Tailored solutions are often required for the inspection of loading lines.

Solutions for a critical loading line lifetime extension

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Loading lines are unique assets in the oil and gas industry that are often deemed critical for pipeline networks. In many cases, these assets offer the only option for import and/or export of product into the entire distribution system. Additionally, the location of these lines can be critical as they are, in part, situated in a subsea environment, making any potential integrity flaw even more consequential.

After having fully understood why such assets must be inspected using reliable methods, operators are generally faced with a grave reality; more often than not it is the case that these assets cannot be inspected using conventional inspection approaches, and specialised solutions must be devised to ensure proper integrity management is possible.

The ROSEN Group has dedicated a specialised division, the Challenging Pipeline Diagnostics Division, to do just that.

The 'ROSEN Toolbox' is a pivotal asset in this regard. It offers a large portfolio of measurement technologies, methods to create pipeline access, and various types of sensors that allow for the propulsion of any in-line inspection tools through a variety of pipelines. Thanks to their experience and operational expertise, solution engineers are then capable of combining these components to tailor solutions for challenging scenarios, including loading lines.

The challenge

This approach was once again put to the test in the case of a loading line in Asia Pacific. The 40 inch line connecting to a subsea PLEM for transporting crude oil from a local tank farm to sea-going vessels was in need of inspection. Previous inspections had been conducted and internal corrosion anomalies had been repaired, however upon review, the choice was made to keep the line out of service for fear of integrity risks closer to the PLEM.

To extend the lifetime of the loading line, the client initiated a modification of the existing PLEM. This required that a wye piece and its associated piping needed to be removed and replaced with a modified arrangement. During the replacement of the PLEM, it would be necessary to raise the pipe above the water line to where the PLEM, wye piece, and some of the connected pipe would be placed on a barge.

The team was faced with accessibility, negotiability, and propulsion issues, specifically:

- Single access to the line from the tank farm area
- Propulsion of the tool in both directions
- The tool had to stop five meters before the wye piece

The solution

In order to combat the various challenges presented in this case, the ROSEN team needed to approach the solution with various elements from the Toolbox.

Monitoring and maintaining a predefined velocity for the inspection tool is essential for any inspection. The inspection tool itself was set to record in distance mode, meaning that it would record data at predefined forward rotations of the odometer wheel. If the inspection tool travels at an increased velocity, the amount of data samples taken per second increases. For optimal data quality, it is ideal to ensure the magnetisation range is within 10 kA/m and 30 kA/m.

In typical bidirectional inspections, it is often standard practice to measure and monitor the flow of the propulsion medium to better determine the tool's location in the subsea section. Though in principle, this method is sufficient, in cases where the tool must be stopped prior to a critical area, the margin of error is often deemed too high. Essential variables such as product bypass over the tool, velocity changes attributed to elevation transitions, and inefficient flow meters all contribute to variances in the tool's actual location. As the tool was required to stop within 5 m prior to the wye piece connected to the PLEM, these inaccuracies could not be tolerated. In order to increase efficiency and to determine an ideal 'reverse' point, a subsea monitoring system was deployed consisting of:

- Electronic Tool Detector III (EPD III) read-out consoles
- EPD subsea antennas placed on the pipeline for permanent and undisrupted communication

A transmitter unit was installed onboard the inspection tool, which could be adjusted to emit both a continuous and pulsed radio frequency. For this inspection, the transmitter was set to emit a continuous frequency. Though this can increase the battery consumption of the transmitter unit, the signal tends to be easier to detect with the specialised subsea antennas. This signal, once detected, triggers an indication on the read-out console connected to the antennas, indicating the passage of the inspection tool.

As the radio frequency emitted by the transmitter unit was not strong enough to be detected above the water line, EPD antennas were positioned in predetermined intervals of 50 m, 20 m, and 10 m along the subsea line before the wye piece.

On its way towards the wye piece, the inspection tool signalled its passing at the 50 m antenna, where the pumps were slowed down to reduce the velocity to 0.2 m/s. Once it passed the 20 m antenna, the pumps were slowed further to 0.1 m/s. Finally, once the passage of the tool was detected at the antenna located 10 m from the wye, the pumps were shut down, stopping the inspection tool within 5 m of the wye piece.

As soon as the barge crew was ready, the flow was then reversed and the inspection tool pushed back to the launcher/receiver station. The 3 detectors confirmed the tool's passage again to ensure that the tool was travelling at an ideal velocity.

Often, these types of assets are inspected with self-propelled UT measurement technologies with reduced measuring specifications. As both data quality and measuring specifications were so critical to ensuring all the defects were repaired prior to and during the replacement operation, MFL technology was chosen over other less validated techniques.

This technology provides ideal measuring performance for small pit-like defects and general corrosion. Furthermore, MFL technology is less susceptible to debris in the pipeline, which would influence the measuring performance of other measurement technologies such as UT.

The inline inspection tool itself was a bi-directional MFL-A solution containing the following elements:

- Bi-directional low friction 40 inch MFL unit
- High resolution MFL technology
- 1.5D back-to-back bend-passage capabilities

In spite of unforeseen environmental influences, such as multiple typhoons, the project was completed as scheduled.

Extensive subsea monitoring systems implemented for the tracking to ensure the optimal reverse point.

The ILI run was completed within the required velocity range of 0.1 m/s – 3.0 m/s, and the specified magnetization levels of 10 kA/m– 30 kA/m.

The collected data ensured a detailed integrity assessment of the entire pipeline. In fact, multiple girth weld anomalies with greater than or equal to 10 per cent wall loss were observed for the last 500 meters before the PLEM.

The benefits

Minimised risk exposure

Risk is always a focal point when it comes to dealing with the integrity of any oil and gas asset.

If this asset is located in a subsea environment, the concern around risk increases tenfold, therefore, the prevention of integrity flaws is a primary concern.

This solution, offering 100 per cent coverage in one pass, not only saves operational cost, but also offers the highest probability of anomaly detection.

Increased uptime

Loading lines are not only deemed critical because of the substantial effects of integrity flaws but also because of their vital need in feeding entire distribution networks.

Their essential role in the systems means downtime has a prominent effect on the entire supply or receipt of product.

Because of this, inspecting these assets must occur in a timely and efficient manner.

Lifetime extension

The current market situation calls for an even sharper focus on the care of existing assets in the oil and gas industry.

In the case of this particular loading line, the main reason for conducting this inspection was to provide required information to ensure the safe rehabilitation of a vital component. **P**

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