A Helping Hand

Danny Constantinis, EM&I, UK,
reviews the importance of managing the integrity of offshore floating assets.

Managing the asset integrity of offshore floating assets has always been challenging. The different asset integrity requirements of marine and process equipment and the deepwater locations and long field lives of offshore floating assets have been a driver for development within the industry.

Organisations such as the FPSO Research Forum, IADC (International Association of Drilling Contractors) and HITS (Hull Inspection Techniques and Strategy) have helped define the direction for improvements in inspecting, maintaining, and repairing FPSOs, drill ships, semisubmersibles and other floating assets.

The downturn in the oil industry over the last three years has accelerated the need for major cost reductions, increased efficiency and improved safety.

The asset integrity industry has responded to the challenge by developing disruptive technologies and new ways of working to generate the significant savings and efficiencies required in a US$50/bbl world.

Figure 1. *NoMan camera.*

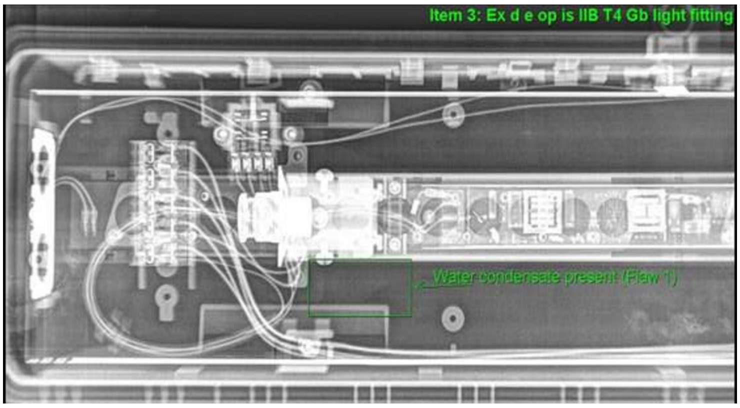

Figure 2. *Non-intrusive Ex inspection.*

Figure 3. *Camera insertion through ODIN access port.*

Industry cooperation

The FPSO Research Forum is one of the leaders with respect to new developments in floating production assets by enabling service providers, regulators and classification societies, lease operators and oil majors to work together to raise the bar through their JIPs (joint industry projects) by discussing common problems and solving them together.

One of the most successful JIPs in recent years is called HITS. The purpose of this was to define hull inspection challenges and encourage solutions such as eliminating or reducing the need to use divers or personnel working in hazardous areas, at height, or in confined spaces. HITS participants include major class societies, oil majors, lease providers, service companies and academic institutions.

The HITS JIP has defined the inspection objectives, set the performance parameters, monitored R&D progress, observed demonstrations and issued guidance to the industry on a number of new developments.

This has enabled the classification societies to accept new technologies more quickly, on a 'case by case' basis following demonstrations and studies, and this in turn has helped bring these developments to the market quickly.

Some of the technologies to come out of this JIP are the ODIN® diverless UWILD (under water inspection in lieu of drydocking), and the NoMan® remote camera technologies for tanks and pressure vessels.

The ODIN system achieves diverless UWILDs using specialised ROVs for general and close visual inspection and specialised cameras and manipulators inserted into the piping adjacent to critical valves through class approved access ports.

This enables safe, rapid, and thorough inspection of the sea valves under operating conditions, and if a valve proves to be faulty ODIN can be used to isolate the valve for replacement or repair.

Specialised mini deck-launched ROVs are used to examine the external hull, bilge keels, propellers, rudder, and inlet grills to the sea chests, etc. The mini ROVs are equipped with cavitation blaster cleaning heads to remove marine growth from the inlet grills of sea chests where required.

Mooring chain inspections are also carried out without divers and use a specially equipped mini ROV which measures the chain angle and link dimensions.

Future developments include LORIS™ which is a robotic tool that attaches itself and climbs the chain while cleaning and inspecting it, thus increasing work efficiency.

This type of UWILD strategy provides better quality data at a lower cost, with 70% fewer people on board and with improved safety.

The ODIN technology only requires a 3 - 4 man team for a much shorter period than conventional diver based methods. All the work can be carried out while the vessels are on hire, on station, and in operation. This is particularly important for DP (dynamically positioned) drill ships, as it is dangerous to use divers near thrusters.

ODIN has been used on over 20 projects throughout the world, on FPSOs, drillships, semisubmersibles and jack up rigs, without using divers or work class ROVs.

Importance of early detection of critical isolation valve condition

Early knowledge of the condition of critical isolation valves is important for giving operators sufficient time to carry out a repair or replacement. In some cases the valves are as old as the original vessel itself (usually a VLCC), and there are no spares available, so an early indication of condition allows for better planning and lower costs.

ODIN is capable of inspecting and isolating such valves without diver intervention by using inflatable bladders inserted through specialised ODIN ports.

Case study

During a recent project on a Drill Ship in Angola, 21 critical valves were inspected and three repaired using this technique, while the vessel was on hire, on station, and in operation, to the satisfaction of both the client and class society.

Impact

The NoMan remote inspection technology has made an impact on inspection of tanks and other confined spaces, as it removes the need to put personnel in hazardous situations, and reduces the man hours required for visual inspections by around 90%. The technology avoids the need to prepare the tanks for man entry or the risk associated with personnel working at height or in confined spaces.

NoMan uses an advanced camera system originally developed for use in the nuclear industry, and a further development uses a synchronous laser system to measure distortion, pitting and wall thickness. This means the system can meet the full requirements of a class tank inspection provided the tank is cleaned to normal inspection standards.

For cargo and ballast tank inspections the camera system is inserted into the tanks through deck openings and manipulated remotely to precise and pre-determined locations to achieve the required coverage agreed with the class society or regulator.

On a recent project on an FPSO in the North Sea, a two man team with a class surveyor completed four cargo tank inspections in just two days using NoMan technology. The client estimated it would have taken a five man rope access team roughly 100 man-days to have achieved the same results. Both the client and class society were pleased with the results, and the client intends to use this technology for all future tank inspections. A number of other FPSO and MODU operators are now beginning to use NoMan methods.

Ex version development

The cameras are pressurised and watertight to a depth of 50 m (164 ft) and can operate both in and out of water with an improved Ex rated version being developed that increases efficiency and reduces tank preparation time.

The NoMan technology also includes a mini ROV capability for close up inspections, ultrasonic gauging, coating measurements, and other types of NDT (non-destructive testing) in ballast tanks filled with water.

Digitisation and robotics

Digitisation and robotics are becoming the key to improved efficiency and cost reductions for the offshore asset integrity industry.

If the increasing complexity of offshore assets are considered with the thousands of structural, pressure system and electrical components and the large volume of historical and new data available, it is clear that better use of the data can be made by digital analysis.

Inspection, being a high cost Opex item, is an area where digitisation can bring significant benefits. A more efficient approach to inspection will not only meet regulatory requirements, but will also help prioritise maintenance scopes. Clearly, it is not practical to inspect every component, so an existing approach has been to use some form of RBI (risk based inspection) or priority based methodology to focus the scope and periodicity of inspections.

Figure 4. *ODIN access port to seachest and valve.*

Reducing costs

RBI is well developed for pressure systems, but less so for electrical equipment and structural inspections, although this is rapidly changing. However, even the more advanced RBI methods generally only achieve a detection rate of anomalies per inspection campaign of around 5%.

The question that should be asked is: if 95% of inspection costs are wasted, what can be done about it? Digitisation and statistics are like radar or a microscope as they create the ability to see things that would not normally be seen. This means that the target can be hit first time without much reconnaissance and be much more effective and efficient.

Clearly a step change is needed to reduce costs safely. A current project has fleet wide data for a number of FPSOs over a five year period. Traditionally most of the data is discarded because it contains no anomalies, but a new statistical analytical method, ANALYSE™

uses this data to demonstrate that future inspections can be reduced by over 50% without compromising integrity and safety.

Inspecting Ex equipment

Deciding on the optimal inspection and maintenance programmes for maximum efficiency and safety is vital when dealing with HAE (hazardous area equipment). With many of the larger offshore floating assets having over 20 000 items of HAE equipment, it is important to know what to inspect and when. Current methods are largely prescriptive, and it is difficult to meet the inspection requirement because of the large volume of components.

Inspection efficiency is improving with prioritised workscopes, suitable databases, hand held 'palmtop' computers and RFID (radio frequency identification) tags, which help to record, update, and store data.

Conventional RBI could be used to improve the process if sufficient data can be gathered to link failure mechanisms to consequences, and this task is clearly one where 'Big Data' analysis can be effective.

However, a significant part of the cost is linked to having to isolate electrical systems and strip down the components for inspection.

Advanced trials have taken place with the ExPert™ system to minimise such strip downs using imaging techniques derived from the medical sector.

Confidence is growing that there is good information out there which can be analysed to improve the RBI process for Ex equipment, and which in combination with non-intrusive methods to 'see' inside critical components such as connectors, junction boxes and switches will lead to a step change in cost and efficiency by reducing unnecessary scope and isolating systems for intrusive inspections.

A robotic solution

Robotic methods work well in combination with digitisation, but require quite significant changes in terms of how business is done. If current and future methods of inspection are compared, much more onshore engineering planning to pinpoint high risk areas and expected failure modes would be seen, derived from 'Big Data' analysis and far fewer man-days spent on the offshore assets.

The offshore team would be reduced to one or two engineers driving robotic systems using remote cameras, lasers, or other advanced detection methods, linked to an onshore support team in real time. Inspection data would be analysed, and information provided rapidly to the maintenance and operational management, which they could use to optimise integrity and operating costs.

Conclusion

Although it is currently possible to apply these methods to existing assets, there are already plans for how to design a new generation of assets that will incorporate digitised and robotic integrity systems. The digitised transformation is now being felt in the asset integrity management of oil and gas facilities around the world. Though it is not a panacea for effective asset integrity, leading global asset integrity companies are now changing their business models to harness the potential of digitisation.

In an increasingly digitised world, it is predicted that the future of asset integrity management and the associated inspections will be even more engineering led than it is at present. Nowhere is this more evident than statistically based RBI methods coupled with robotic systems, remote inspection methods, and NII (non-intrusive inspection) techniques.