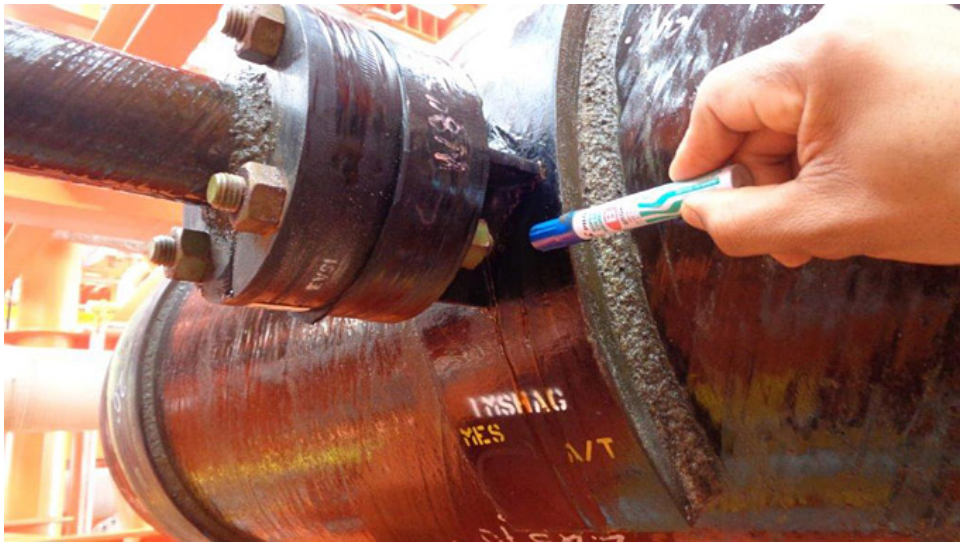
ENERGY NORTHERN PERSPECTIVE

Composite restores FPSO integrity



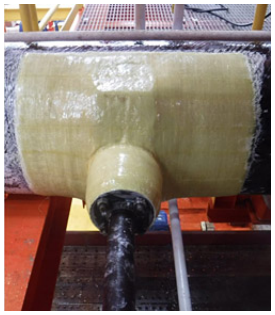
A leak is detected on a joint between a 508-mm (20-inch) and 51-mm (2-inch) GRE branch line (photos courtesy of ClockSpring|NRI)

By Sean Connolly, ClockSpring|NRI

It is not unusual for Floating Production Storage and Offloading (FPSO) vessels to be on site producing oil for decades. More and more, these assets are remaining active beyond the original design life, and as the units age, processing systems and components begin to wear. Because taking FPSOs to dry dock for repairs is costly and impractical, maintenance is carried out offshore whenever possible. While this appears to be a simple matter, it is a complex undertaking that introduces logistics challenges and often is impacted by sea state and weather conditions. In addition, if repairs are made using traditional methods, production must be shut in while the work is being done, which compounds the cost of the repair.

Technicians used a proprietary composite injection system to arrest the live leaks and Syntho-Poxy™ 101 to improve the complex geometry of the lines

Although composite materials have been used to repair offshore assets for many years, they are not always the first solution considered when damage is discovered on a drilling or production rig, but composite technologies are changing the way repairs are carried out offshore. They have been used for years in a broad range of applications, including structural repairs to risers, caisson leak repairs, and for life extension work on large components that have experienced corrosion and environmental damage. Adoption of this technology in the oil and gas industry has not been rapid, but composites are gaining ground as an alternative that can compete directly with traditional repair techniques to extend the service life of these critical assets.



Once the leak was sealed, ClockSpring|NRI technicians applied 10 layers of Thermo-Wrap™ Inspectable ECR to the 51-mm (2-inch) branch

When an operator discovered leaks on several live glass reinforced epoxy (GRE) cooling water lines on an FPSO offshore Angola, decisions were made to take immediate steps to mitigate the damage. Stress and internal erosion had led to cracks and through wall defects in several places, including a joint. A repair solution was needed that would arrest the leaks and restore the line integrity for continued safe service.

A traditional solution was not a good option because it would have required multiple areas on the line to be cut and replaced. Since that repair approach could not be carried out without shutting in production, the owner began looking for an alternative. Recognizing that a composite solution might be a better choice, the next step was to contact ClockSpring|NRI with a request to assess the situation and determine if a composite product could address the damage. Experts formulated an engineered composite repair (ECR) that would be able to restore the vessel to safe operations without halting production.

When engineers are designing a composite, they focus on three characteristics:

- Fiber type: glass, carbon, or aramid (strong, heat-resistant synthetic fibers frequently used in aerospace and military applications).
- Fiber form (typically roving, tow, mat, or woven fabric).
- Fiber orientation or architecture (Reinforcement can be oriented in any direction the designer desires. The most common structural elements are designed with greater strength in the direction subjected to the greatest load).

For a composite to be effective in an offshore environment, it must be designed to ensure its mechanical properties can provide the necessary strength to restore damaged components to their original design specifications. When installed, the composite must deliver performance that is the same as or better than a traditional repair in terms of safety, longevity, and economics.

With the Thermo-Wrap™ Inspectable ECR installed on the joint between the 508-mm (20-inch) and 51-mm (2-inch) GRE lines, technicians covered the repair with 2 layers of UV-stable epoxy to protect the repair from future corrosion and abrasion

Putting composites to work

Engineers from the ClockSpring|NRI office in Manchester examined the multiple GRE leaks on the FPSO, including one under a bolted flange on a 355-mm (14-inch) line and another on a joint between a 508-mm (20-inch) line and a 51-mm (2-inch) line. Taking into account the complex geometry, the team evaluated the products available and determined that the best approach would be to use its composite injection leak arrest system to seal the live leaks and then apply a Thermo-Wrap™ Inspectable ECR to reinforce the line and ensure continued service.

Two ClockSpring|NRI technicians mobilized to carry out the repair and reinforce both repair areas using Thermo-Wrap™ Inspectable, a custom-engineered system that uses a high modulus fiberglass architecture in conjunction with a patented epoxy system. Its thick, non-crimped, glass fiber architecture and nano-tube-enriched resin combine to yield high strength characteristics. This ECR is designed for high-temperature environments and contains a contrasting agent that enables the repair to be monitored using common radiographic inspection methods to "see" the composite repair as well as the pipe wall.

With the leak sealed, technicians applied 8 layers of the Thermo-Wrap™ Inspectable ECR to the 355-mm (14-inch) line

The first step in the repair process was to use a proprietary composite injection system to arrest the live leaks and Syntho-Poxy™ 101 to improve the complex geometry of the lines. With this step completed, technicians applied eight layers of the Thermo-Wrap™ Inspectable system on the 355-mm (14-inch) line and 10 layers on the 51-mm (2-inch) branch. Within 8 hours, the repairs were fully cured, and the lines were safe for continued service.

This advanced ECR allowed multiple damaged GRE lines with difficult geometry to be restored to safe operations without interrupting production and with little disruption to day-to-day operations. The final repair will enable monitoring for the duration of FPSO operations.

In the final step of the 355-mm (14-inch) line repair, technicians applied 2 layers of UV stable epoxy to protect the repair from future corrosion and abrasion

Sean Connolly, Managing Director, ClockSpring|NRI, Europe

ClockSpring|NRI simplifies asset stewardship and helps drive global economies by providing safe, sustainable solutions as well as associated engineering support and training services for construction, maintenance and emergency repair of critical infrastructure, including oil, gas, product, and water pipelines, natural gas distribution lines, and high-consequence industrial pipework. ClockSpring|NRI composite pipe repair systems and inline insertion valves are in use in more than 75 countries and include industry-leading products such as Clock Spring™, Syntho-Glass® XT, Scar-Guard®, Contour, and DiamondWrap® composite products, as well as the award-winning AVT EZ Valve™ for water lines and the recently introduced Full Metal Gasket™, designed with the Pipeotech proprietary DeltaV-Seal™, for emission-free sealing of flange locations. All ClockSpring|NRI products are easy to install, cost-effective to deploy, and durable for decades. For more information, please visit www.cs-nri.com.