DEEPWATER, HIGH-PRESSURE AND MULTIDIAMETER PIPELINES
A CHALLENGING IN-LINE INSPECTION PROJECT

PPSA ONE-DAY Seminar
Marcliffe Hotel Aberdeen

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1. The 14”/18” Multi-Diameter Challenge
2. Project Procedure
3. Tool Design
4. Test Loop Construction
5. Testing
6. Contingency Plan
7. On-Site operations
8. Summary
1. The 14"x18" Multi-Diameter Challenge

**Pipeline Specifications**

- **Length**: 164 km; min. Bend: 5D (14"&18")
- **WT max = 22.2 mm (14"); 28.6 mm (18")**
- **Water depth about 1900 m**
- **Medium: Gas**
- **Check valves, Full Bore Tees, Wye-piece, Jumper-Loops (!)**
1. The 14"x18" Multi-Diameter Challenge

**Challenging Requirements:**

- Internal Diameter Ratio: 300 mm/418 mm = 0.717
- That means an operating range of about 28%
- High Pressure Design: 300 bar
- Passage of Installations
- Particular wye-piece passage
2. Project Procedure

Phase 1: Tool Design
- Definition of Test Program
- Discussion of Operating Conditions

Phase 2: Tool Manufacturing and Assembly
- Construction of Test Loop
- Component Tests

Phase 3: Tests of the complete Tools
- Evaluation of Tests and Modif.
- Launching/Receiving Procedure
- Contingency Plan

Phase 4: Cleaning and Inspection Runs
- On-Site Run and Data Evaluation

Phase 5: Data Evaluation and Reporting
3. Tool Design: 14”/18” XGP Model

3.26 m

1.5 m

1.4 m

Transmitter

PDL

Battery Unit

XGP-Sensors and Electronic

Driving Segments

XGP Measuring Unit
3. Tool design: 14”/18” CDP Model

- **Magnet Units**
- **Battery and Electronic Box**
- **Driving Segments**
- **Transmitter**
- **PDL**

Dimensions:
- 5.32 m
- 1.5 m
- 3.44 m
3. Tool Design: 14”/18” XGP - Picture

The Specifications of the Tool are:
Passage ID: 285 mm
Bend Capability (14”): 3D (295 mm)
Bend Capability (18”): 1.5D
Operational Range: 286 mm – 457 mm

37.4 % ID Reduction
3. Tool Design: 14”/18” CDP - Picture

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Operational Range: 286 mm – 457 mm

37.4 % ID Reduction

Magnetization:
Max wt (18”) = 23.5 mm
Max wt (14”) = 35 mm
4. Test Loop Construction

3D sketch of Test Loop

- simulated Connector
- Check Valve
- Jumper bend combinations
- simulated Valve Bore
- simulated Flex Joint
- Barred Tee (10” offtake)
- simulated Valve Bore
- Reducer (18” to 14”)
- Reducer (20” to 14”)
- Reducer (24” to 18”)
- Wye (18”)
- Barred Tee (12” offtake)
- simulated Valve Bore

All simulated installations were supplied by the Operator!
4. Test Loop Construction

Pump Test Loop is operated with water. Flow can be adjusted up to 1.2 m/s in 14”. Flow and pressure (launcher and receiver) are measured.
5. Testing

The test phase was divided in three basic segments:

1. **Basic Components tests like:**
   - Pressure testing of basic components (e.g. Sensors)
   - Sealing and over flip capabilities of the cup
   - Durability test of support wheels

2. **Tool Segments tests like:**
   - Pull tests of the Driving Unit (condition, pulling Load)
   - Pump test of the Driving Unit (pressure, condition)
   - Pressure test of electronic compartments

3. **Tests in the 14”/18” test loop:** (shown in the following)
   - Pump velocity about 0.7 m/s in 18” and 1.1 m/s in 14”.
   - On board pressure and acceleration measurement (PDL).
5. PDL Data of 1. XGP Pump Tests in 14”/18” Loop

Synchronized Analysis of PDL Data

Differential Pressure

- 9 bar pressure peak!
- 14” pipe
- 2 bar
- 18” pipe
- 1.2 bar

Tool Inclination

- Jumper 1
- Launching
- Jumper 2
- Receiving
5. 14”/18” XGP: Pump Test Results

3D color-view of caliper data (not to scale)
5. PDL Data of CDP Pump Tests in 14”/18” Loop

- **Differential Pressure**
  - 7.5 bar
  - 3.8 bar

- **Wye-piece**
  - 14” pipe
  - 18” pipe

- **Tool Inclination**
  - Jumper 1
  - Launching
  - Jumper 2
  - Receiving
6. Contingency Plan

Discussion and definition of a contingency plan between ROSEN and the Operator!

-Scenarios
-SCADA measures
-Communication
-Decision Points
-Possible Actions
7. On-Site Operations

Vertical Launching of Geometry and MFL Tool
Run conditions: 100 bar and 2 m/s in 14”
7. On-Site Operations

Launching tube was required because of Launcher length!
7. On-Site Operations

Tool in Receiver after smooth and successful run with complete Data!
Geometry Tool measurement of check valve.

Checked immediately and approved for MFL run.
A project for a challenging Multi-Diameter Pipeline was conducted in close co-operation between ROSEN and the Operator.

Cleaning and Inspection Tools (Geometry and MFL) were developed and built as well as a full size Test Loop containing simulations of all relevant Installations. A wide range of tests have been performed.

The runs were successfully conducted.

The Operator and ROSEN have defined several procedures including a Contingency Plan.
Thank you for joining this presentation.