Case Study

Verify Emerging Pipeline Cracking

Using Ultrasonic Technology

Challenge

A pipeline operator required the inspection of six 12" pipeline segments transporting light crude oil. They wanted to identify circumferentially oriented crack-like indications within an 814 km (506 miles) pipeline with inspection segments ranging in length from 61 km to 251 km (38 to 156 miles) each.

Previous integrity digs identified circumferential crack-like indications requiring the entire system to be inspected to accurately determine the severity of these threats. The majority of the line segments consisted of grade X46 low frequency ERW pipe with 4.78 mm (0.19 in) wall thickness. Circumferential cracks form at/or near circumferential welds and/or local stress/strain accumulations. They are caused by soil and pipe movement which are typically the result of local earthquakes and landslides.

For this pipeline, several slopes were actively monitored utilizing strain gauges. Due to active geotechnical areas, some sections of this line were rerouted, while in other areas, directional bores were installed. Various other slope mitigation and monitoring techniques were also utilized. Elevation changes along this pipeline route varied by as much as 500 meters (1,640 feet) in one segment, and 1,000 m (3,280 feet) throughout the system.

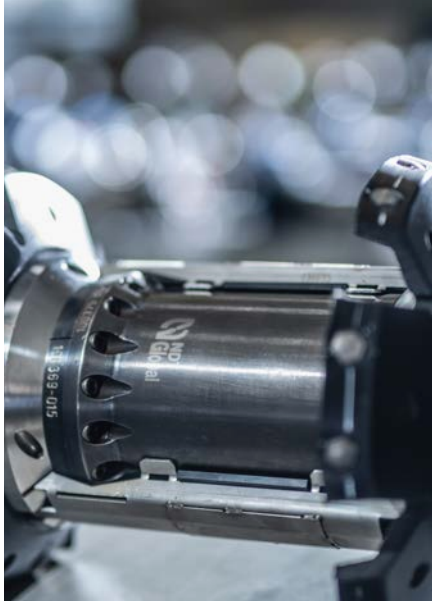
Solution

NDT Global utilized a 12" inspection tool which has inspected more than 2,600 km (1,616 miles) in a circumferential configuration. This ultrasonic circumferential crack (UCc) inspection tool was prepared to accurately size and detect circumferential features with an axial sampling resolution of 1.5 mm (0.6 in). This unique “direct measurement” solution identifies circumferentially orientated cracks both in girth welds and the pipe body.

To allow thorough pre-testing of the acoustic properties of the light crude oil, the customer provided a sample of the liquid transported in the system prior to the inspections. Due to the length of the longest section of pipe, two separate passes were required to enable the recording of the complete line length. The first inspection was ran and the distance recorded.

A second inspection was completed and this time, at approximately 5 km (3.10 miles) prior to the end of the first recorded data set, the inspection tool automatically powered-up into full recording mode to ensure complete pipeline data was recorded. To date, detailed investigations have been completed at 98 locations, with the programs still on-going.

- Axial Cracks
- Circumferential Cracks
- Metal Loss
- Geometry Ovalities
- Mapping



Results

- **99.5% of the identified flaws were within specified tolerance** for depth sizing of circumferential cracks, which is ±1 mm (0.4 in) at 90% confidence. The standard data analysis process resulted in approximately 1,600 crack fields and 420 crack and crack-like indications, all oriented in the circumferential direction. In addition, approximately 100 corrosion anomalies and 360 dent or ID variations also were detected.
- **100% first run success** was achieved on all 6 of the pipe segments. The overall results for the data analyzed shows probability of detection (POD) of > 95% for all circumferential crack fields and crack like defects. Pipeline inspections are major undertakings involving significant time and resources. When dealing with a pipeline in these geographic areas, failure to collect data can have a huge impact on integrity management, operations and profitability.
- **Fast turnaround** between inspections: The average time between inspections on the pipeline segments was less than 6 days from receiving the inspection tool in one section to launching it in the next. During this turnaround time, the inspection tools were completely refurbished and subjected to thorough onsite testing prior to being deemed fit to inspect the following segment.

> **A close collaboration was established for a successful ILI campaign addressing the threat of circumferential cracking.**

Circumferential crack field detected with ILI results using UCc

NDT Global www.ndt-global.com