THE BACK AND FORTH OF DATA GATHERING

Bas Roosken, ROSEN Group, Europe, and Morten Solberg, KTN AS, Norway, detail an inspection carried out to discover the integrity status of an unpiggable pipeline, off the coast of West Africa.

It is a constant back and forth: from sea to land and back to sea. Large oil producers have extensive terminals for offshore production, where product moves from platforms to onshore crude oil storage terminals through pipelines. Arriving onshore, the product is treated and imperfections separated out, to then be temporarily stored in tanks. Once product fills the tanks, the crude oil is transported back onto the ocean to massive ships called Very Large Crude Carriers (VLCCs), where the product's long distribution journey really begins. Every step of the way, the integrity of the infrastructure the product passes through is of utmost importance.

Choosing and preparing a reliable approach

For an offshore operator in West Africa producing approximately 300 000 bpd of crude oil, this was no exception. Having previously inspected one of the pipelines gathering product from the platforms to the onshore tank storage and encountering significant corrosion, the integrity of the 42 in. export line going to the VLCCs became a concern; an inline inspection (ILI) was needed, especially since the line had not been inspected since its fabrication in 2009.

When constructed, this 42 in. line was designed to be piggable and fitted with an onshore launcher and a subsea receiver. However, the receiver was not in operation, reversing the direction of the flow was not possible and the pipeline was, in fact, deemed unpiggable. In addition, the pipeline routing was challenging, as various horizontally and vertically oriented combinations were present. To put it simply, the pipeline runs from the onshore tank facility towards the sea; a flange is present before entering

the water, but it then dips directly downward, continuing vertically until it reaches the seabed, where it runs horizontally to the subsea loading buoy.

After additionally considering the cost of a subsea operation, the need for a one-way entry approach became clear, with access to the pipe from onshore. This would lead to either a bi-directional or a tethered inspection. Weighing all the options and considering all the factors, the operator and the ROSEN Group chose to utilise an ultrasound (UT) tethered inspection approach. KTN AS (a company of the ROSEN Group) provided this solution; a self-centralising crawler with UT sensors, equipped with a tether. The tether not only acts as a failsafe mechanism, it also provides much-needed power to the tool train. The solution also mitigates the need for product flow. In addition, a live data feed is transmitted to tool operators onshore who can monitor the inspection progress, noticing any pipeline particularities and monitoring the tool's positioning in the pipeline using circumferential welds as guides. The unique tractor design with support wheels divided over the full circumference of the inner pipe wall allows for the negotiation of this unpiggable pipe. The KTN tethered solution was able to pass through all bends in this particularly complex pipeline route.

An additional benefit of the crawler approach is the ability to focus its attention on particular sections of the pipeline. In this case, for example, it was determined that the first 500 m from the launch site, including the riser section and the first few spools of the subsea line, would need a closer look. Given that this crawler can move back and forth, multiple passes could be made of this section.

The operation

To access the pipeline for inspection, the operator provided a seven-day window. This would include fully decommissioning the line and returning it back to service, allowing for a five day ILI period. This window of opportunity was created by stacking various VLCCs. However, the onshore storage tanks would be filled after the seven-day period – from the offshore platforms that remained in operation – and the pipeline would be needed again to avoid a compete production shutdown. More than usual, timing was key.

As seems to be the norm, the COVID-19 pandemic of course caused a series of difficulties and delays. Initially scheduled for June/July 2020, the project was postponed to November 2020. All required equipment was shipped by sea or airfreight to minimise its time onsite, allowing for additional testing of the ILI equipment in Bergen, Norway. During this time, additional trial runs allowed for validation of the ILI tool performance specifications according to API 1163. All personnel mobilised onsite two weeks prior to the inspection execution for mandatory self-isolation before going to the site.

With everything, and everyone, onsite, execution could begin. Due to operational challenges, the decision was made to divide the inspection into two sections. This would allow tool operators to start with the long-run inspection and then concentrate on the designated high-focus area. The inspection tool was launched through the onshore flange before the vertical dip into the ocean. Once the tool was in the pipeline, 24 hour operation ensured that as much of the line was inspected as possible. At 2.5 km per 12 hour shift (just over 200 m/hr), the tool crawled into and back out of the pipe. All the while, onshore tool operators monitored the progress of the inspection. The tool traveled approximately 7.8 km offshore towards the loading buoy, covering enough distance to be able to perform an integrity assessment on the rest of the pipeline.

After the return inspection has been completed, the focus turned to the first 500 m after the launch site. Dedicated time was allocated to allow several inspection passes of this section – once again back and forth, much like the product. The complex routing of the pipeline allowed the tool to rotate, making sure that the 480 sensors on the sensor ring inspected the complete inner pipe wall of this high-focus area. The live feed from the tether assured that welds were marked as the ILI tool passed them, allowing data evaluators to mix and match several ILI data sets.

The technology on board the inspection solution was UT. Although UT has many upsides, especially for corrosion detection and sizing, one clear downside is the sensitivity of the sensors to debris. As this specific pipeline was unpiggable, no cleaning was conducted prior to the inspection. Lack of pipeline cleanliness, or rather the presence of debris, can create a series of challenges for inline inspection, including data loss due to UT signal attenuation.

In this case, it resulted in debris accumulation on the ILI tool's sensor ring, which could result in data gaps. However, as the crawler is able to travel into and out of the pipe, data is recorded in both directions; therefore, full sensor coverage is made possible in the debris-covered sections of the inner pipe wall. The live monitoring of the inspection progress through the tether provides assurance that high-quality data is collected for precise data analysis of any anomalies. Ultrasound as a measurement technology also requires a liquid couplant. And although the crawler unit on the tool train propels itself – unlike conventional ILI, where the transport medium pushes the inspection tools through the pipe – a couplant was needed. To achieve this, the pipeline was drained to just below the level of the onshore flange, where the inspection tool was inserted. The stagnant product was kept in the line to provide a couplant, remaining stationary throughout the inspection.

With time to spare within the inspection window, the tool was retrieved from the pipeline, allowing operations to return to normal. At no point during the inspection did the offshore platforms stop producing. The tanks were filled and once the inspection was complete, they were emptied into VLCCs as per usual operation. This meant no interruption of production.

Facilities like this one off the coast of West Africa must run a tight schedule to meet production demands; a vital part of operations is ensuring the safety of all involved assets. This tethered crawler approach provides a no-compromise solution for collecting the data needed to understand the integrity status of an asset, without interrupting valuable production time. The crawler moved back and forth through the line collecting data, so the product can safely move back and forth from tank to ship – all without a back and forth on safety vs. production.