



SAFEGUARDING DEEPWATER PROJECTS

Kartik Ramachandran, Upstream Segment Manager at ExxonMobil Proxima™ systems, shares how advanced technologies can help safeguard deepwater oil and gas projects.

Deepwater oil and gas developments demand the highest level of attention to engineering detail and leave no room for error. As water depths increase, operators must contend with crushing hydrostatic pressures, extreme temperatures and corrosive subsea environments that can compromise flow assurance and infrastructure integrity over a project's lifespan. For these developments, which involve billions of dollars in infrastructure investment, insulation system performance plays a critical role in ensuring reliability, preventing expensive flow disruptions and reducing lifecycle costs.

Deepwater projects must prioritise the insulation of the flowlines transporting hydrocarbons from the production wells to the receiving facility. If insulation materials fail to perform as intended, hydrates and wax buildup will gradually restrict flow, plug subsea infrastructure, and curtail production, while eroding economic returns to the asset owner. With operators facing such a high-stakes choice, the selection of materials of this insulation can have a significant impact on production over the asset lifecycle.

When insulation performance declines over time, the resulting flow assurance issues can take anywhere from days

to months to resolve. If left unresolved, they can impact the production operations and deliverability which creates a cascading effect across the broader subsea infrastructure. On a project with a daily average volume of 200 000 bbls, a prolonged disruption could result in losses exceeding US\$13 million/d, assuming an average oil price of US\$65/bbl.

Traditional subsea insulation materials like silicone and polypropylene can struggle to maintain consistent thermal conductivity over the design life of the subsea asset – which is vital to protecting subsea architecture systems over the lifecycle of the field.

When insulation failure becomes costly

To maintain operations and withstand harsh deepwater environments, subsea infrastructure must have the right level of protection for the long term, requiring an insulation barrier that delivers:

- ▶ High resiliency against deepwater temperatures and pressures.
- ▶ Robust hydrophobic properties, maintaining thermal insulation over the asset lifecycle.
- ▶ Anti-corrosion capabilities.
- ▶ Enhanced thermal management capability.

Certain thermoset resin-based solutions, as compared to typical solutions based on silicone and polypropylene, provide the right balance of strength and toughness, are highly resistant to temperature and pressure, have few depth limitations and are extremely hydrophobic – helping prevent water uptake that can reduce insulation effectiveness.

As pipelines extend into greater depths, advanced materials become increasingly important. Traditionally, different components of subsea equipment have employed different insulation systems, which can cause inconsistencies in thermal conductivity across the flow path, in addition to application complexities. Multi-layer insulation systems can add further complexity because each layer must work together. Additionally, some traditional multi-layer synthetic insulation systems rely on micro glass spheres that can be crushed (during application or installation), adversely impacting thermal characteristics over time.

Given the need for thermal consistency and robustness over longer periods of time, a single-layer thermoset solution can help reduce those variables while also supporting easier installation, shorter pipe fabrication time and more consistent performance over a project's lifecycle, which can span decades.



Figure 1. Onsite molded pipe ready for deepwater installation.



Figure 2. An ExxonMobil deepwater oil and gas facility.

The subsea insulation challenge off the coast of Guyana

With an initial projected daily volume of 250 000 bbls of condensate and 1.2 billion ft³ of gas, ExxonMobil's proposed Longtail development off the coast of Guyana illustrates the critical role reliable subsea insulation systems can play in deepwater environments. If sanctioned, the Longtail development will include 76 km of subsea production flowlines, risers, and jumpers.

To meet the anticipated demands of such a significant offshore development, ExxonMobil selected the company's Proxxima™ resin systems with Goldilocks™ (GDLX) technology by ODYSEA. The solution's unique molding process allows more efficient application, packaging, and shipping of coated pipe to the project site, which would help shorten pipe coating and installation timelines and streamline the supply chain process. A high-performing, versatile, cross-linked thermoset polyolefin, Proxxima technology combines a liquid resin with a catalyst suspension to provide unparalleled benefits.

Additionally, Proxxima solutions provide increased resiliency through improved extreme temperature performance (up to 180°C), active hydrophobic properties, and unique and enhanced thermal property set (K-value, specific heat capacity, and density), which result in longer cool-down times compared to traditional methods. This potentially minimises the risk of costly flow disruptions and reduces

downtime costs, which can translate directly to substantial operational savings over a project's lifecycle.

With subsea insulation applications spanning the Guyana Hammerhead and Longtail development, Appomattox in offshore Louisiana and Usan infield project offshore Nigeria, Proxxima resin systems are resilient in some of the most challenging deepwater environments.

The science behind the resins

Resins work well in deepwater environments because of their durability and ability to maintain their thermal characteristics for long periods of time. These solutions are driven by four distinct technical advantages:

- ▶ Extend cooldown time (up to 25%) to maintain uptime: compared to traditional multi-layer materials, Proxxima resin systems can create value by reducing dead oil circulation events, avoid deferred production from flow assurance downtime, and increase operational flexibility following unplanned outages.
- ▶ Cost savings with onsite application: instead of relying on costly, rigid extrusion methods that require significant manufacturing footprints and largely fixed locations, Proxxima resin systems with GDLX technology can be co-located at pipe mills or shorebases to streamline logistics and reduce transportation requirements.
- ▶ Reduced application time: as most offshore projects have hundreds to thousands of field joints that need thermal protection, application for these components can take significantly longer time. Proxxima resin systems deliver a 50% reduction in application time, with a chemistry that allows for compatibility with existing insulation types to ensure fast and secure joint closures.
- ▶ Industry-standard operational excellence: in the energy sector, claims must be backed by rigorous, standardised proof. Proxxima resin systems meet the established industry standard for thermal insulation systems, ISO 12736.

A new material for new subsea challenges

Subsea assets require significant investment, from initial deployment to ongoing maintenance, unplanned downtime and interventions. With offshore oil and gas operators facing increased demands to deliver more efficient and cost-effective operations, traditional materials must be re-examined and pressure tested for the next generation of deepwater projects.

A further thought: what if the industry shifted from mitigating failure mechanisms to prevent them at their source?

Envision a scenario where longer tiebacks can integrate into the receiving facility, while also extending maintenance intervals. As these projects increasingly require materials that balance absolute resilience with operational efficiency, Proxxima subsea insulation technology makes it possible. The Longtail development demonstrates how the addition of high-performance resin materials can advance deepwater projects. By adopting Proxxima solutions for subsea flowline insulation, operators are doing more than simply protecting subsea assets – they're future-proofing their bottom line and setting a new standard for offshore performance.

Proxxima resin systems also deliver fast-curing, anti-corrosive solutions that reduce costs and prolong asset life in the coatings, infrastructure and mobility industries.

The adoption of Proxxima resin systems is a significant advancement for subsea technology. It is a breakthrough material to help realise ambitions once deemed out of reach in harsh deepwater environments. Ultimately, this innovation marks an important step forward in helping operators tackle increasingly complex offshore challenges and maximising their investments. ■