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

PPSA ONE-DAY Seminar
19. November 2008
Marcliffe Hotel Aberdeen



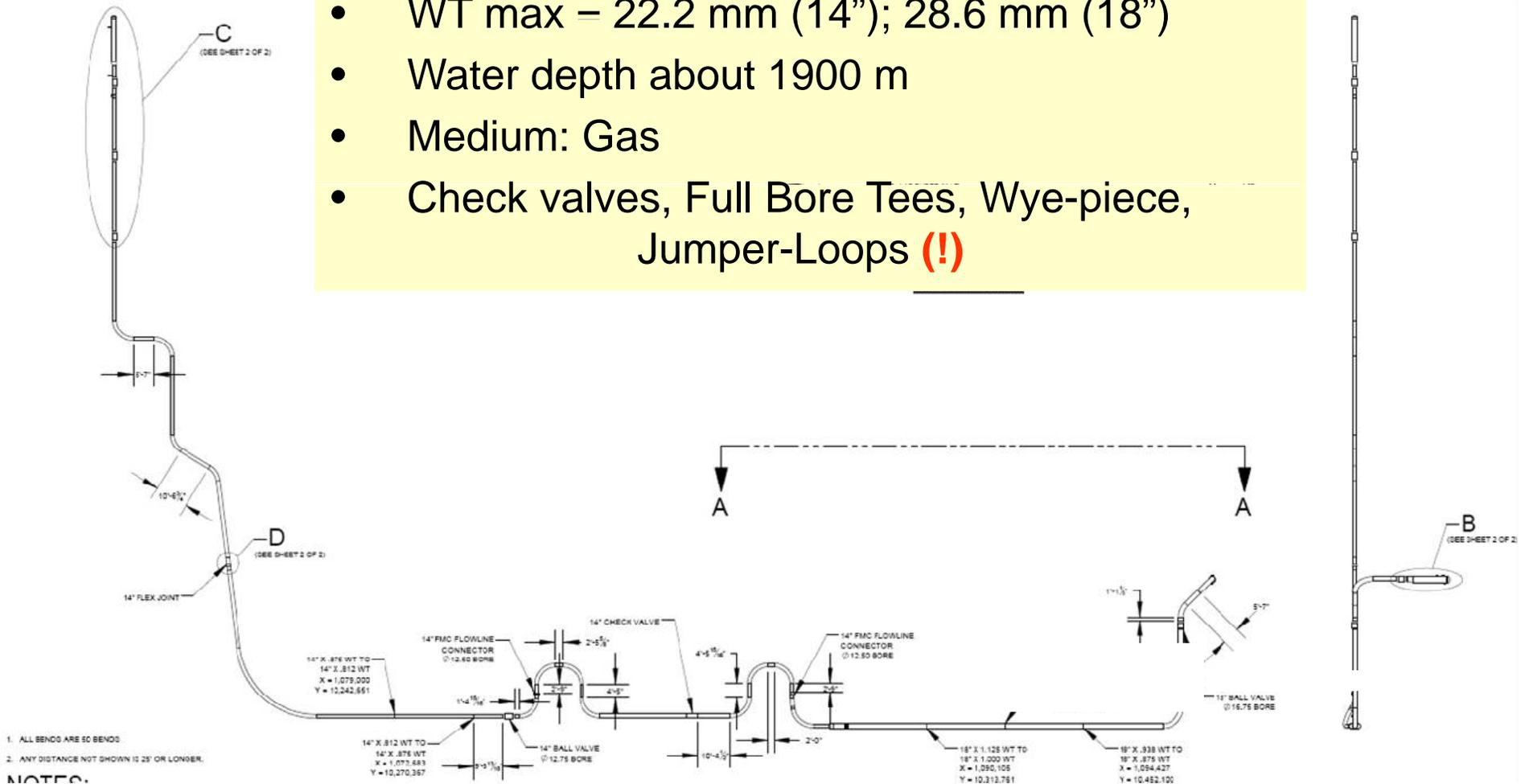
Rosen Research and Technology Center
Hubert Lindner
17-Nov-08

- 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: $300 \text{ mm} / 418 \text{ mm} = 0.717$
- 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

Define

Phase 2: Tool Manufacturing and Assembly

Construction of Test Loop
Component Tests

Discuss

Phase 3: Tests of the complete Tools

Evaluation of Tests and Modif.
Launching/Receiving Procedure
Contingency Plan

Witness

Phase 4: Cleaning and Inspection Runs

On-Site Run and Data Evaluation

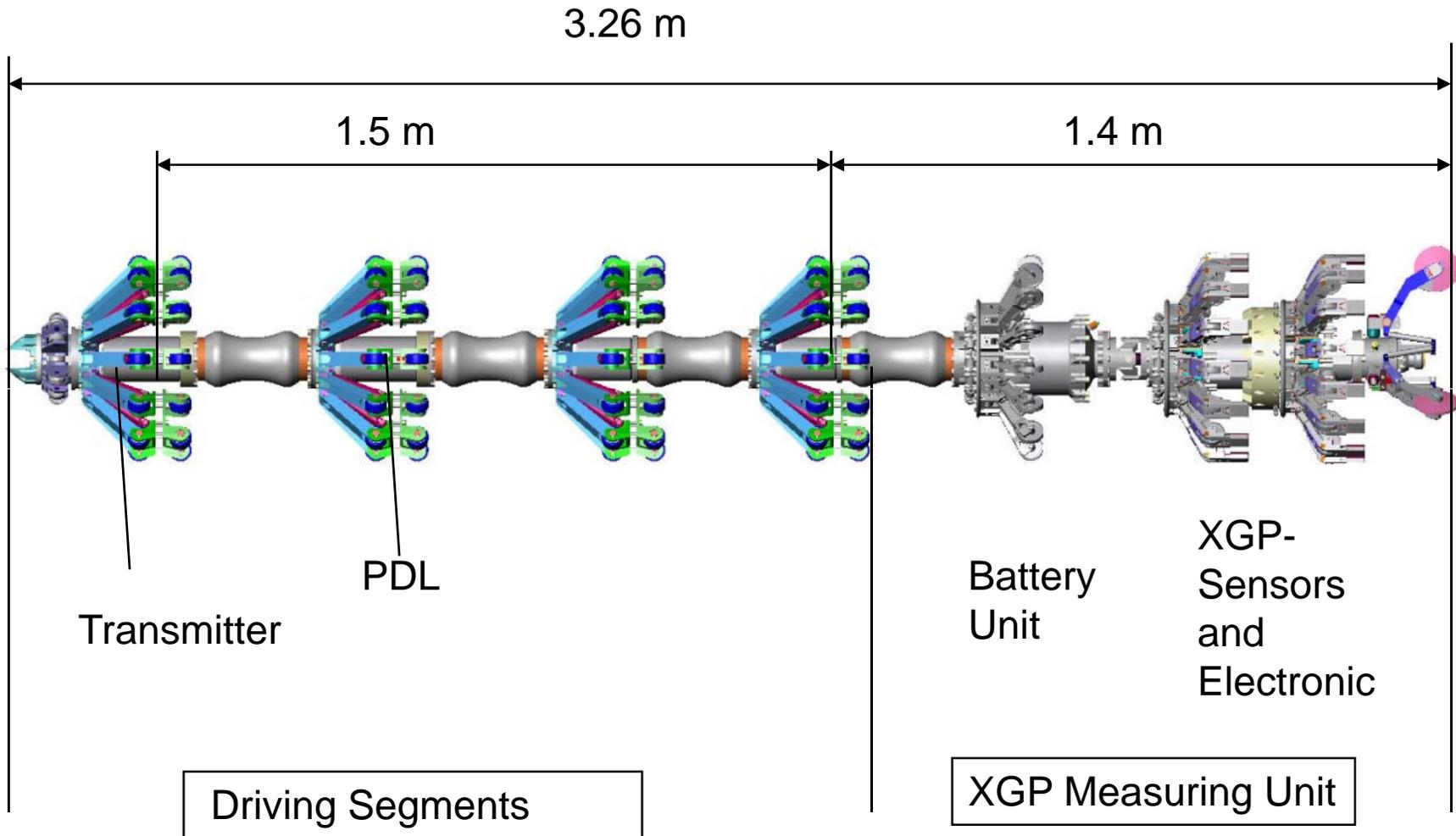
Agree

Phase 5: Data Evaluation and Reporting

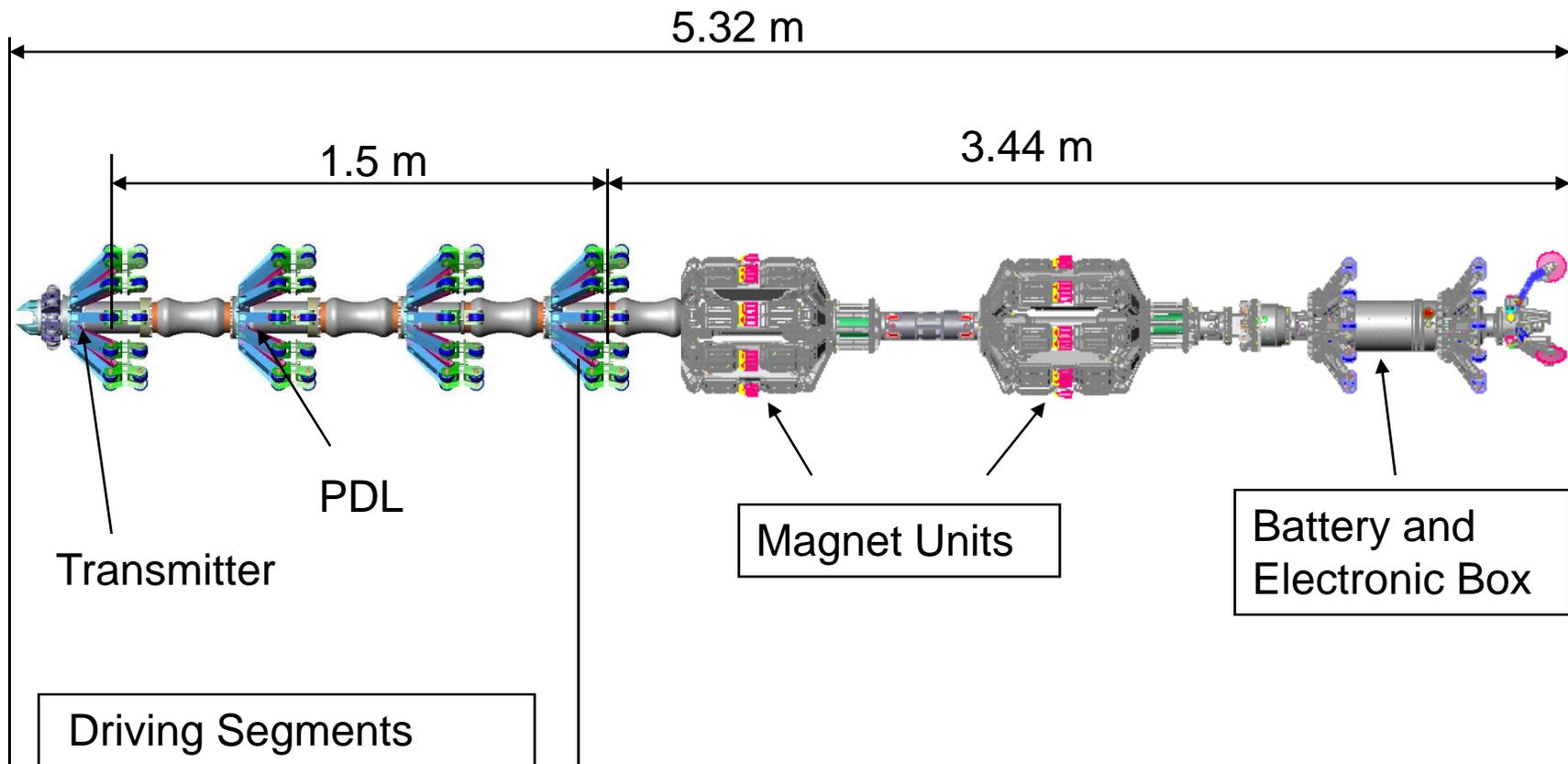
Co-operate

O
P
E
R
A
T
O
R

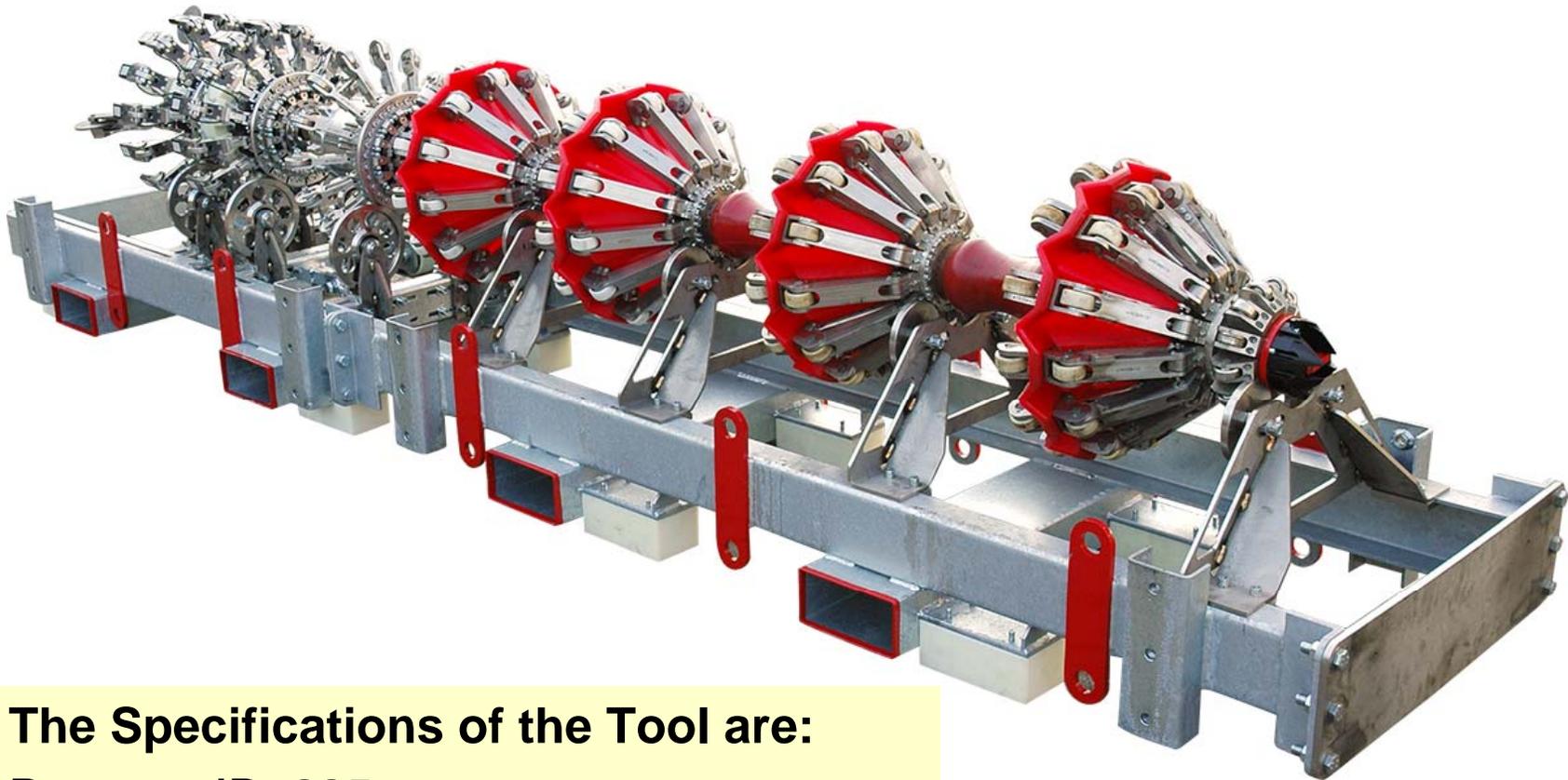
3. Tool Design: 14"/18" XGP Model



3. Tool design: 14"/18" CDP Model



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

37.4 % ID Reduction

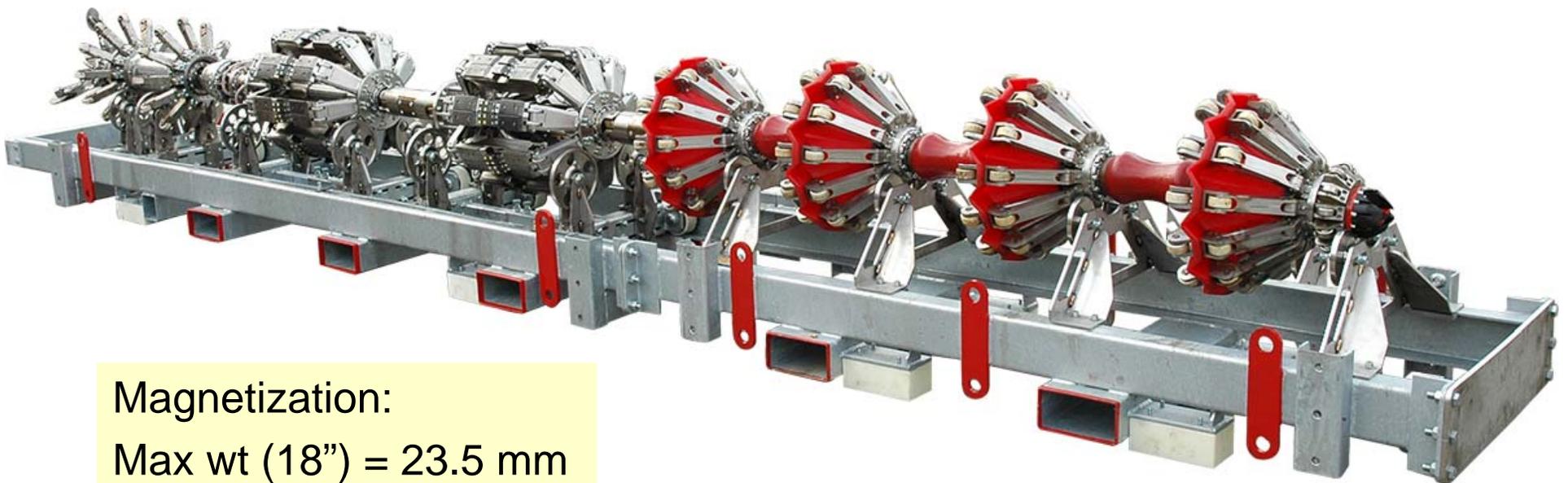
The Specifications of the Tool are:

Passage ID: 285 mm

Bend Capability (14"): 3D (295 mm)

Bend Capability (18"): 1.5D

Operational Range: 286 mm – 457 mm



Magnetization:

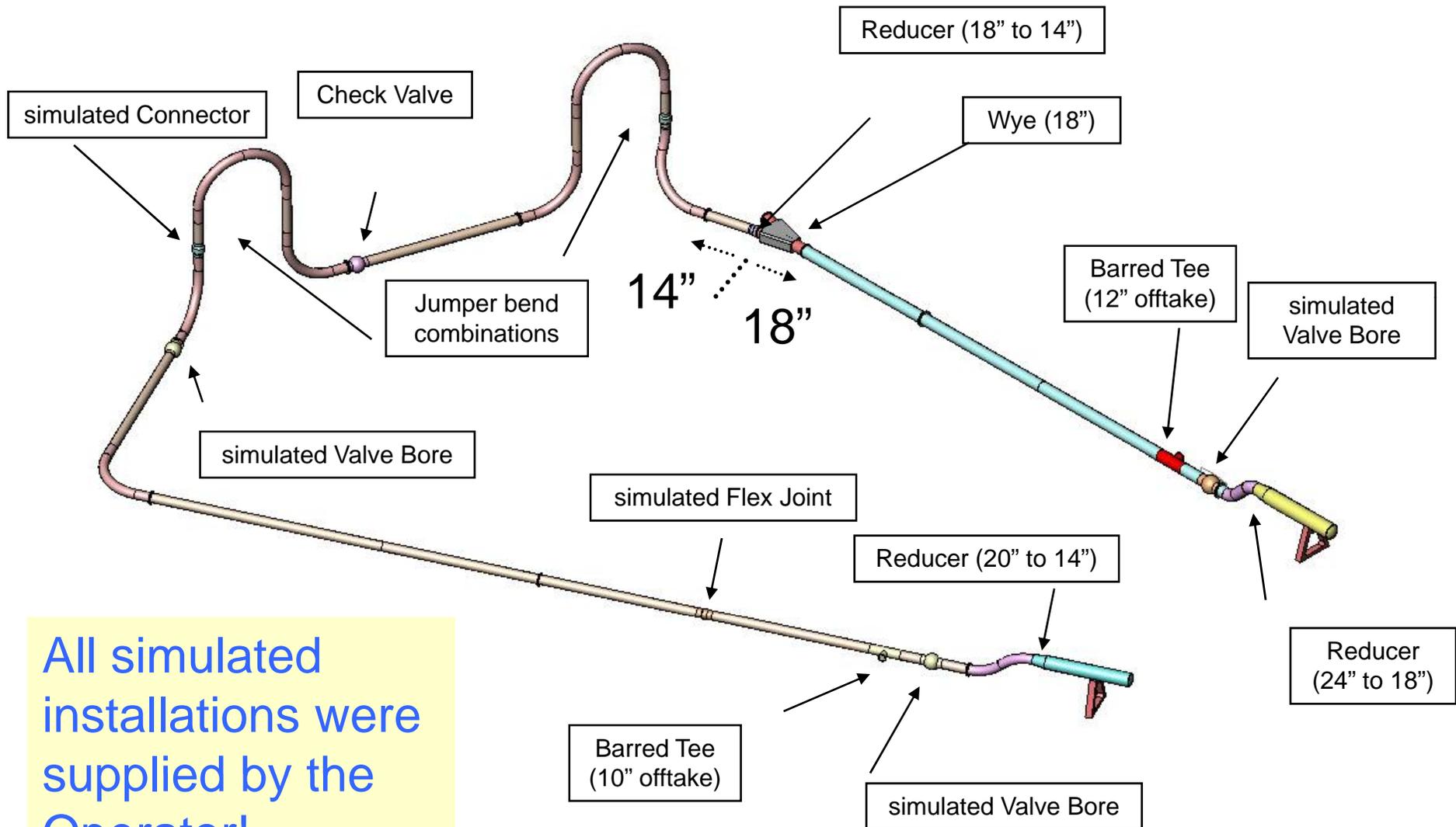
Max wt (18") = 23.5 mm

Max wt (14") = 35 mm

4. Test Loop Construction



3D sketch of Test Loop



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

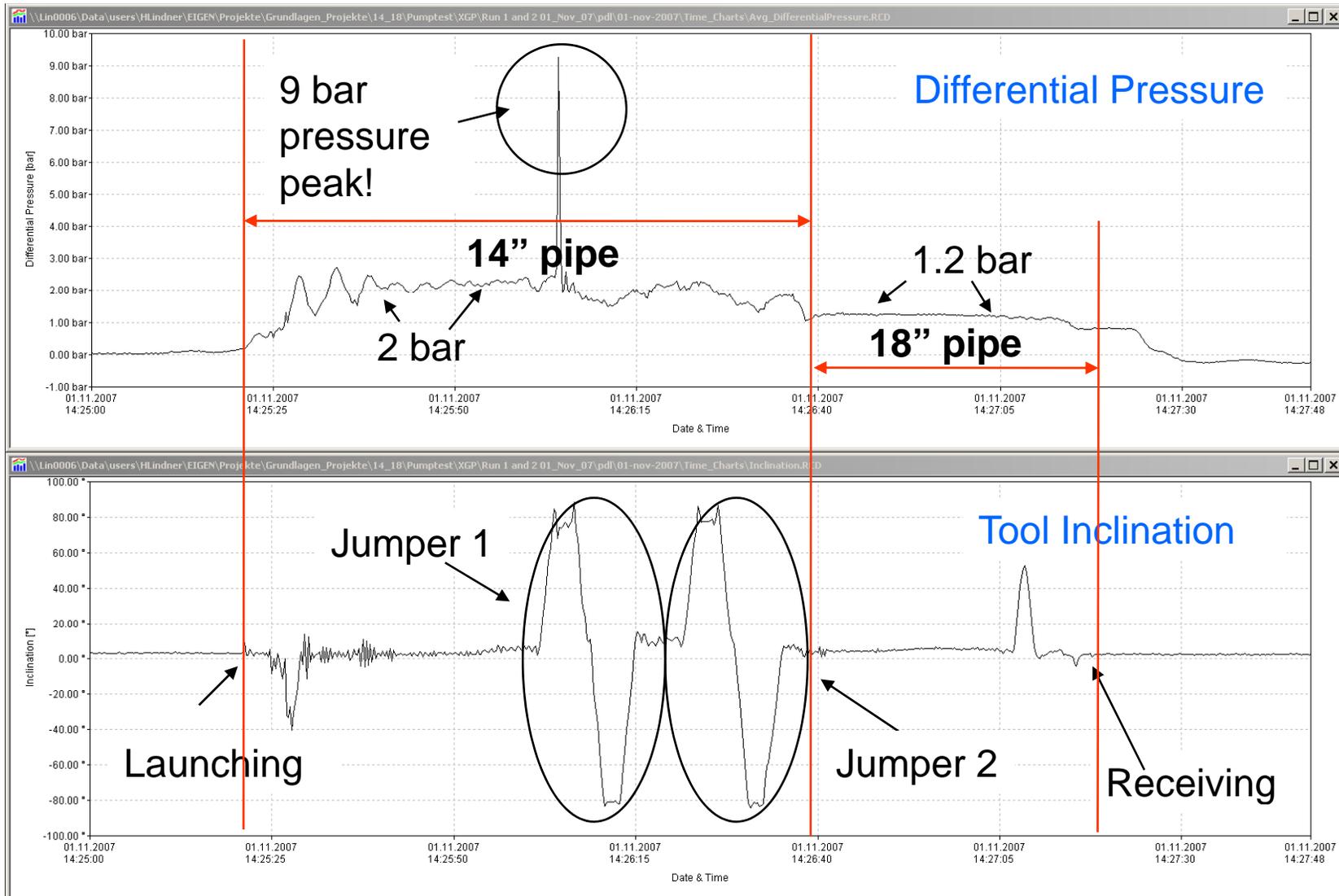
3. **Tests in the 14"/18" test loop: (shown in the following)**

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

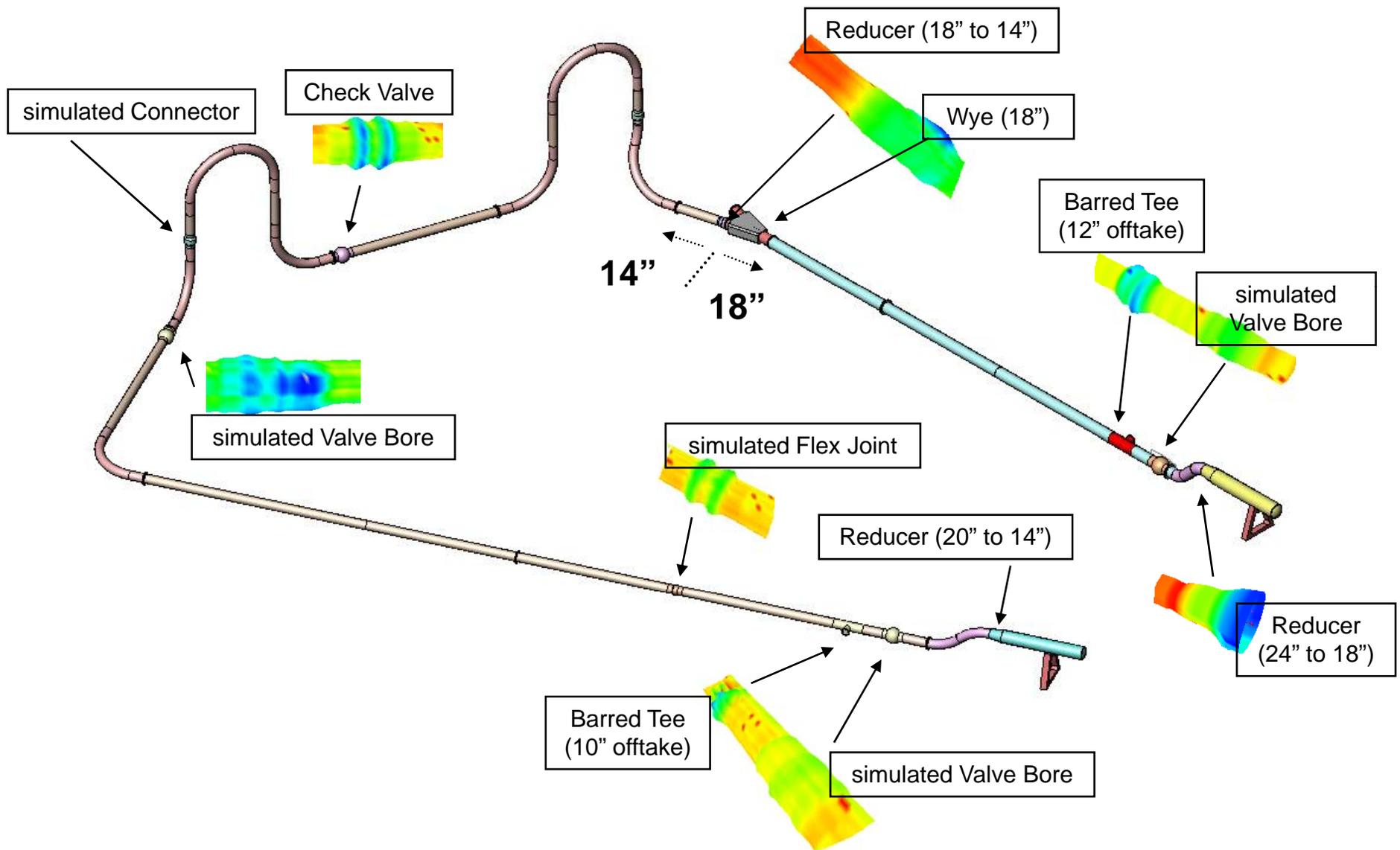


Synchronized Analysis of PDL Data

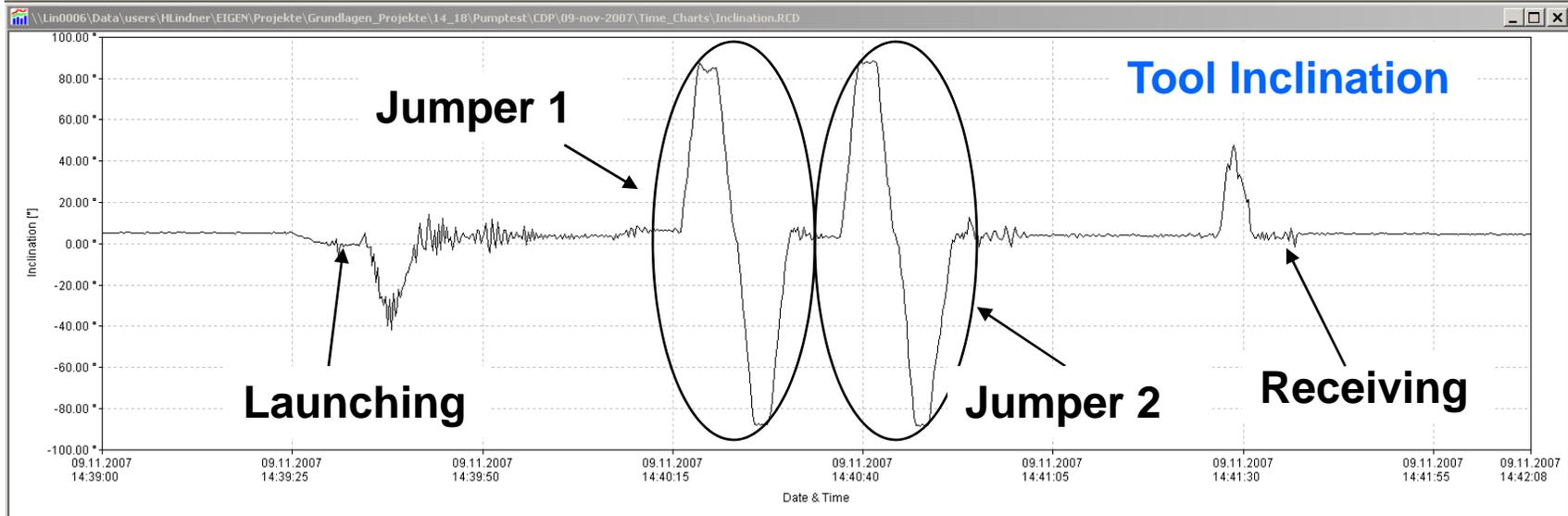
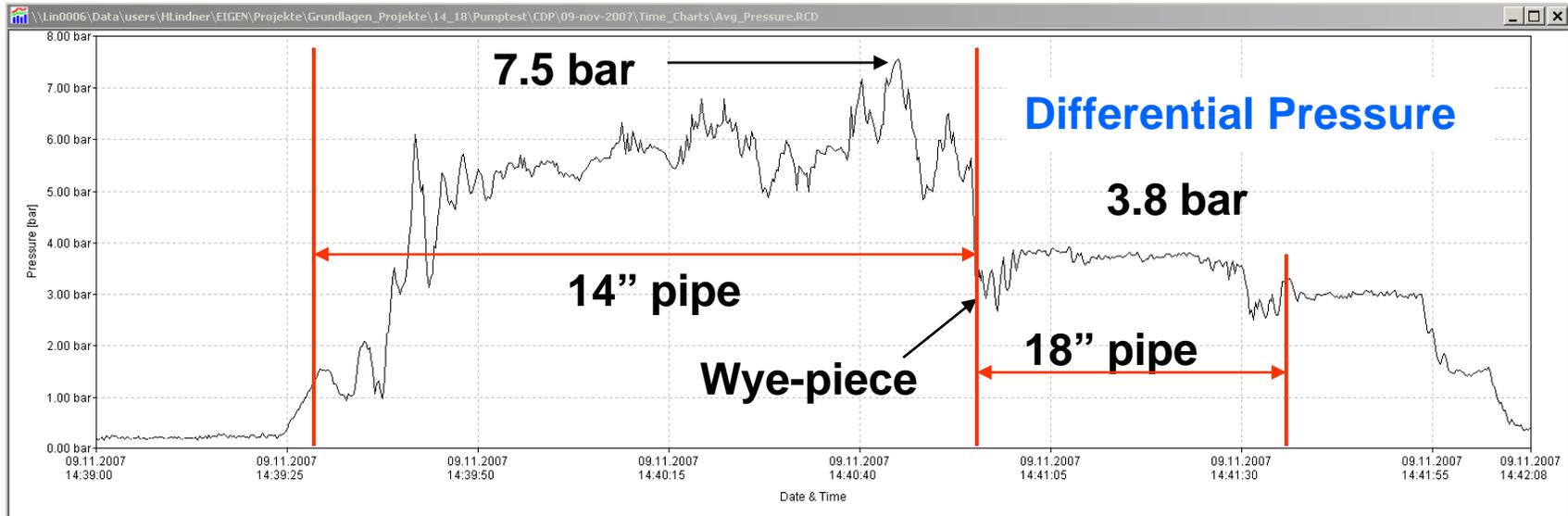


5. 14"/18" XGP: Pump Test Results

3D color-view of caliper data (not to scale)



5. PDL Data of CDP Pump Tests in 14"/18" Loop



6. Contingency Plan

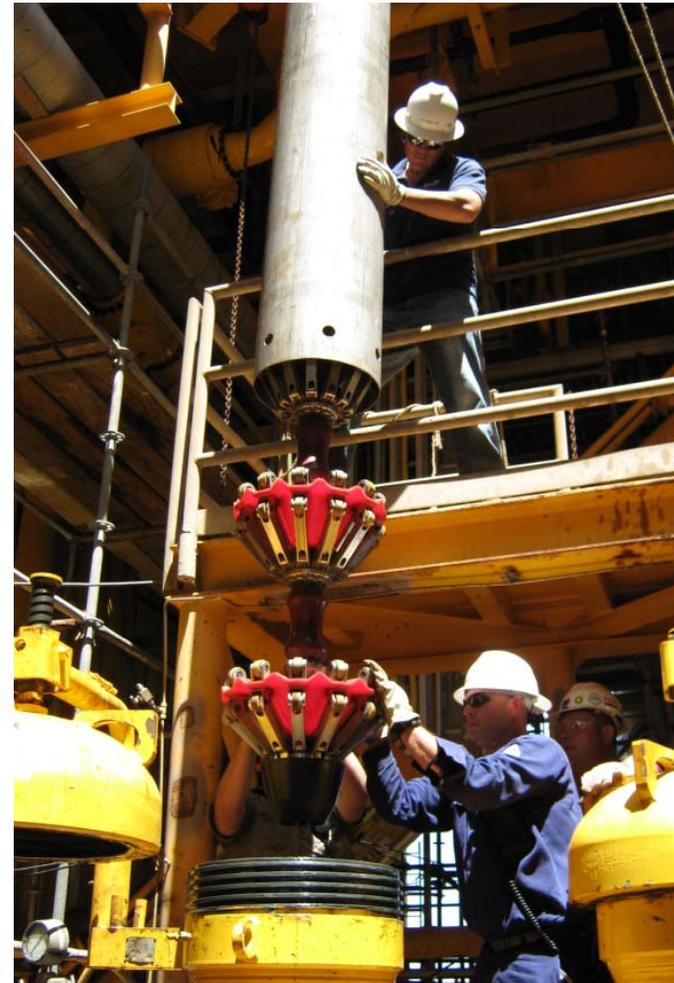


Discussion and definition of a contingency plan between ROSEN and the Operator!

- 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"



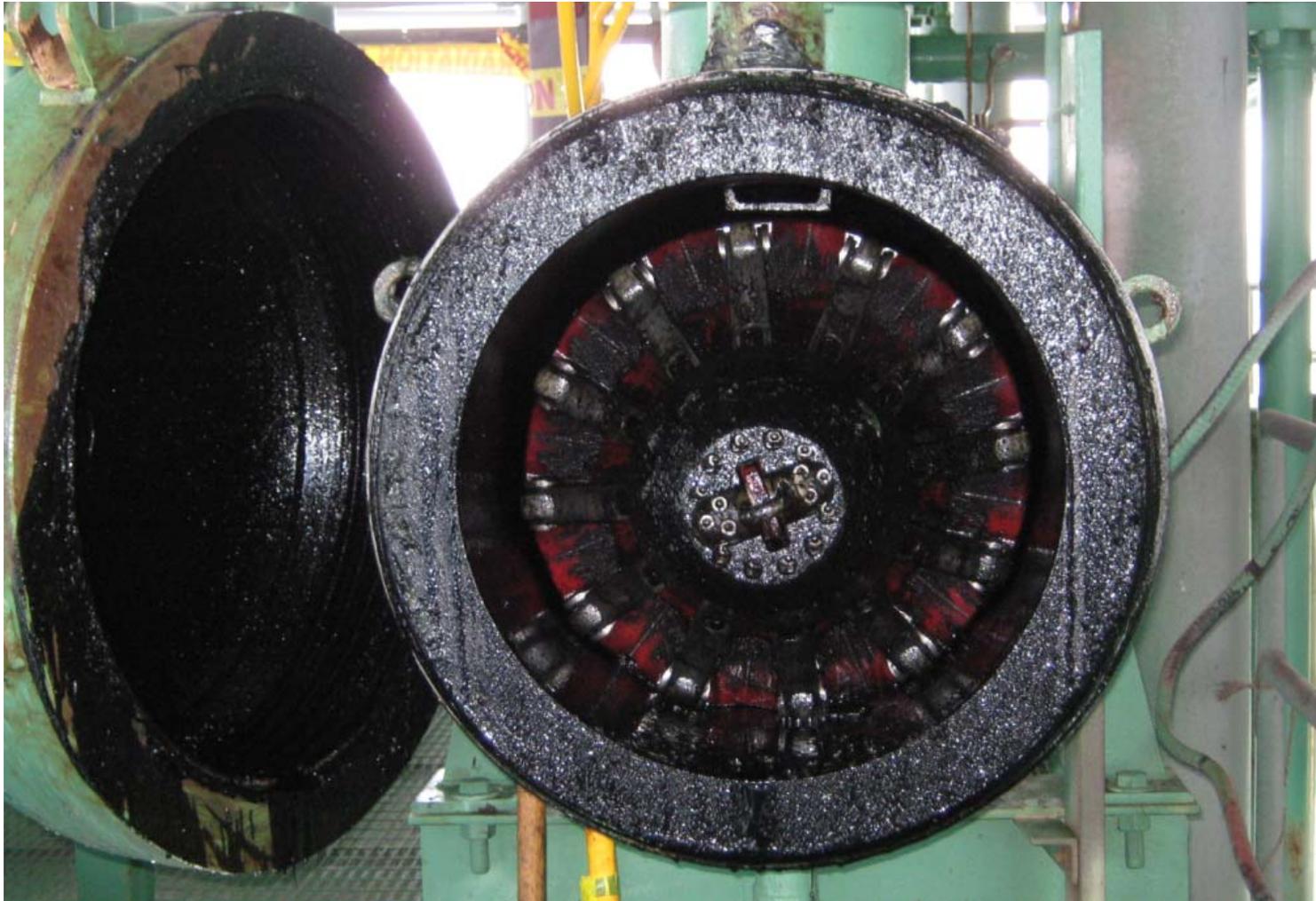
7. On-Site Operations

Launching tube was required because of Launcher length!



7. On-Site Operations

Tool in Receiver after smooth and successful run with complete Data!

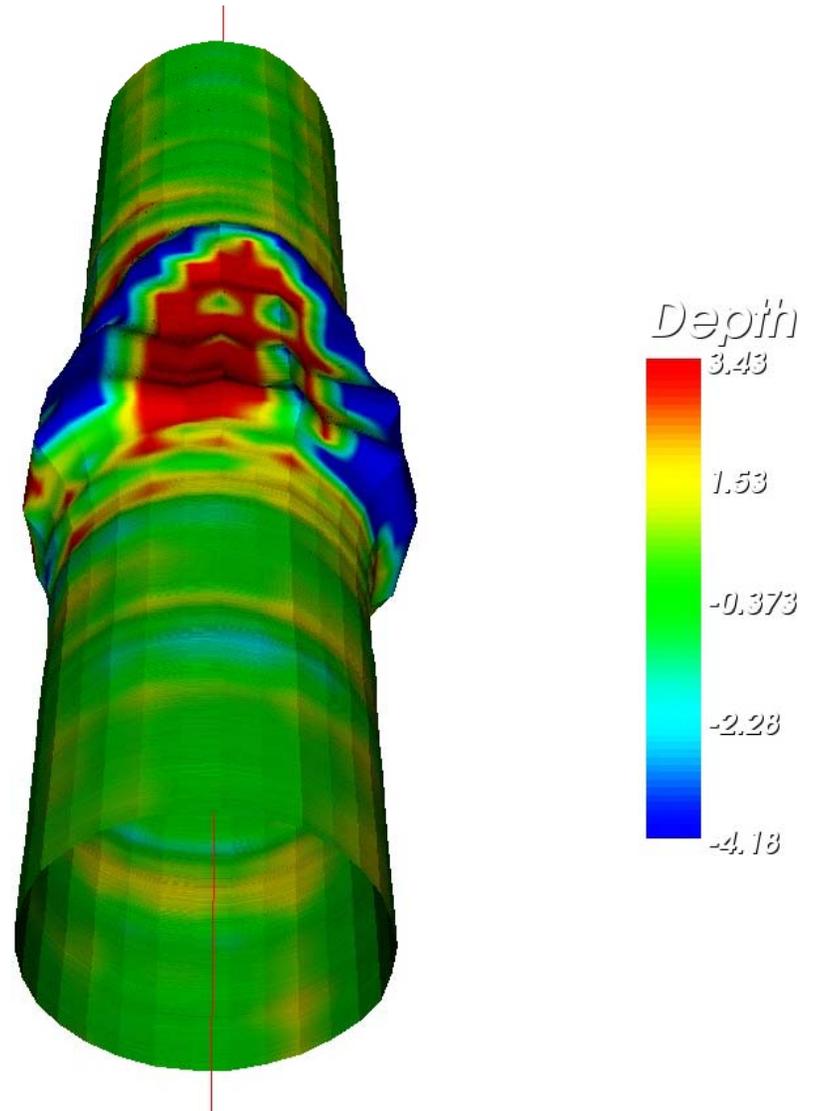


7. On-Site Operations



Geometry Tool measurement of check valve.

Checked immediately and approved for MFL run.



8. Summary



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.

