UNPIGGABLE NO MORE!
PRACTICAL SOLUTIONS FOR CHALLENGING PIPELINES

PIGGING PRODUCTS & SERVICES ASSOCIATION

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empowered by technology
1. Evolutional Process
2. Managing Complexity – Simplified View
3. Risk Based Inspection / Selection
4. Case by Case – Examples
EVOLUTIONAL PROCESS

“Unpiggable” a function of time and market needs

- 1965: Tools become 1.5D capable.
- 2013: Dual-Diameter Tools become available.
- Gas velocities up to 1.5 m/s become possible.
- Heavy Wall Tools become available.
- Pressures up to 300 bar possible.
- Crack Inspection in gas
- Ultra Compact MFL Tools for bi-directional Operation
- Self Propelled Tools
- Low Flow - Low Pressure Tools become available
- 50 km in a single run becomes possible.
- Active Speed Control allows for gas velocities up to 12 m/s.
- Multi-Diameter Tools become available.

Toolbox of Technologies and Strategies

Practical Solutions for Challenging Pipelines
1. Evolutinal Process
2. Managing Complexity – Simplified View
3. Risk Based Inspection / Selection
4. Case by Case – Examples
MANAGING COMPLEXITY – SIMPLIFIED VIEW

Questionnaire

Pipeline Modification ?

Tool Modification ?

New Development

Time & Effort

Standard Tool

New Application

Tailored solutions based on tool box concept
Practical Solutions for Challenging Pipelines

MANAGING COMPLEXITY – SIMPLIFIED VIEW

Questionnaire

Pipeline Modification?

Tool Modification?

New Development

Time & Effort

Temporary access launcher / receiver

Exchange of fittings and bends

Interruption of operation, flow reversal, batching
ILI standard focus on data analysis and verification (repair)

Challenging pipeline add up-front strategies, preparation and technologies

Note Inspection Run Time is increasing for shorter sections!
1. Evolutional Process
2. Managing Complexity – Simplified View
3. Risk Based Inspection / Selection
4. Case by Case – Examples
Essentially:
Risk based **inspection** and risk based **selection**.

dPOF = reduction in probability of failure
1. Evolutional Process
2. Managing Complexity – Simplified View
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4. Case by Case – Examples
CASE BY CASE – BIDIRECTIONAL MFL SERVICE

Versatile Elements – Bi-Directional ILI Tools

24” BiDi MFL ILI Tool
Travel in either direction and capture data both ways (redundancy).
Asymmetric pigging operation for cleaning, gauging and inspection
CASE BY CASE – BIDIRECTIONAL MFL SERVICE

Inspection of 16”, 24” and 32” Loading Lines
Onshore / Offshore operation. BiDi operation. Gauging program identified severe or impassable dents. First line completed with BiDi MFL. Second line Geometry only. Third line rescheduled.
Bi-Directional ILI Tools for Pig-Valve Operation
10” 3-Way-Valves typically used for spheres and cylindrical pigs with a length of 1.4 x D
Bi Directional Inspection of 20” In-Field Gathering Line
Tie in into piggable 20” trunk line. Inspection from launcher to full bore unbarred tee and back. Single body tool with tee-extension.
Inspection of 10” In-Field Gathering Lines
Pipeline pressure 116 psi (8 bar). Required differential pressure for tool 10 psi (0.7 bar) only; 20 psi (1.4 bar) at forged bend. Unidirectional set-up of BiDi tool.
CASE BY CASE – TETHERED BIDI MFL SERVICE

Inspection of 12” Lateral Flow Lines Tied into 16” Trunk Line

12” BiDi MFL ILI tool used. Lateral connection from well to 16” trunk line. Inspection during revision program. Push in with air 100 psi (7 bar). Pull back with winch. Provision of Gauging, Geometry and Corrosion Services.
Bi Directional Inspection of 16” Off-shore Riser
UT wall thickness tool was lowered in water and pulled back.
CASE BY CASE – ROBOTIC BIDI EMAT SERVICE

Inspection of Girth Welds
• Lack of Penetration
• Hot Cracking
• HAZ Corrosion or Cracking
CASE BY CASE – ROBOTIC BIDI EMAT SERVICE

Inspection of Girth Welds
- Lack of Penetration
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CASE BY CASE – TETHERED BIDI EMAT SERVICE

Acceptance & Rejection Curves
semi automated process to accept or reject a weld with user interface onsite
CASE BY CASE – ROBOTIC HELIX TOOL

- Single body
- Rotating measurement system based on MFL
- Light weight
- Easy to handle
- Front & rear camera system

Single Tractor & Inspection Unit
CASE BY CASE – 10” ROBOTIC MFL CRAWLER

The self-propelled RoCorr MFL/BiDi/MTC inspection solution consists of the following elements:

<table>
<thead>
<tr>
<th>Inspection technology:</th>
<th>MFL</th>
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</thead>
<tbody>
<tr>
<td>Carrier:</td>
<td>Bi-directional / low friction</td>
</tr>
<tr>
<td>Propulsion:</td>
<td>Multi Trotter Crawler</td>
</tr>
<tr>
<td>Power:</td>
<td>Onboard accumulators</td>
</tr>
<tr>
<td>Operation &amp; control:</td>
<td>External via wire line</td>
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<tr>
<td>Fail safe:</td>
<td>Cable</td>
</tr>
</tbody>
</table>
### Technical Specifications

- **Inspection Range**: 200 mtr
- **Nominal Inspection Velocity**: 50 m/h
- **Nominal Pulling Power**: 11,000N
- **Peak Pulling Power**: 22,000N
- **Pressure Resistance**: 2 Mpa (20 bar)
- **Operating Pressure**: ambient
- **Product Temperature Range**: 0 - 45 °C

### Mechanical Specifications

- **Tool length**: 5200 mm
- **Operational weight**: 293 kg

### Tool locating system

- **Transmitter**: ITX 503

### Pipeline requirements

- **Min. Bend Radius**: 1.5 D
- **Min.Bore in Straight Pipe**: 232 mm*
- **Min.Bore in 3D Bend**: 240 mm*
- **Straight Pipe between b2b bends**: 1000 mm
- **Max ID Step Changes**: 10 mm*

### Sensor specification 10” MFL configuration

- **MFL channels**: 144
- **Wt range**: 4.0 - 10.0 mm
- **Magnetization level**: 10 – 30 kA/m

*) Limited by the MFL unit
CASE BY CASE – 10” ROBOTIC MFL CRAWLER

Full-scale testing

10”x16” tee  Full bore offtake
1.5D bend
CASE BY CASE – 10” ROBOTIC MFL CRAWLER

Field Operation
CASE BY CASE – 10” ROBOTIC MFL CRAWLER

Cost effective - Bi-directional approach avoids the need for expensive receiver while the MFL technology avoids the need to liquid fill the line

Safe - Extremely powerful crawler provides full control over the tool movement whilst well designed fail safe measures ensure the tool can always be recovered

Quality - high resolution MFL data quality, 100% coverage in one single pass and tool records both ways

Reliable - MFL technology is a robust and proven technology known to be least sensitive to debris

Easy - The crawler approach avoids the need for heavy equipment such as compressors/ wire line trucks
CASE BY CASE – ROBOTIC SURVEY SYSTEM (RSS)

• Configurable for different sizes (here 16”)
• Eddy current sensor unit for shallow internal corrosion measurements
• Unit with geometric measurement sensors
• Camera for visual inspection
Field test with the RSS 16”. Line was approximately 150 meters long and subjected to significant debris. Tool travelled in both directions.
THANK YOU FOR JOINING THIS PRESENTATION.