VERIFICATION OF ILI INSPECTION RESULTS WITH THE USE OF AUTO UT DATA

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A CASE STUDY OF AN OFFSHORE PIPELINE

Introduction

The Pipeline
- History, Importance
- Condition, Inspections

The Problem
- Integrity Concerns
- Verification of in-line inspection data

The Software and Assessment
- The software tools
- The assessment methodology

The Results
- The findings of the investigations following the assessment and verification
The Pipeline
Background and History

Large Diameter, Offshore, Crude Oil Pipeline

• Multiple Inspections
  – MFL, USWM and Calliper
  – Most recent inspection conducted with an MFL inspection vehicle

• Multiple Integrity Studies
  – Fitness For Purpose Studies
  – Corrosion Growth Assessments
  – Remaining Life Investigations

Critical line for operations and supply.
The consequences of a leak would be severe
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The Pipeline MFL Tool Sizing Spec

The most recent inspection was carried out using PII’s MFL3 ILI tool

Corrosion Summary:
- Specification for 12” - 56”
- Applicable for seam welded/ERW/spiral weld/seamless pipelines
- Specification given for pitting and general corrosion
- Smaller features are reported when visible
- Standard sizing spec therefore is ± 10% wt at the 80% confidence interval

<table>
<thead>
<tr>
<th>METAL LOSS CATEGORY</th>
<th>Pitting &lt;(3x3t)*</th>
<th>General &gt;(3x3t)*</th>
<th>Gouging</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Depth for Accurate Sizing</td>
<td>0.2t with surface dimension greater than: (7mm)x(7mm) or (0.4x0.4)t**</td>
<td>0.1t</td>
<td>If w &gt; 0.1t or 7mm** = 0.2t if w ≥ 3t = 0.1t</td>
</tr>
<tr>
<td>Sizing Accuracy (Depth)</td>
<td>±0.1t</td>
<td>±0.1t</td>
<td>±0.1t</td>
</tr>
<tr>
<td>HAZ</td>
<td>±0.15t</td>
<td>±0.15t</td>
<td>±0.15t</td>
</tr>
<tr>
<td>Sizing Accuracy (Length)</td>
<td>±10mm</td>
<td>±20mm</td>
<td>±20mm</td>
</tr>
<tr>
<td>HAZ</td>
<td>±15mm</td>
<td>±25mm</td>
<td>±25mm</td>
</tr>
</tbody>
</table>
The Pipeline Condition

The pipeline has >600,000 corrosion features throughout its length

Corrosion Summary:

- Predominantly internal and at bottom of the line (6 o’clock)
- Previous Corrosion growth studies found Corrosion was active and growing
- Features typical of pitting and areas of general corrosion
- Recent studies had predicted features required repair within 5 years
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The Pipeline Data Example

Internal corrosion (centred around 6 o'clock)

Girth weld
The Problem
Verification of ILI Results

**Aims**
- Verify MFL ILI results
- Confirm repair options
- Bring pipeline back into operation after mothballing

**Challenges**
- Difficult to match the AUT with MFL ILI data
- Certainty AUT is scanning the same area of corrosion as reported by the MFL ILI,
- Tolerances on: length/depth/distance/orientation
- Challenges of carrying out AUT in-field (offshore)
- Typical verification is performed on the peak depth of a small number of defects per site

**In-field Investigation**
- AUT scans were performed where the MFL ILI reported significant corrosion (predicted to require repair in the near future).
- Concrete coating was removed from the pipeline and the survey was conducted by scanning the outer surface of the pipeline
- AUT scans were centred on the 6 o’clock position of the pipeline
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The Software and Assessment

DigCom

Comparison of AUT and MFL data was performed in DigCom software

Software:

- Comparison of depths and investigation of the full profile and interactions within complex corrosion features
- Maps ILI data directly onto the in-field scan using weld number and relative distance
- Visual process allows the ILI data to be aligned and scaled
- Point to point match for high degree of confidence
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The Software and Assessment Data Matching

Provided AUT data

Matched to ILI using DigCom

AUT may only form part of a larger clustered feature / or be part of several clusters.
The Software and Assessment Data Matching

**In-Field AUT Scan Data**
- Converted from scan grid data
- Warmer colours signify deeper pits

**ILI MFL Data**
- Colour scale on ILI to match AUT data
- Warmer colours signify deeper pits
The Results
MFL ILI vs Auto UT

Excellent agreement between MFL and AUT

Results Summary:
- >500 defects matched
- Sample taken from 9 spools throughout the line
- Sample included a range of feature depths
- Sample is considered representative
- 80% confidence interval is ± 5.96% wt, therefore the ILI contractual sizing specification was exceeded
The Results
Auto UT Corrosion Rates

Several sites had been scanned using Auto UT previously

Results Summary:

- Corrosion Growth rates were determined by matching and comparing the depths

- This was carried out using the DigCom software using the MFL ILI data as a reference to enable defect matching

- Sample is considered representative

- In order to complete the integrity assessment on these defects a combination of the measured defect morphology was used (MFL ILI and AUT)
Conclusions

Automated Ultrasonic scan data was successfully matched and aligned with Magnetic Flux Leakage in-line inspection data.

Corrosion growth rates were successfully determined from comparison between Automated Ultrasonic scans.

The MFL ILI tool exceeded stated specification at the 80% confidence interval (± 5.96% wt compared to ± 10% wt for general corrosion and pitting within the pipe body).

Defect morphology was successfully combined between technologies to determine improved feature sizing in investigated areas.