Multidisciplinary Pipeline inspection project
Agenda

- Development of the Piglet
- Principle Piglet UT ILI tool
  - Resolution Axial/Circumferential
- Challenging pipeline inspection project
  - engineering
  - re-design of tool
  - mock-up qualification test
  - execution of inspection
Data Acquisition Unit

On-line inspection data
Example Piglets

4-10” UT Piglet  >16” UT-Piglet  4” UT furnace Piglet  6” UT Push Pull Piglet
Axial & circumferential resolution

Flow direction

Fixed transducers

Rotating transducer

Axial direction, coverage depending on speed (Pulse repetition frequency)

Circumferential direction, coverage depending on:
- amount of transducers
- beam spread (depends of crystal diameter/frequency)
Definition of Resolution
Axial as circumferential direction

Low resolution               3Tx3T
Standard resolution       2Tx2T
High resolution              1Tx1T
Ultra High resolution   0.5Tx0.5T

- Low resolution
- Standard resolution
- High resolution
- Ultra High resolution

- Axial slotting
- Circumferential grooving
- Pitting
Test-Facilities:

- Test loop’s +/- 200m: 4”, 6”, 12”, Flanged
- Various Mock-up on clients demand
- Furnace 4”, 5”, 6” & 8”, multiple 1D bends
Training

- Training & Certification
  - ILI - Operator Level I/II
  - ILI – Data Analyst Level I/II

- Practical pigging courses
  - For clients “pigging is my life”
  - Masterclass inspection technologies
  - Onshore practical pigging
Inspection of 12” pipeline, never been inspected

- Sept – first discussion client
- Oct – proposal
- Nov-Feb – clarifications
- March – Order
- April – Mock-up test
- June – inspection
- July – final report
Dear Mr,

We would like to know if you can inspect the following pipeline:

1. **Size**: OD=323.2 mm and 318.5 mm
2. **Length**: about 3.1 km
3. **Wall thickness**: 14.3 mm and 10.3 mm
4. **Bend radius**: Please refer to the attached drawing
5. **Fluid transported**: Crude oil or Sea water
6. **Operating pressure**: 0.5 - 0.6 MPa
7. **Temperature**: Ambient
8. **Pipeline structure**: Double pipes consisting of 12" inner pipe and 38" outer pipe

As you can see in the attached drawing, there are bend restrictions such as **forged bends** (<1.5D) and **mitre bends** (R=1448 mm). In this context, we firstly would like to confirm if your UT Piglet can negotiate this pipeline on the above condition.
As you see, the pipeline is a triplex structure.
The one we need to inspect by pigging is the Pipe 1 only.
Photograph location
Pink line shows the path of pigging.

Barge with pumping unit.

Sea Area

Launcher/Receiver in and out.

Land area

Pigging Direction. ↔ (Bi-di)

We stop pigging and pump backward.
Pigging procedure

Fig 3. When Pig Is Stopped During Pigging

Fig 4. Pigging Operation in the Reverse Direction (from Sea to Land Area)
Mock-up for testing and acceptance test by Client
Situation on-site
Controlling by measuring flow & pressure
Cleaning using foam pigs
Inspection
Data recovery & cleaning tool
## SUMMARY OF ANOMALIES

<table>
<thead>
<tr>
<th>Total number of anomalies</th>
<th>607</th>
</tr>
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<tbody>
<tr>
<td>Number of metal loss anomalies</td>
<td>129</td>
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<tr>
<td>Number of geometry anomalies</td>
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<tr>
<td>Number of laminations and inclusions</td>
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## SUMMARY OF METAL LOSS ANOMALIES

<table>
<thead>
<tr>
<th>Total number of metal loss anomalies</th>
<th>129</th>
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<tr>
<td>Number of internal anomalies</td>
<td>39</td>
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<tr>
<td>Number of external anomalies</td>
<td>90</td>
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<tr>
<td>Number of non applicable anomalies</td>
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<tr>
<td>Number of general anomalies</td>
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<tr>
<td>Number of pits</td>
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<tr>
<td>Number of pinnholes</td>
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<tr>
<td>Number of axial and circumferential grooves</td>
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<td>Number of axial and circumferential slottings</td>
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<tr>
<td>Number of anomalies with depth 0 - &lt; 10 % t</td>
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<tr>
<td>Number of anomalies with depth 10 - &lt; 20 % t</td>
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<tr>
<td>Number of anomalies with depth 20 - &lt; 30 % t</td>
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<tr>
<td>Number of anomalies with depth 30 - &lt; 40 % t</td>
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<td>Number of anomalies with depth 40 - &lt; 50 % t</td>
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<td>Number of anomalies with depth 50 - &lt; 60 % t</td>
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<td>Number of anomalies with depth 60 - &lt; 70 % t</td>
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<td>Number of anomalies with depth 70 - &lt; 80 % t</td>
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<tr>
<td>Number of anomalies with ERF 0.6 - &lt; 0.8</td>
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<tr>
<td>Number of anomalies with ERF 0.8 - &lt; 0.9</td>
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<tr>
<td>Number of anomalies with ERF 0.9 - &lt; 1</td>
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<tr>
<td>Number of anomalies with ERF ≥ 1</td>
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## LIST WITH MOST SEVERE ANOMALIES

<table>
<thead>
<tr>
<th>Log distance (m)</th>
<th>Feature type</th>
<th>Feature identification</th>
<th>Anomaly dimension class</th>
<th>Clock position (h:min)</th>
<th>Length (mm)</th>
<th>Width (mm)</th>
<th>Remaining t (mm)</th>
<th>Surface location</th>
<th>ERF</th>
<th>Psafe (MPa)</th>
<th>Comments</th>
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<tbody>
<tr>
<td>3004.04</td>
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<td>General</td>
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<td>n.a.</td>
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<td>6.7</td>
<td>External</td>
<td>0.14</td>
<td>7.29</td>
<td>In HAZ</td>
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</tbody>
</table>
Reported anomalies

Laminations

Internal

External

Amplitude variation of internalしかるものを異常度と距離

Amplitude variation of external Vernon Tubi Inspector 2.45.office 2003 beta v.16

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