Prevention First 2002 Conference

Inspection of Marine Terminal and Plant Piping Utilizing Long Range Guided Ultrasonic Inspections
Marine Terminal Piping Inspection

- Visual Inspections
- Fit for Service Hydro
- Ultrasonic Thickness Measurements
Ultrasonic Measurements
9" X 5" Corrosion Area

.200" Wall Loss 1" Dia.
Corrosion under support

40% Wall Loss
16” Line Underground
Guided Ultrasonic Ltd. (GUL)

Wavemaker Pipe Screening System
Waves are sent along the pipe

- Several hundred feet of pipe are examined from one location depending on pipe conditions.
Typical Applications

• Rapid, full coverage screening of pipe
• Especially cost effective in difficult to access locations
  – Monitoring overhead piping on columns
  – Corrosion under insulation (CUI)
  – Roadcrossings
  – Wall penetrations
  – Pipe racks
  – Pipe support point of contact corrosion

• Can detect cracks and general metal loss (greater than 3% of the cross-sectional area)
How it works

• A ring of transducers is placed around the pipe
• No couplant is required
• Usually no surface preparation required
Two types of waves can be used

**Torsional**
(twisting of the pipe)

**Longitudinal**
(compression of the pipe)
Results from a painted four inch line as it crosses under a roadway (for which it is epoxy painted on at least one side). The line is in good condition except possible for the point where it enters the west side of the road crossing.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Location</th>
<th>Class</th>
<th>Phase</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>+F1</td>
<td>2.65</td>
<td>Weld</td>
<td></td>
<td></td>
</tr>
<tr>
<td>+</td>
<td>3.59</td>
<td>Support</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>+F2</td>
<td>4.92</td>
<td>Minor</td>
<td></td>
<td>Corrosion present at the point where the pipe enters the roadway.</td>
</tr>
<tr>
<td>+</td>
<td>4.93</td>
<td>Entrance</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>+F3</td>
<td>8.91</td>
<td>Weld</td>
<td></td>
<td></td>
</tr>
<tr>
<td>+</td>
<td>11.24</td>
<td>Exit</td>
<td></td>
<td>End of the road crossing (as measured).</td>
</tr>
<tr>
<td>+F4</td>
<td>15.27</td>
<td>Weld</td>
<td></td>
<td>Weld with larger weld cap than usual as seen from other side.</td>
</tr>
<tr>
<td>+F5</td>
<td>21.38</td>
<td>Weld</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-F1</td>
<td>-3.85</td>
<td>Weld</td>
<td></td>
<td>The first of a series of very regular welds.</td>
</tr>
<tr>
<td>-</td>
<td>-6.59</td>
<td>Support</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>-F2</td>
<td>-10.28</td>
<td>Weld</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-F3</td>
<td>-16.55</td>
<td>Weld</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Position of Ring

Decay Curves

Series of Welds

Forward

Backward

Iconic representation of identified features

Corrosion is indicated by large red component
The symmetric nature of a reflection can help classify it.

When the feature does not extend very far around the circumference, RED = BLACK

When the feature extends significantly around the circumference, RED << BLACK
Small Diameter Pipes

- Tested using solid rings
- For pipes 1 - 8 inches diameter
- Can be mounted in less than a minute
- 3 inches clearance needed around pipe
- Temperature limit of 300°F
Large Diameter Pipes

- Tested using inflatable ring
- For pipes 10 – 46 inches diameter
- Employ conventional foot pump to inflate
- 2 inches clearance needed around most of pipe
- Temperature Limit of 300°F
650’ of Pipe Screened From a Single Location
Long Range Guided Wave Ultrasonics Performing CUI Inspection
### Test Information

- **Test ID:** 1707
- **Plug:** 5" Cast Iron
- **Other Notes:** Thermocouple
- **Location:** West Side
- **Size:** 5" inch

### Test Details

- **Pump:** 720 GPM
- **Rating:** 1200 GPM
- **Calibration:** 1000 GPM
- **Date:** April 12, 2000
- **Time:** 11:17

### General Notes

- **Issues:** B 301 Heater, Boiler

### Test Results

<table>
<thead>
<tr>
<th>Flange</th>
<th>Location</th>
<th>Size (in)</th>
<th>BCL</th>
<th>Class</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1</td>
<td>22&quot;</td>
<td>0.56</td>
<td>-</td>
<td>Support</td>
<td></td>
</tr>
<tr>
<td>H2</td>
<td>42&quot;</td>
<td>1.62</td>
<td>-</td>
<td>ID Band</td>
<td></td>
</tr>
<tr>
<td>H3</td>
<td>72&quot;</td>
<td>0.288</td>
<td>Y</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H4</td>
<td>3/4&quot;</td>
<td>1.13</td>
<td>-</td>
<td>Flange</td>
<td></td>
</tr>
<tr>
<td>J1</td>
<td>1-1/2&quot;</td>
<td>1.37</td>
<td>-</td>
<td>Angle</td>
<td></td>
</tr>
<tr>
<td>J2</td>
<td>1-1/2&quot;</td>
<td>0.612</td>
<td>17</td>
<td>Medium</td>
<td></td>
</tr>
<tr>
<td>J3</td>
<td>6-1/8&quot;</td>
<td>0.266</td>
<td>14</td>
<td>Medium</td>
<td></td>
</tr>
<tr>
<td>J4</td>
<td>1-1/16&quot;</td>
<td>0.048</td>
<td>16</td>
<td>Valve</td>
<td></td>
</tr>
<tr>
<td>J5</td>
<td>1-1/8&quot;</td>
<td>0.711</td>
<td>-</td>
<td>Bend</td>
<td></td>
</tr>
<tr>
<td>J6</td>
<td>1-5/16&quot;</td>
<td>0.207</td>
<td>-</td>
<td>Support</td>
<td></td>
</tr>
</tbody>
</table>

### Graphs

- **Graph 1:** Electric Field Magnitude vs. Distance (in)
- **Graph 2:** Electric Field Magnitude vs. Distance (mm)
Example of Insulated Pipe

Typical Weld

Drain
General Condition of Pipe

- Clean Pipe
- Generally Corroded Pipe
Typical Road Crossing
Example of Point of Contact Corrosion Under Supports
Point of Contact
Corrosion Under Supports
Corrosion Noted in Elbow
Example of Corrosion Noted in Elbow
Example of Weld Examination
Weld Examination
Offshore Piping Inspection
Platform
Riser
Inspection
Long Range Guided Wave Limitations:

- Inspector qualifications and experience
- Temperature limitations $300^\circ F$?
- Wave mode – Torsional or longitudinal?
- Insulation type
- Design of supports
- Pipe survey vs. Quantitative results
- Pipe geometry
  1. Flanges & valves
  2. Two to three elbows
  3. Branch connections
Quantifying G.U.L. Inspection Results With B-Scan
TMI-150
Hard Copy Prints

- UNITEK Energy Service technicians take hard copy prints of corrosion pits to verify the pit profiles and provide a detailed report.
## Factory/ Company Certifications

### Appendix 1 Table of qualification levels for applications

For training applications the required qualification levels are mandatory for all other applications they are recommended.

<table>
<thead>
<tr>
<th>Application description</th>
<th>Type of application</th>
<th>Qualification level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Training</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 1 training course (Lead trainer)</td>
<td>Advanced</td>
<td>Qualification Only</td>
</tr>
<tr>
<td>Level 1 training course (Second trainer)</td>
<td>Advanced</td>
<td>Level 2</td>
</tr>
<tr>
<td>Level 2 training</td>
<td>Advanced</td>
<td>Only Qualification D, Alkyne and D. Proklevci</td>
</tr>
<tr>
<td>Level 3 training</td>
<td>Advanced</td>
<td>Qualification Only</td>
</tr>
<tr>
<td>Procedure development</td>
<td>Advanced</td>
<td>Level 3</td>
</tr>
<tr>
<td>Written practice for applications</td>
<td>Advanced</td>
<td>Level 2</td>
</tr>
<tr>
<td>Auditing reports</td>
<td>Advanced</td>
<td>Level 2</td>
</tr>
<tr>
<td>Auditing field activities</td>
<td>Advanced</td>
<td>Level 2 or 3</td>
</tr>
</tbody>
</table>

- **Simply supported long runs of pipe**
  - Long lengths of simply supported pipe in pipe rack: Basic, Level 1

- **Monitoring**
  - Simple sample monitoring (in place of random thickness checks): Basic, Level 1
  - Monitoring after period using “repeat shot” and “overlay” features: Advanced, Level 2

- **Buried pipe applications**
  - Buried crossings in sleeves painted (no special coatings): Basic, Level 1
  - Buried crossings in sleeves painted (no special coatings) with coating laps: Advanced, Level 2
  - Buried pipe in sand/silt painted (no special coatings): Advanced, Level 2
  - Buried pipe with alternative coatings: Advanced, Level 2
  - Short tunnels through bend walls etc: Advanced, Level 2

- **Different materials**
  - Stainless steel: Basic, Level 1
  - Plastic to check wells: Advanced, (Qualification only) Level 3

- **Testing pipes with different contents**
  - Gas, low velocity: Basic, Level 1
  - Gas, high velocity: Basic, Level 1
  - Light viscosity liquid: Basic, Level 1
  - Heavy viscosity liquid: Basic, Level 1
  - Very high viscosity liquids: Advanced, Level 2
  - Liquids that leave accumulating internal deposits: Advanced, Level 2

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GUL Applications

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