All aboard FPSO safety

Floating production storage and offloading (FPSO) units and other offshore assets require critical firewater to be readily available at a moment’s notice – but how to ensure fire systems and piping are not adversely affected by the challenging environments they are expected to work in? Jose Sanchez de Muniain looks at the latest in fire water protection solutions as well as more established systems.

Flexible piping for critical firewater

The Elastopipe project began in 1996 as a collaboration between Swedish company Trelleborg and a number of industry stakeholders (Conoco-Phillips, Norsk Hydro, BP Amoco, Statoil amongst others) and Royal Norwegian Navy Material Command.

These stakeholders had noted the launch in 1990 of a jet-fire resistant rubber compound by Trelleborg, Hans-Leo Hals, Elastopipe Group Product Manager, explains more: “They wanted to see a non-corrosive system that could also withstand both high impact and jet fires. They already knew we had Firestop (technology providing blast-proof, passive fire protection of structures and equipment), so the question was, could it be used to coat existing materials, or could we develop a new type of solution?” The answer was a resounding yes, and since its commercialisation in 1998, Elastopipe systems have been installed in six offshore locations for companies that include BP Amoco, Statoil and Conoco-Phillips.

So what makes Elastopipe special? Three layers make up the non-corrosive, rubber-like Elastopipe – an outer fire shield, middle pressure liner, and inner layer. The outer layer provides the jet-fire resistance, and it can resist a heat flux of 390kW/m², as well as temperatures above 1,350°C and flame speeds above the speed of sound, for an impressive one hour, with no water in the pipe for the first five minutes.

It also has a high impact resistance, and when struck it behaves similarly to a car tyre – first it bends and then it goes back to its original shape. “That means that even after impact it will transport the liquid inside it,” explains Hals. In fact, the system can maintain burst pressure following a collision force of up to 800 J. It can also tolerate an explosive overpressure pulse of 1.5 bar and 200 ms duration. But perhaps what makes this solution unique in the market is its corrosion-free properties. Hals points out that in some areas of the world traditional water deluge systems incorporating stainless steel pipes can suffer significant degradation in as little as two years – which can result in expensive refurbishment or even replacement programmes. “In Australia for example you have high temperature and humidity, so all the ingredients for corrosion are there. In other areas marine growth can close up nozzles within months.” In locations such as these, high levels of maintenance and repair not only add significant costs, but also – importantly – they can interrupt production. “Traditional steel piping requires hot-work on site which naturally has an impact on normal operations” This isn’t the case with Elastopipe, which requires no hot-work and – in the case of a refurbishment – little if any disruption.

The maintenance-free side of the Elastopipe system is important not only in the context of traditional piping for critical water, but also in the context of the latest generation of oil and gas exploration. The expected lifetime of offshore assets used to be in the region of 20 years – no longer, points out Hals. “New technology is allowing operators to dig deeper and we are finding in the oil industry that the lifetime of assets is increasing to 30 years – in some regions there is demand for 40 years. We are now currently working on a lifetime version of 40 years.”

Elastopipe FOR (fire and oil resistant) is the latest version of the Elastopipe family. As its name suggests, as well as being jet-fire resistant, the new version of the synthetic rubber-based flexible piping system can transport organic materials without degrading. The latest development incorporates a polymer-based lining material with high resistance against degradation by hydrocarbons (lifetime of 50 years). Offering weight advantages over conventional steel the Elastopipe FOR is suitable for H2S ventilation lines, produced water (water mixed with oil), open and closed drains, and waste lines.

Ceramic protection

Family-owned Norwegian company Favuseal AS has been supplying glass-reinforced epoxy (GRE) piping protection since the invention of the Favuseal Fire Barrier System (FFBS) in 1988.

Favuseal is a thermoplastic compound with extraordinary properties when subjected to high temperatures. It consists of mineral fillers inside a thermoplastic “matrix” which is wrapped around the relevant piping. When subjected to high temperatures FFBS goes through two phases. Firstly, in the temperature range 200-250 °C, it generates crystal water during an endothermic (heat absorbing) reaction which prevents the temperature rising further until the complete release of H₂O. During the second phase – which occurs between 700-800°C – the minerals in the fillers oxidise and form a cellular ceramic material that is glass-like and has very low thermal conductivity (0.07 W/m°K). The ceramic material is physically stable in temperatures of up to 1,500 °C, and will provide 15 minutes of protection with a 5mm layer of Favuseal, and 30 minutes with 10mm during a violent jetfire – and this is with dry pipes as opposed to water-filled pipes.
Erik Schlytte-Henrichsen of Favuseal explains that FFBS is often used to protect the steel and GRE piping in water deluge systems: "You cannot have a fire protection system containing water due to the risk of corrosion/contamination and subsequent risk of non-functioning nozzles due to corrosion and foreign contamination. So the challenge is to keep the pipes' temperature low enough until the water arrives. So Favuseal buys the system time enough to do its job." One of the main benefits of Favuseal is that no hazardous emissions are created when the system is active: "This makes it possible for responders to tackle the fire with no risk of inhaling toxic gases," explains Erik.

Today the company has installations in South Korea (offshore and onshore), Middle East, the Netherlands (oil and gas GRE pipes onshore), Denmark, Norway (cooling systems and firefighting waterpipes), and a major cable manufacturer is using Favuseal to protect cables in the North Sea and all over the world.

Traditional solutions

Allan Beeston is Global Manager (Fire Protection) for Morgan Thermal Ceramics' (previously Thermal Ceramics) range of FireMaster products. Thermal Ceramics, headquartered near Liverpool in the UK, is part of the Morgan Crucible group.

The FireMaster fire insulation solution was especially formulated in the 80s as a lightweight solution against hydrocarbon and jet fires, and today it is used in various process and fire protection solutions both onshore and offshore. Key offshore references for fire pipe protection include Conoco Sanah, Sevan Marine No4, Sevan Marine 300 No5, Ningaloo Vision, and Marathon Alvheim.

FireMaster is a non-combustible flexible matt manufactured from low biopersistence alkaline earth silicate fibres exonerated from classification as a carcinogenic material under EU health regulations.

In August 2008, FPSO Sevan Hummingbird became the first cylindrical FPSO to be installed in the North Sea. FPSO owner Sevan Marine decided to install Elastopipe for a number of reasons – not least of which was the material's corrosion-free properties. While the original specification for steel piping calls for system tests every three months, Elastopipe's properties mean that testing is only required every 24 months – and this only due to the limiting factor of peripheral materials.

The fact that no welding or metal cutting is required for Elastopipe installation meant that no disruptions due to hot work were necessary for the rest of the FPSO Sevan Hummingbird's installers. Elastopipe is also experiencing increased take up for major refurbishments of existing stainless steel fire deluge systems. One such replacement occurred between 2005-2006 on Statoil Hydro’s Oseberg, which was experiencing corroding welds and pressure leaks. A specifically designed system was completed by Trelleborg with Aibel Engineering, comprising of 13,000 metres of Elastopipe, which was installed in a straight one-to-one replacement. Again, no welding or metal cutting was required.

Hans-Leo Hals of Trelleborg says that with the exception of the Gulf of Mexico, Elastopipe now has a worldwide presence – not yet the standard of choice on offshore locations but, says Hals, certainly a material of choice. "It has been time-consuming to certify this type of product because it is not a standard material, such as steel. However, we have received approval for Elastopipe installations on a case-by-case basis and hope that it will become a standard material."
The Favuseal Fire Barrier System has been used to protect fibre reinforced epoxy (as above) and steel piping since 1988.

For man-made fibres, its fire protection properties are impressive and fire tests, explains Allan, have proven performance of the FireMaster 607 for up to four hours in hydrocarbon fires and one hour in jet fires. “It is a common solution for FPSO units where basically process equipment is fire proofed using some kind of jacketing system – usually a flexible jacket. Commonly there are many suppliers with different jacketing designs but with a FireMaster core” What makes it popular is that as a dry, passive material it can be easily installed and removed, depending on the jacketing system used, with no welding required.

With the FireMaster providing the thermal protection, the main consideration revolves around weather protection and how well the system is maintained. “In Norway for example there is a standard approach which consists of a combination of materials that is slightly different to the norm. NORSOK standards (formed by the Norwegian petroleum industry with support from the Norwegian Oil Industry Association) stipulates foamglass on the pipes, with a layer of FireMaster, and then on top stainless steel cladding. This makes the system weather-proof, while the foamglass as a closed cell material doesn’t allow water to get through to the pipe.”

There is currently no clear winner as regards jacketing technologies vs steel cladding, even with the NORSOK (Norwegian petroleum industry association) preference for steel cladding. “Flexible jackets were all the rage 10 years ago, but even with the Norwegian approach in the last few projects I’ve seen our clients have used flexible jackets, so it isn’t easy to say.” As for the future, Allan is unsure that there will be any revolutionary developments in passive fire protection in this field. Thinner solutions with better performance, perhaps, but jet fires require a robust approach: “There is nanotechnology floating around out there, and we’ve seen it for jacketing system – usually a flexible jacket. Commonly there are many suppliers with different jacketing designs but with a FireMaster core” What makes it popular is that as a dry, passive material it can be easily installed and removed, depending on the jacketing system used, with no welding required.

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