry projects (JIPs) are an important part of the solution, where major stakeholders work together to solve common problems, agree on standards and encourage or fund solutions.

The EM&I Group has led a JIP on behalf of the Global FPSO Research Forum called Hull Inspection Techniques and Strategy (HITS), which has produced a number of innovations and technologies over the last eight years, including diverless inspection and maintenance (ODIN®), remote inspection of tanks (NoMan®) and reduced need for tank cleaning.

New JIPs, such as the 'FloGas' JIP for floating gas assets, e.g. FLNG, FSRU and FSRP vessels, are already underway and other JIPs are being discussed for managing the integrity of floating wind assets.

Figure 1. *ExPert scanner.*

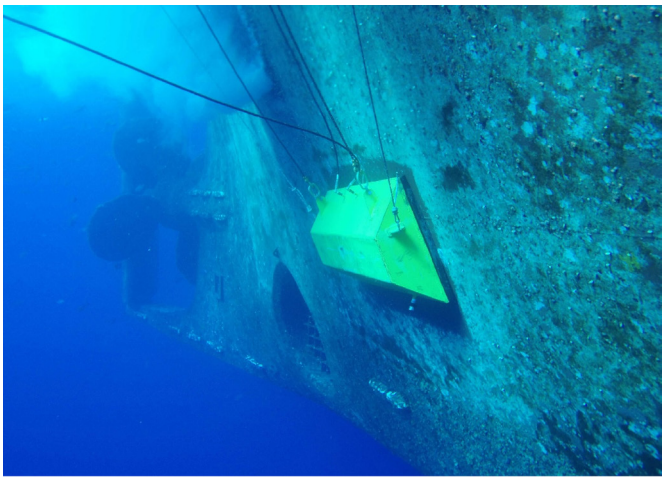

Figure 2. *Hull repair using diverless caisson.*

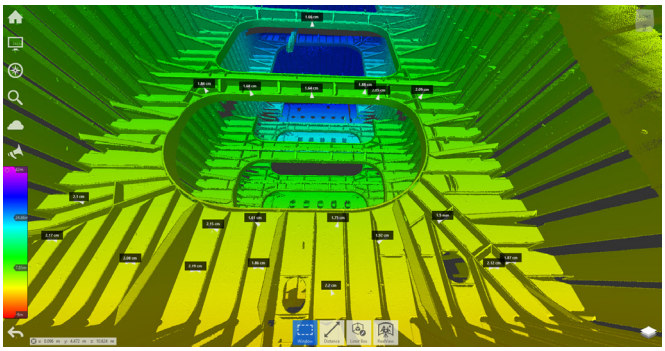

Figure 3. *Laser image of cargo oil tank.*

Improving oil

From onshore to offshore the oil industry has developed dramatically over the last century and overcome tremendous engineering challenges in both exploration and production. However, it is now largely governed by fluctuating and short-term demands for oil and returns for shareholders.

This is a difficult juggling trick for an industry that requires long-term investment decisions. Inevitably this results in a 'stop-go' industry that can move from glut to dearth quite quickly. Many experts think that 'peak oil' demand has already been reached, and that the industry will gradually stabilise and then wind down over the next 30 years or so as reliable, alternative, renewable and 'greener' sources of energy become commercially available.

Oil will still be required in the short to medium-term for transport, lubrication and chemicals but in the meantime, greener, more efficient and safer methods of operation and maintenance are required to attract investment.

Assets will increasingly be based in deep water with fewer personnel on board (POB). This objective requires remote inspection, maintenance and production technology such as diverless and unmanned tank inspection methods.

Inspection strategy will change from a means of discovering anomalies to one where remote monitoring determines and predicts fitness-for-service, and inspection is simply used to confirm the monitoring data.

Digital data offers major improvements in how asset integrity is assured. It is clear that many inspection and maintenance costs can be safely reduced by analysing data to obtain better and faster insights into plant condition.

Increased use of gas

Many see floating gas as a transition energy source from oil to renewables, and it has become a fast-developing market as it is a relatively clean, plentiful and low-cost fuel that can now be produced offshore by FLNGs.

Gas supplied to FSRUs also provides a 'quick fix' electricity supply for many isolated or emerging economies with little or no infrastructure.

Most of the integrity challenges and solutions associated with FLNGs are similar to FPSOs, although FRSUs are often moored on jetties in river estuaries and generally near population concentrations.

Lack of water clarity, strong currents, port and terminal operations and sophisticated gas containment systems pose challenges for integrity assurance, but nevertheless improved remote inspection technology will ensure that floating gas will be an important part of the energy mix for many years to come.

The future – renewables

Renewables are the future for clean, green energy, much of which will be offshore, from wind, wave or tidal energy solutions. The principal problem is 'intermittency', as these energy sources cannot guarantee 24/7 power and battery technology is not sufficiently developed to cope with peak power for more than a few hours at the most. 'Back up' power will therefore still need to be available to cope with peak demand until battery technology or other solutions can be developed. Gas-powered solutions would appear to be the obvious choice to reduce carbon emissions, with nuclear being an efficient but socially unpopular option.

Floating wind shows real promise

Wind – particularly offshore and floating wind – would appear to be one of the most promising of all the renewables. It does not take up any valuable land space or create any noise problems offshore.

Shallow water fixed bottom solutions have already been installed very successfully in many countries throughout the world.

However, the most attractive option is for floating wind turbines, which can be installed in more productive and available acreage and even relocated if required.

Floating turbines can be huge – up to 20 MW capacity currently with 100 m blades, so capable of generating considerable energy in the wind speeds available in deepwater locations.

While they are technically quite different from floating carbon-based units, many of the technologies developed for inspecting and maintaining floating assets can be adapted for the floating wind sector, noting the benefits of asset duplication and the need for lower unit costs.

The future of floating wind asset integrity may well include high levels of monitoring and resident robots where appropriate.

The many infrastructure and regulatory challenges, as well as design standardisation, will need to be addressed as the market develops and the transition from fossil fuels accelerates.

Other renewables will form part of the offshore mix

Wave energy is another promising technology that could be combined with the floating wind market. Many different solutions have been developed, from articulated 'worm-like' floating chambers – which bend in the waves to generate power – to underwater 'paddle' type structures, which move back and forwards in the motion of a wave to generate power.

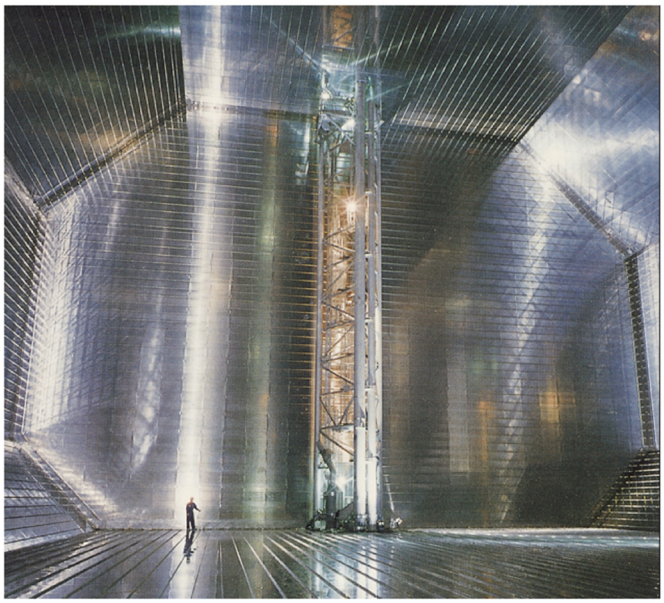

Figure 4. *LNG storage tank.*

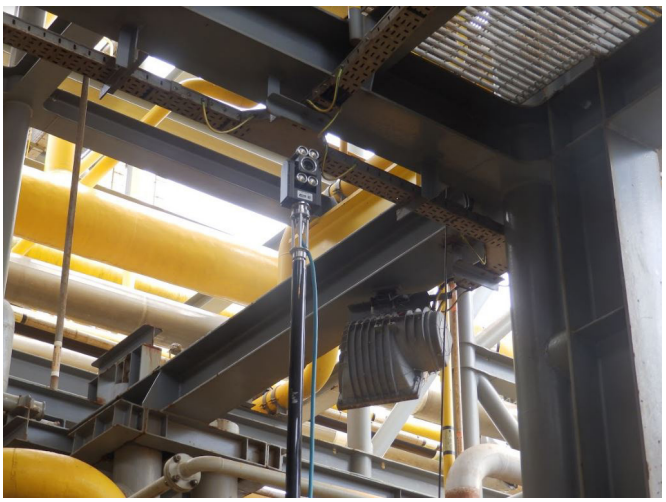

Figure 5. *NoMan camera on telescopic pole.*

Developments driven by tides and currents are moving forwards, with the potential for overcoming 'intermittency' by combining multiple energy solutions in one asset. This may well also reduce overall costs and avoid the need for multiple transmission systems.

Asset integrity challenges

A consistent challenge for all the changes described is the need to manage and assure the integrity of offshore assets.

Clearly, unmanned renewable assets will pose a lower risk to safety than heavily populated FPSO and FLNG units. However, the risk of a large floating wind turbine breaking free of its moorings and damaging other units and the subsea infrastructure is something operators, owners, insurers and regulators will want to avoid.

Asset integrity strategies and methods have advanced hugely in the last few years to become much more economic, efficient, safer and greener.

Some of these diverless, robotic and digital technologies are readily adaptable to the diverse types of asset that will be used to overcome the challenges encountered offshore in the coming years.

ODIN diverless hull and valve inspections and repairs have been used successfully on hundreds of projects throughout the world in the last few years. Cost benefits of over 50% and 70% POB have been achieved, and all these technologies can be used while the vessels are on station, on hire and in operation, reducing the need for shutdowns or out of service periods.

NoMan technology that uses remote cameras and 'synchronised' laser scanning for tank and confined space inspections is replacing manned entry, significantly reducing the safety risks associated with confined space entry and working at height. By way of example, a 90% reduction in man time was achieved on a recent North Sea project.

ExPert™ is intended for the non-intrusive and remote inspection of Ex electrical items. This technology can 'see through' electrical components and detect any anomalies without having to isolate or dismantle them. Ex equipment that normally requires rope access for close inspections can now be inspected using robotic cameras in under 50% of the time, without the risk of working at height.

ANALYSE™ optimises the inspection of pressure systems. By using a combination of both risk-based inspection (RBI) and probability theory, this has made it possible to safely reduce the number of thickness readings to establish the level of safety required. Savings of over 60% have been achieved on recent projects.

HullGuard® is used for the diverless cathodic protection of hulls and sea chests, using retractable impressed current cathodic protection (ICCP) anodes. These can be readily installed through class-approved access ports in the hull or sea chest – either in the shipyard or retrofitted at any stage during the life of the asset. They can also be retracted for inspection, cleaning or replacement whenever required.

LORIS™ has been created for the inspection and temporary repair of mooring chains and risers; the LORIS robot can swim to, attach itself and climb up and down the items to be inspected. Armed with measurement and inspection tools and robotic arms, the system can operate in much harsher conditions than free-swimming ROVs or divers.

Conclusion

The offshore industry is constantly faced with new challenges that have to be addressed if we are to survive. Fortunately, the industry is innovative and resilient and will find solutions that improve safety, environmental impact and efficiency.