Flexible pipe integrity management: searching for the Holy Grail

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With the increased use of unbonded flexible pipes in offshore applications, the drive for integrity management (IM) solutions rivaling those available for rigid pipelines is steadily increasing.

This demand is evident both in product improvements for newer flexible pipes and with numerous innovations in monitoring and external scanning solutions for in-service assets. The current challenge for operators is to develop and implement robust and cost-effective IM strategies to maximise the value of these critical assets. Rosen is now applying its in-house IM strategies to maximise the value of these monitoring and external scanning solutions for flexible pipelines.

The flexible pipe and riser market today

With respect to new projects, the design and installation of flexible pipes has advanced significantly in the past decade. Key influencing factors include evolving industry standards (driven by a better understanding of key failure modes), improvements in materials, and more-advanced design, manufacturing, and testing methods.

In more recent years, progress has been hastened by the need to accommodate more challenging field applications, including deepwater, H.S. service, high CO₂ levels, higher pressures, increased diameters, and extended life. For more remote locations there is also an increasing need to minimise inspection and maintenance activities. This progress can be illustrated by the significant increase in the number of load cases used to assess and verify fatigue life for a dynamic riser (from under 50 in the early days to up to 5,000 in today).

There is now a large number of flexible risers in operation, with a significant number approaching or exceeding their original stated design life. Additionally, there is a large number of installed subsea flexible jumpers and production tie-backs (static applications), with an increasing trend to select flexibles for such applications.

With respect to in-service and ageing assets, operators face a daily challenge to ensure that they are being operated correctly, failure risk is minimised, and the desired remnant life is attained. In many cases exceeding the original stated design life is necessary to align with extended field life.

The flexible pipe and riser market today

The flexible pipe and riser market today is steadily increasing, from distinct approaches adopted by individual operators, to methods more akin to those adopted for rigid pipelines. This includes adapting IM systems to capture the key inspection and testing routines to be implemented. Key elements within a generic ‘plan-do-check-act’ cycle can typically include:

- Monitoring operating conditions and bare-throat composition
- ROV inspection
- Visual inspections
- Annulus testing
- Vessel motion and weather monitoring
- Other, less common items include:
- Annulus-gas-sampling/monitoring
- Polymer-coating ageing checks
- External-scanning systems
- Magnetic stress-measurement systems

Rosen is working to support operators by developing a dedicated IM approach for flexible pipelines. The company’s flexible-integrity-management system (FIMS) approach can be implemented either as a second-level procedure, to be integrated into an existing over-arching pipeline-integrity-management system (PIMS), or a top-level system for an individual field development.

CURRENT IM PRACTICE

IM practice for existing flexible-pipe systems is steadily evolving, from distinct approaches adopted by individual operators, to methods more akin to those adopted for rigid pipelines. This includes adapting IM systems to capture the key inspection and testing routines to be implemented.

Where to from here?

While coherent strategies and tools to monitor and diagnose the health of flexibles are being developed, there is still no solution to rival that of an ILI for a rigid carbon-steel pipeline. Rosen is investigating what can be achieved using existing inspection techniques to better understand the potential of delivering an ILI solution. This is being investigated through re-evaluating inspection data from previous operations, where ILI tools have traversed flexible pipe sections (typically production jumpers), and through testing work at the company’s Technology and Research Centre at Lingen in Germany.

Although flexible pipe is proven to be very durable and can give a long operational life, ensuring integrity throughout its full life-cycle remains challenging.