EMPIT

INSPECT THE UNPIGGABLE

CASE STUDY

DETECTING ACTIVE EXTERNAL CORROSION FOR HARZWASSERWERKE GMBH

INSPECTION OF A WATER TRANSMISSION PIPELINE DN 600 USING CURRENT MAGNETOMETRY INSPECTION (CMI)

BACKGROUND

The inspected water transmission pipeline is an approximately 80 km long steel sleeve pipe with longitudinal conductivity, commissioned in 1943. Since the commissioning of an active Cathodic Protection (CP) in 1972, no perforation due to external corrosion is known. However, due to the later-installed CP, there are numerous pre-damages from the period without active corrosion protection. Subsequent to the Cathodic Protection, a retrofitted cement mortar lining was added, which has since prevented internal corrosion.

From Direct Current Voltage Gradient (DCVG) survey and targeted excavations, sections with coating holidays and areas with pre-damage are known and documented. Nevertheless, the overall condition of the steel pipe, as well as the state of the inner and outer walls, remained largely ambiguous.

CLIENT'S PRIMARY CONCERN

The primary concern of Harzwasserwerke GmbH was the detection of external corrosion. The water operator aimed to ascertain the localized proof of CP-effectiveness at coating holidays, which was paramount to ensure the longevity and safe functioning of the pipeline. The External Corrosion Direct Assessment (ECDA) procedure proved the most suitable in this regard, aligning with the client's specific needs and ensuring focused and efficient corrosion monitoring.

The limitations of indirect assessment techniques in the second phase of the ECDA procedure are well understood. Specifically, while conducted DCVG surveys could identify the locations of coating defects, they could not directly ascertain if there was metal loss from active corrosion. For a thorough, data-driven assessment, it was essential to use an inspection method capable of seamlessly determining the 3D position of the pipeline, its depth, and the presence of active corrosion at any coating anomaly – all in one inspection run.

To achieve a thorough, data-driven evaluation, Harzwasserwerke needed an inspection method capable of simultaneously recording the pipeline's 3D position, depth, and detecting active corrosion at coating anomalies. Operational limitations meant the pipeline could not be shut down. With these challenges and the unsuitability of smart pigging, the CMI method became the obvious choice. This approach allowed for non-invasive inspection from above ground, eliminating the typical risks of internal assessments such as Inline Inspection (ILI).

INSPECTION OBJECTIVES

+ Implement a non-invasive method ensuring uninterrupted drinking water supply and negating the risks typically associated with Inline Inspection (ILI).
+ Efficiently and accurately detect active corrosion at identified coating holidays
+ Seamless mapping of the 3D location, pipe bends, and depth of cover
+ Confirm localized Cathodic Protection effectiveness at each coating anomaly, addressing Harzwasserwerke GmbH's primary concern

PREPARATORY MEASURES, PLANNING AND FIELD INSPECTION

From the operator's side, the preparatory measures are minimal, so it is only necessary to ensure a cleared path that allows for walking (use with the hand-held inspection system). In cases of dense vegetation, the use of an inspection drone is suitable (see Figure 1).

During the Current Magnetometry field inspection, the route was walked or flown over using intelligent inspection equipment that has been developed by EMPIT. The daily productivity averaged about 5 km, completing the roughly 8 km long pre-selected inspection section in just 2 days.

RESULTS

The inspection highlighted that the majority of the pipe wall was in good condition, surpassing the anticipated technical service lifespan. Anomalies primarily resulted from inconsistencies in the initial manufacturing process. The inspection focus lay on anomalies that coincided with coating defects at the same location on the pipe to determine if external metal loss was present. With CMI's capability to differentiate whether these anomalies had a protective layer that could prevent corrosion, it became possible for the first time to assess the corrosion risk of each coating defect and therewith determine if CP was working accurately. Consequently, the usage of CMI allowed for the identification of actively corroding defects that are now scheduled for repair, ensuring an extended technical lifespan for the pipeline.

Figure 1: Inspection tools used (UAV and hand-held CMI-system)

INSPECTION TECHNIQUE VALIDATION

In general, it was determined that the specifications of CMI could be met at every validated point. Thus, during the three reference excavations, in addition to coating defects, two external pipe wall anomalies and one deformation were identified (see Figure 2 and 3). The same applies to the comparison with already known pipe wall defects. These could be reliably detected by CMI.

Ultimately, during the reference excavations, the absolute positions of the pipeline coordinates and pipe depths were recorded and compared with the previously reported results, and further known points from the existing documentation were used for further comparison. Here too, differences in the range of a few centimeters were detected.

During the result validation, Harzwasserwerke used the following methods:

+ **Comparison with known pipe wall defects/metal loss from the pipeline documentation**
+ **Comparison with known coating defects through DCVG**
+ **Comparison with known 3D pipe positions, DOC, and bend angles**
+ **Three reference excavations for verifying metal loss and validating the 3D pipe position**

SIGNIFICANCE FOR ASSET MANAGEMENT

The results facilitate the prioritization of renewal sections and offer a valuable supplement to empirical evaluations, enabling more targeted and cost-efficient planning.

Figure 2: Verified anomaly, ext. corrosion at 3 o'clock, at a coating defect

Figure 3: Exposure of internal anomaly, int. corrosion at 5 o'clock

CONTACT

**ELECTROMAGNETIC
PIPELINE TESTING GMBH**

Alt Biesdorf 11
12683 Berlin, Germany

+49 (0) 30 51 65 60 40

info@empit.com
www.empit.com