Innovation: An EM&I retractable anode removes the need for diver or ROV maintenance Photo: EM&I

Getting to the bottom of hull inspection

HITS joint industry project is advancing diverless techniques to improve safety and reduce costs

Russell McCulley
London 29 Aug 2019 22:00 GMT *Updated 2 Sep 2019 07:58 GMT*

A long-running joint industry project is applying lessons from its work in floating production, storage and offloading vessel inspection and repair to the relatively new business of floating gas production.

The Hull Inspection Techniques & Strategy (HITS) JIP was set up about six years ago under the auspices of the FPSO Global Research Forum and tasked with developing new techniques to improve safety and reduce the costs surrounding FPSO integrity issues, with a special focus on the hull.

More recently the JIP, whose participants include classification societies, contractors and several major oil companies, has turned its attention to floating liquefied natural gas and floating storage and regasification units, which present some of the same inspection challenges as FPSOs but differ in some respects.

The HITS participants early on identified three main challenges for improving inspections — minimise the use of divers, keep people out of confined spaces and devise methods to inspect bottom plating without first having to clean tanks. “All of these activities were considered to be hazardous and costly,” says Danny Constantinis, executive chairman of EM&I, the asset integrity management company that leads the HITS project.

Six years on, the JIP has racked up some successes, aided by collaborations with other industries.

To address the diverless inspection challenge, investigators looked to the gas industry, where regular inspections and maintenance are carried out on pipes and valves “while they’re active and under pressure”, Constantinis says.

Critical valves

EM&I developed a system that uses cameras to monitor critical valves in FPSO hulls while in operation and devised a method for removing marine growth on valves and inlet grating without damaging the paint by equipping mid-size remotely operated vehicles with specially adapted cavitation blasters.

“So, we can clean the hull, visually inspect it, take thickness readings and look at valves without divers,” he says.

The company drew inspiration from forestry to develop a robotic device that can grab onto mooring chains for inspections at the points where diver and ROV inspections are difficult, and where damage is most likely to occur — near the surface, where there can be a lot of turbulence, and at the seabed, where chains wear rapidly and mud can interfere with the view.

The HITS team has also made good progress on the unmanned tank inspection challenge, Constantinis says.

Traditional inspections require tanks to be emptied, cleaned and free of gas before inspectors can enter.

Rescue systems must be in place and safety personnel need to be stationed outside the tank during inspection.

The JIP encouraged the development of a system that uses high-performance cameras mounted on a robotic “arm” that can be deployed and operated from outside the tank, he says, adding that this remote inspection technique used on a North Sea FPSO demonstrated that a class-approved survey that would normally take 16 days could be done in a single afternoon without putting a person inside the tank.

The inspection system also uses remotely operated synchronised lasers to create a 3D image and measure the thickness of the steel so that problem areas can be identified. But the large volume of data offers other potential benefits, he says.

“We knew that using synchronous lasers would allow us to assess the thickness of the plating. It did, which was good, but it opened another question — what else can we do with all this data?

“We believe we can take these clouds of information and feed them directly into a finite element model,” Constantinis says.

"That means we can calculate the strength of any component, and of the total tank, very accurately and very quickly, without going through this retrograde step of trying to measure thickness," he adds. "So that’s where we are now — we are able to inspect a tank visually and with lasers and meet the complete requirements of assurance.

"But we can also use that data to work out the structural strength and feed it into a digital twin. We kind of leapfrogged into an area we weren’t quite expecting.”

At its next meeting, in October, the HITS JIP — one of 16 projects under the FPSO Research Forum umbrella — will move ahead with plans to address the bottom-plate inspection initiative.

“The funding is in place and we expect by 2020 to have completed the first phase of that work, which entails finding non-destructive testing methods that work under different degrees of residue,” he says.

Robot

The second phase will involve construction of a robot that can be deployed from outside the tank.

Constantinis describes the design as “two sliding surfaces with pneumatic retractable legs — kind of a walker-slider”.

He adds: “We are fairly confident that by the end of 2021 we will have found the non-destructive testing method and a robotic means of deploying it, maybe combining novel inspection methods with the required degree of ‘robotic’ cleaning.” Normally, it can take up to six months to clean tanks to a level appropriate for bottom-plate inspection — “a very laborious, dangerous and environmentally risky job”, he says.

An FPSO Forum meeting in Singapore this past April focused on floating gas and could result in another JIP with its first meeting planned in Houston this October.

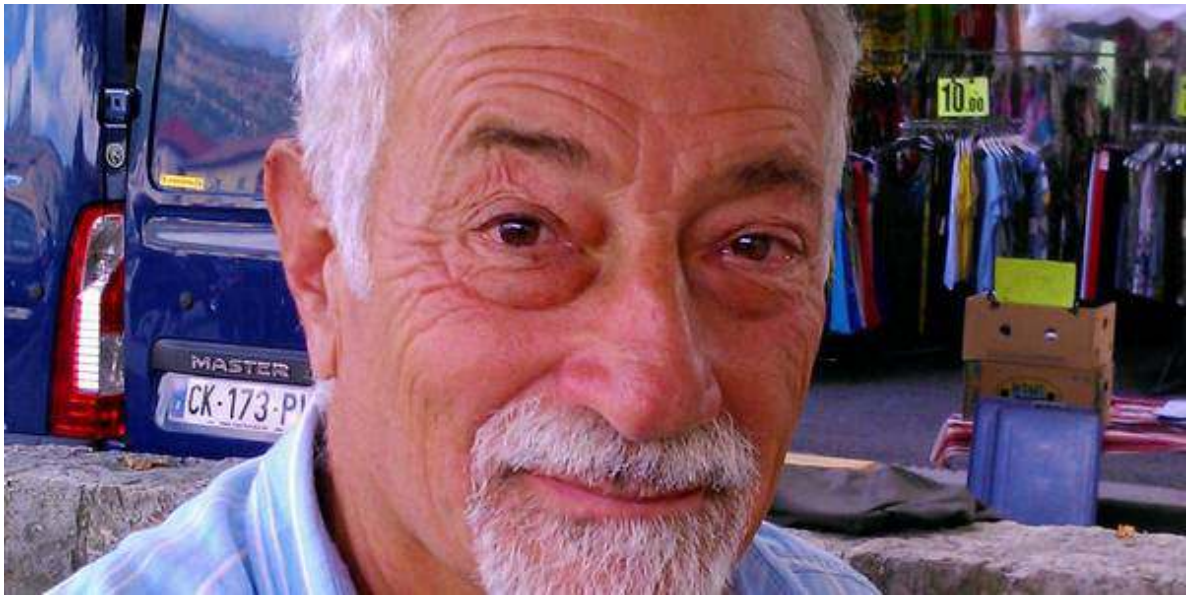
FSRU vessels are installed so close to shore that even a small spill can be a major problem, Constantinis says.

The hull must be cleaned frequently to prevent decaying marine growth from washing up on the shore, and if the unit is moored to a jetty, the integrity and behaviour of the entire system must be considered.

“There are so many similarities between FPSOs and FLNG and FSRU vessels that lessons learnt from one sector can be used to help improve the efficiency and safety of asset integrity management for all floating vessels,” he says.

“But we need to keep an open mind and identify specific floating gas challenges and their solutions.”

Grip: inspired, by the forestry sector, the 'LORIS' is used for inspecting mooring chains Photo: EM&I



Focus: EM&I executive chairman Danny Constantinis Photo: EM&I

Major assets: Hoegh LNG's Independence FSRU receives a cooldown cargo from Golar Sea
Photo: HOEGH LNG