ON THE ISSUE OF INSPECTING CHALLENGING PIPELINES

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INTRODUCTION

• There are appr. 4 million kilometers of oil & gas transmission pipelines globally.
• Roughly 40% of these lines are considered „non-piggable“
• In addition there is a large number of pipelines upstream that require regular inspection.

What does „piggable“ mean?
“PIGGABLE“

- In-Line Inspection (ILI) of pipelines is well-proven, widely used and in parts of the world even prescriptive
- ILI is performed for metal loss, crack, geometry and leak detection
- The mission is to provide accurate, reliable and consistent data for integrity assessment and fitness-for-purpose investigations

A pipeline is considered „piggable“ if it can be inspected with an ILI tool, without the need to modify the tool or the pipeline
„PIGGABLE“ VS. „UNPIGGABLE“

<table>
<thead>
<tr>
<th>Piggable</th>
<th>Un-Piggable</th>
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<td>Internal Access</td>
<td>External Access</td>
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<tr>
<td>• Free Swimming ILI</td>
<td>• External Non-Destructive Testing</td>
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<tr>
<td>• Speciality Free Swimming</td>
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<tr>
<td>• Tethered Tools</td>
<td>(manual or automated)</td>
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<td>• Robotic Tools</td>
<td>• Direct Assessment</td>
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<td>(ECDA, ICDA, SCCDA)</td>
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“UNPIGGABLE“ ISSUES

- Accessability
- Negotiability
- Propulsion

These issues remain:
Flaw types: metal loss, cracks, geometric anomalies
POD, POI – issues of data quality, data management
THE TOOL BOX APPROACH

- Technology
- Tailor Made Processes and Procedures
- Expertise and Experience
ACCESSIBILITY

- Hot tapping
- Pig launch valves
- Temporary or permanent launcher
- Spool piece
- Bi-directional operation
NEGOTIABILITY

• Uni-directional

• Bi-directional

• Low friction

• Ultra compact

• Multi – diameter
PROPULSION

• Medium propelled

• Nitrogen/ Air

• Batching

• Self-Propulsion

• Cable operated
MEASUREMENT TECHNOLOGIES

- MFL – Magnetic Flux Leakage
- UT – Ultrasonic Technology
- EC – Eddy Current
- EMAT – Electro-Magnetic Acoustic Transducer
- ...
The Challenge:

- 6” fuel line, length 1300 m
- Wall thickness: 4.5 to 5.6 mm
- No launching or receiving traps installed
- Access only possible from one end
- Tight miter bends in the line
- No digging possible
- Low operational pressure during inspection
- No interference of aircraft movement tolerable
CASE STUDY: JET FUEL LINE FEEDER LINE

The Solution:

- Small diameter UT inspection tool
- BiDi capability
- Mechanical design of tool allows negotiation of mitre bends
- Tool capable of negotiating 1D bends
- Tailor made and specialized procedures
CASE STUDY: JET FUEL LINE FEEDER LINE

The Benefit:

• Reliable inspection of line providing high resolution UT data
• Zero disturbance to normal airport operations and aircraft movement
• Cost saving by avoiding any digging
• No line modifications required
• Inspection using medium transported in line – jet fuel
• Risk minimization due to Bi-Di design of tool
The Challenge:

- Inspection of 10“ multi-phase flow lines
- Multiple lines between 1 and 10 km long
- Hard to clean
- Medium at elevated temperature
- High water cut
- No possibility to install launchers & receivers
- Only access possible via 3-port valve
Valves are 3 port ball valves that are used in pipelines that require frequent maintenance pigging. They can also be used to run short ILI tools – if available!
CASE STUDY – MULTI-PHASE OIL LINE

The Solution:

• Specially designed BiDi MFL tool, that can be launched and received via 3-port valve
• Tailor made procedures
• Tool can operate in LF/LP conditions
• Specialized tool tracking equipment
The Benefit

• **Cost effective**
No impact on operation, no pipeline modifications no need to liquid fill the line or for pumps, hydro test can be avoided

• **State-of-the-art inspection quality**
Same performance as high resolution uni-directional MFL tools

• **Light weight and easy to handle**
No need for cranes, less manpower

• **Flexible operation**
Online inspection - less dependent on production planning

• **Safe and reliable**
Robust and proven MFL technology that only requires moderate cleaning
CASE STUDY – LOADING LINE

The Challenge:
Offloading pipeline at a MBM (Multi Buoy Mooring), from PLEM (Pipeline End Manifold) to beach head area, no pig traps and previous UT inspection was unsuccessful due to questionable data.

Size: 20"
Length: 1800 mtr
Product: Jet Fuel / Gasoline
The Challenge (continued):

The line cannot be inspected with conventional tools because of:

- No traps
- Subsea entry
- Pressure limit of 6.5 kg/cm² (6.4 bar) during inspection

Boundary conditions

- No interference with offloading operations
- Risk to be minimized
- Full inspection coverage
- Eliminate possibilities of contamination to the ocean during the submarine activities of disconnecting hoses and installation of launching spool at PLEM
- Send only clean product to storage tank
The Solution:
For this inspection ROSEN engineers selected a medium propelled low friction MFL inspection solution in combination with pre-inspection cleaning.

Pigging direction: from subsea PLEM to onshore beach head.

Propulsion: with jet fuel during normal offloading.
CASE STUDY – LOADING LINE

Launching trap design & construction

Design enables launching cleaning and MFL pig without intermediate spool recovery.
CASE STUDY – LOADING LINE

Beach head with trap and filters installed
CASE STUDY – LOADING LINE

Pre-loading of cleaning and MFL tool into launching spool

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CASE STUDY – LOADING LINE

The Benefit:
High resolution data collected for advanced Integrity Assessment
Successful procedures for complex operational conditions and a short time frame
Risk minimization and no impact on normal operations.
THANK YOU FOR JOINING THIS PRESENTATION.