

Mooring system integrity a hot button question



Shaker: mooring socket failures add to shackle woes Photo: MMS

THE DOZEN or so mooring system failures that have occurred around the world over the last year or two are starting to change the view from head office about this Cinderella sector of the floating production business.

A particularly high-profile event was the failure of forged shackles at Malaysia's Kikeh project.

That in turn pointed the spotlight on the identical product about to be used on the Gulf of Mexico Tahiti field.

It triggered a re-appraisal there that is delaying the project by one year, along with a general safety alert issued by the US Minerals Management Service.

In the North Sea region, industry group Oil and Gas UK has had a set of risk-based mooring guidelines out for comment in recent weeks and these are due to be issued later this month.

Highlighting the growing concerns about the integrity of mooring systems, UK designer and manufacturer First Subsea this week launched a two-year investigation into the integrity of forged steel shackles and other assemblies for such systems.

This will be the industry's first such project and it is being undertaken in collaboration with the UK University of Sheffield's Institute for Microstructural and Mechanical Process Engineering (Impetus).

The institute boasts world-class experimental facilities for hot deformation of metals.

As a supplier of subsea connection systems, First Subsea developed the ball and taper-based mooring technology known as Ballgrab.

This has now been used in

Series of failures sparks industry investigation into materials and current manufacturing processes

TECHTALK

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more than 200 subsea mooring installations around the world.

Ballgrab projects include BP's Mad Dog spar, other spars for Kerr McGee and Murphy, West African FPSOs for Total, and mobile drilling units in numerous drilling programmes.

The product is available in sizes up to 2500 tonnes minimum breaking load.

The objective of the research project is fully to understand what happens during the forging process and so to better characterise the micro-structure of forged metals.

Ultimately, First Subsea expects the project will produce a standard that can be used when specifying its mooring connection systems.

General manager Brian Green said: "This project will ensure our mooring systems continue to set the benchmark for engineering integrity."

Bradley Wynne, project leader at Impetus, commented: "Although forging is widely used, there is little academic research in this area.

"So this is a significant opportunity to review the entire forging process and identify those critical variables that influence large-scale forging operations. At

the end of the project First Subsea will lead the industry in such knowledge."

Concerns about the engineering integrity of forged metals and their implications for shackles, triplates, cable sockets and H-links were highlighted this January by the US Minerals Management Service.

The regulator issued a safety alert entitled 'Catastrophic failures in mooring systems possibly put floating structures at risk'.

The alert followed two separate incidents: the failure of a forged mooring shackle at Kikeh, with its implications for the US Tahiti platform, and the failure of a mooring system for a mobile drilling unit in the Gulf of Mexico.

At Kikeh, an eight-inch shackle weighing one tonne and sited at a seabed anchor pile failed.

Subsequently, during testing, an identical shackle scheduled to be used in the US Tahiti project also failed catastrophically under loads below its specification.

Operator reviews of the manufacturing and testing procedures and additional tests indicated that all of the shackles were possibly defective, said the MMS alert. This has caused an upset to the Tahiti project that will delay production start-up by at least a year.

In the second incident cited by the MMS, two sockets in a mooring array for a deep-water drilling rig failed under moderate loading. Testing of the remaining



Back to basics: new research project aims to gain better understanding of the integrity of mooring components formed by the hot deformation of steel that is the forging process Photos: FIRST SUBSEA

sockets found that others were also defective and a number of them failed catastrophically at less than specification loading.

Among their conclusions, the MMS and the US Coastguard noted: "In both cases the manufacturing procedures are thought to have been defective. Heat treating after casting apparently resulted in a metal unable to meet standards for material toughness."

Additionally: "In both cases the operator's material testing requirements were either not followed or were not adequate to

ensure specifications were met. Material handling during transportation and installation may have exposed the equipment to potential critical damage."

The MMS recommended that operators review their specifications and testing requirements, and ensure their test coupons are properly representative.

Perdido job first outing for Scanrope 'ruler': Page 20

Welaptega Marine offering allows for rope health check

MOORINGS integrity specialist Welaptega Marine, based in Nova Scotia, was this week granted the status of 'approved supplier' of systems for in-service inspection of mooring systems by DNV.

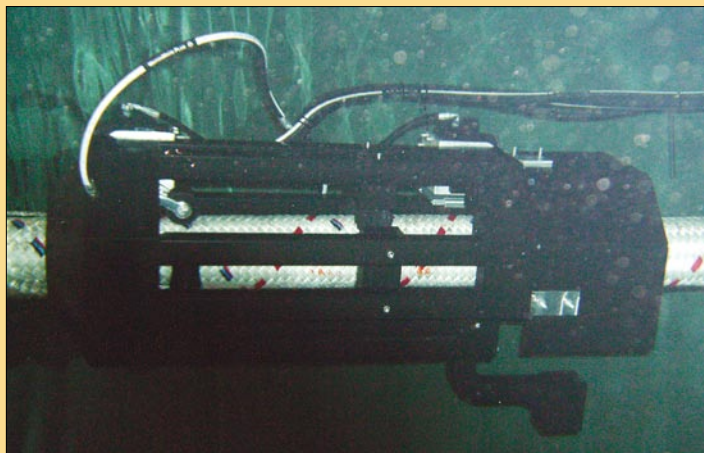
"This will be added to the type approval that we received from Lloyd's late last year," said Alastair Trower, the company's European-based business development director.

"We are the only company to have received these approvals."

Welaptega describes itself as "world leader in underwater moorings integrity verification solutions for the offshore oil and gas sector".

Services include mooring inspection systems deployed by remotely operated vehicles for floating production installations. The company's name is Mi'kmaq for 'eagle eye'.

Also, said Trower: "Based



Inspection system: the sled is towed by an ROV, cleaning line as it goes and recording dimensions to check for any signs of potential deterioration

Photo/Graphic: WELAPTEGA

on industry demand we have designed and now trialed a rope measurement tool specifically for permanently moored floating

production units. This is mostly geared towards deep-water West African and Gulf of Mexico assets, driven by the current requirement

to remove and break-test sacrificial sections of rope."

Two months ago Welaptega successfully completed a full tank trial of its prototype rope measurement system (RMS) in Dartmouth, Nova Scotia.

"The system performed exactly as we hoped, and we are now confident that it is ready for offshore deployment," said Tony Hall, managing director, based in Halifax.

The system assesses the condition of fibre or wire rope moorings while they are in-service, still in the water. It centres on a frame equipped with a hydraulic sled and fixed cameras that is deployed onto the mooring line by an ROV.

There, a hydraulic sled encircles the rope and clasps shut.

As the frame is towed along the rope by the ROV, the sled removes marine growth using

a combination of mechanical plough, high-pressure water jetting and an annulus of brushes.

At the same time, rope dimensions are recorded and compared with manufacturer's specifications to identify any changes in cross-section.

The video signal is transmitted to a topside computer suite where algorithms measure the rope at approximately 50 millimetre increments. These measurements are indicators of potential deterioration, which can increase the risk of failure in a mooring system.

"At the moment, operators are limited to time-consuming and expensive visual inspections," said Hall. "The RMS gives them the opportunity to measure and monitor rope mooring lines without removing them from the water, reducing downtime and risk."