

# Pigging in the Arctic Circle

Challenging operational variables

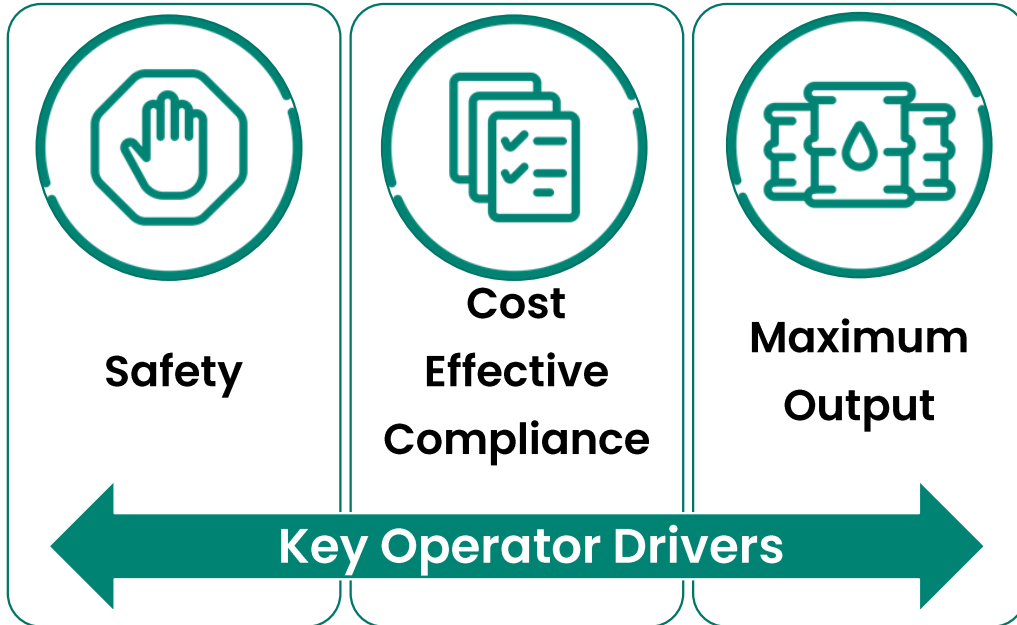


**Richard Sharvin – ILI Sales Manager**

Prepared for: PPSA Virtual Seminar, 18 November 2020

# Introduction

## ➤ Variable Operator Challenges

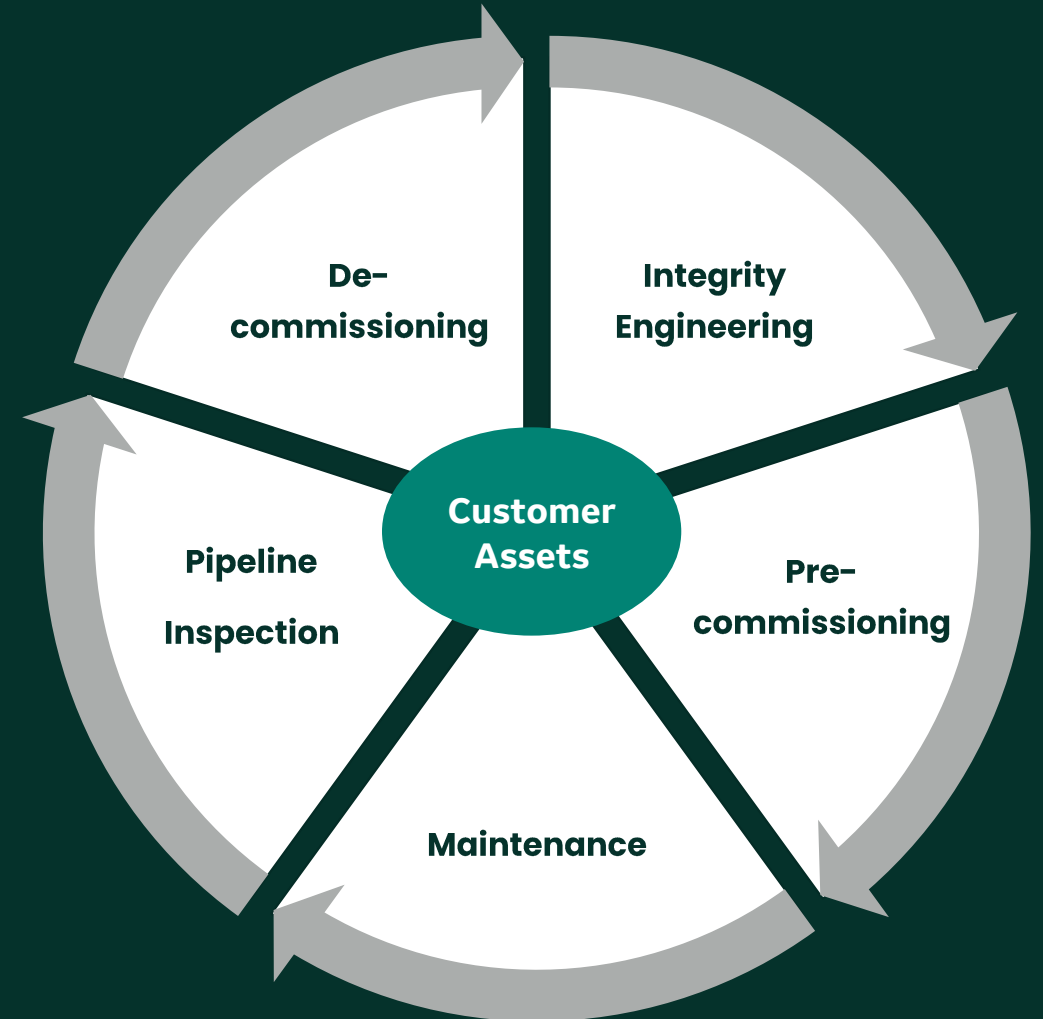


## ➤ Role of Inline Inspection (ILI)

- Inspect and analyze pipelines
- **Reliable & Accurate data** to assess + **predict** potential issues
- **Enhanced Profitability** via effective **Pipeline Integrity Management**

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# Baker Hughes – Process & Pipeline Services (PPS)



- **Delivering actionable insights to enable decisions that promote environmental and public safety**

**Baker Hughes** 

# Pigging in the Arctic Circle



Introduction

**1. Project background**

2. Planning & Preparatory work – 2017 ILI Program

3. 2017 Operation review & collaboration



4. Feasibility Study & Testing

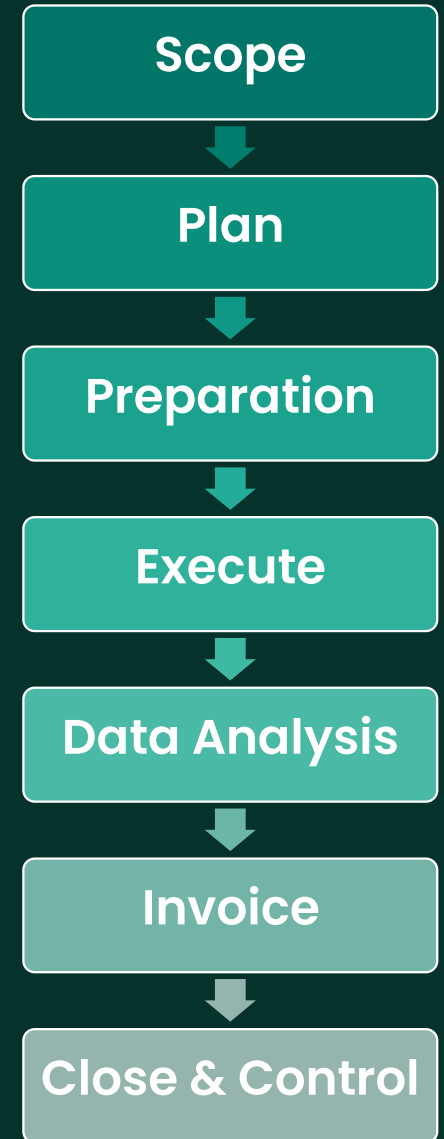
5. Operations Execution – 2019 ILI Program

6. Minimum ID identification

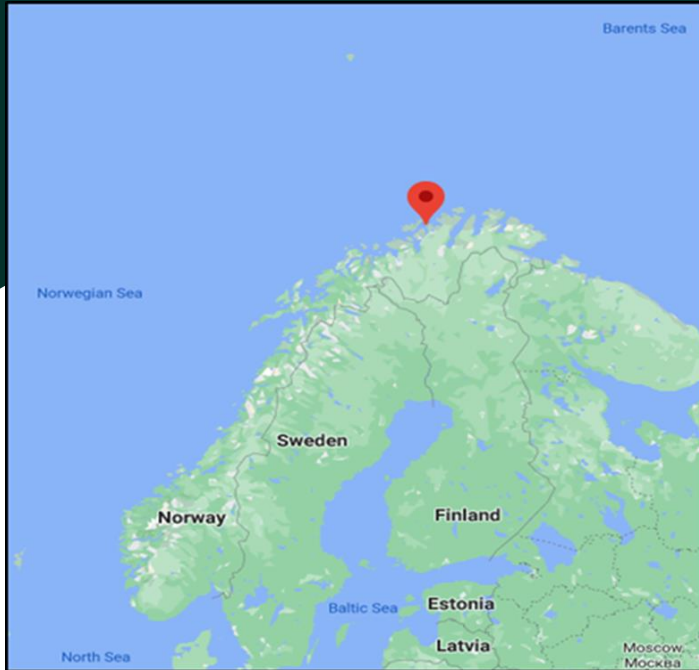
Conclusions

# Project background – Goliat Field 2017

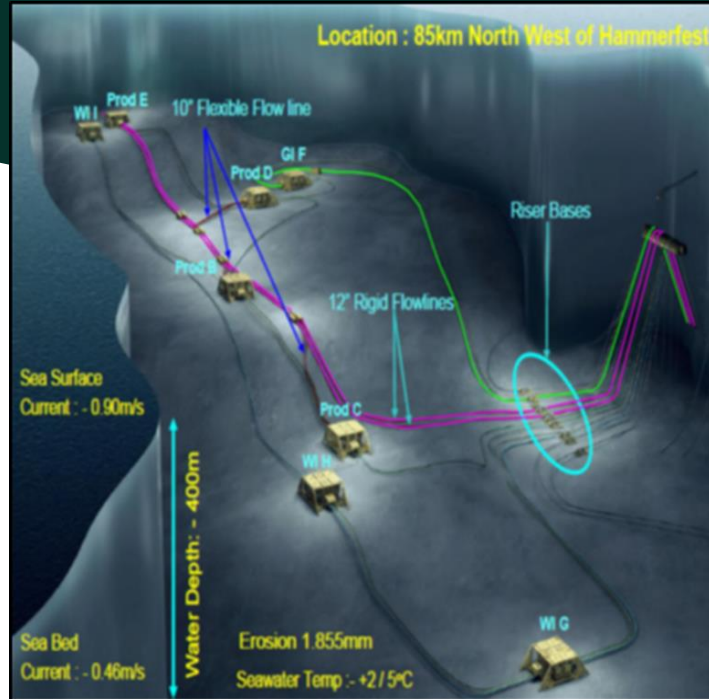
- **IKM Testing ITT for ILI survey – 10"x7km Gas Injection Line**
  - SOW initially scheduled to be performed in Aug/Sept 2017
  - Temporary subsea trap (PLR) to main deck onboard the Goliat FPSO:
    - Assess the internal pipeline geometry
    - Create a pipeline tally
    - Detect metal loss defects
    - Map the pipeline route (3D)
  -  IKM was the EPC and  
IKM Testing AS
  -  Var Energi the Operator  
vår energi
  - Competitive tender process



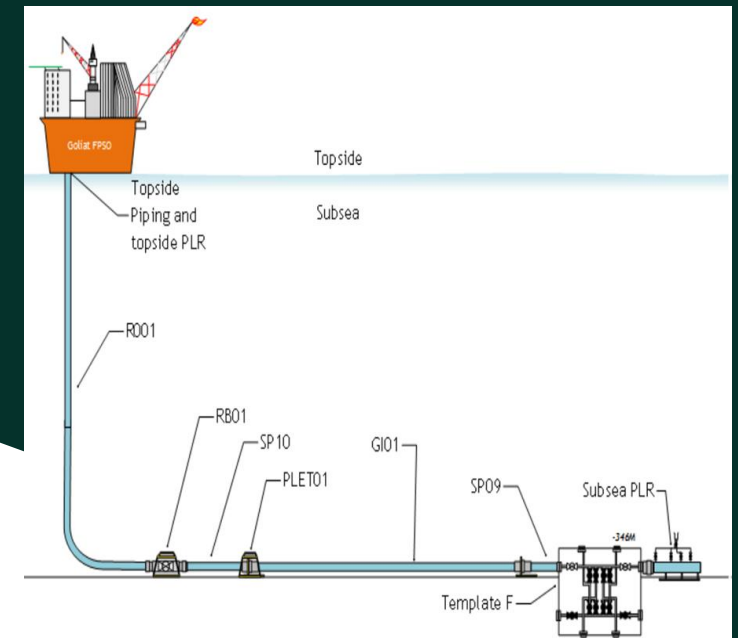
# Goliat Field & 10" x 7km Gas Injection Flowline



- Goliat Field located in Barents Sea
- ±50 nautical miles NW of Hammerfest, Norway
- Water Depth of 430m



- Eight templates in total:
  - 4 x production templates
  - 3 x water injection templates
  - 1 x gas injection template



- Operational since 2016
- Max. Pressure: 170barg
- Seabed ambient / 5°C
- Nominal WT – 14.5mm
- Velocity 0.3 – 0.5 m/s
- Pipe type: Seamless

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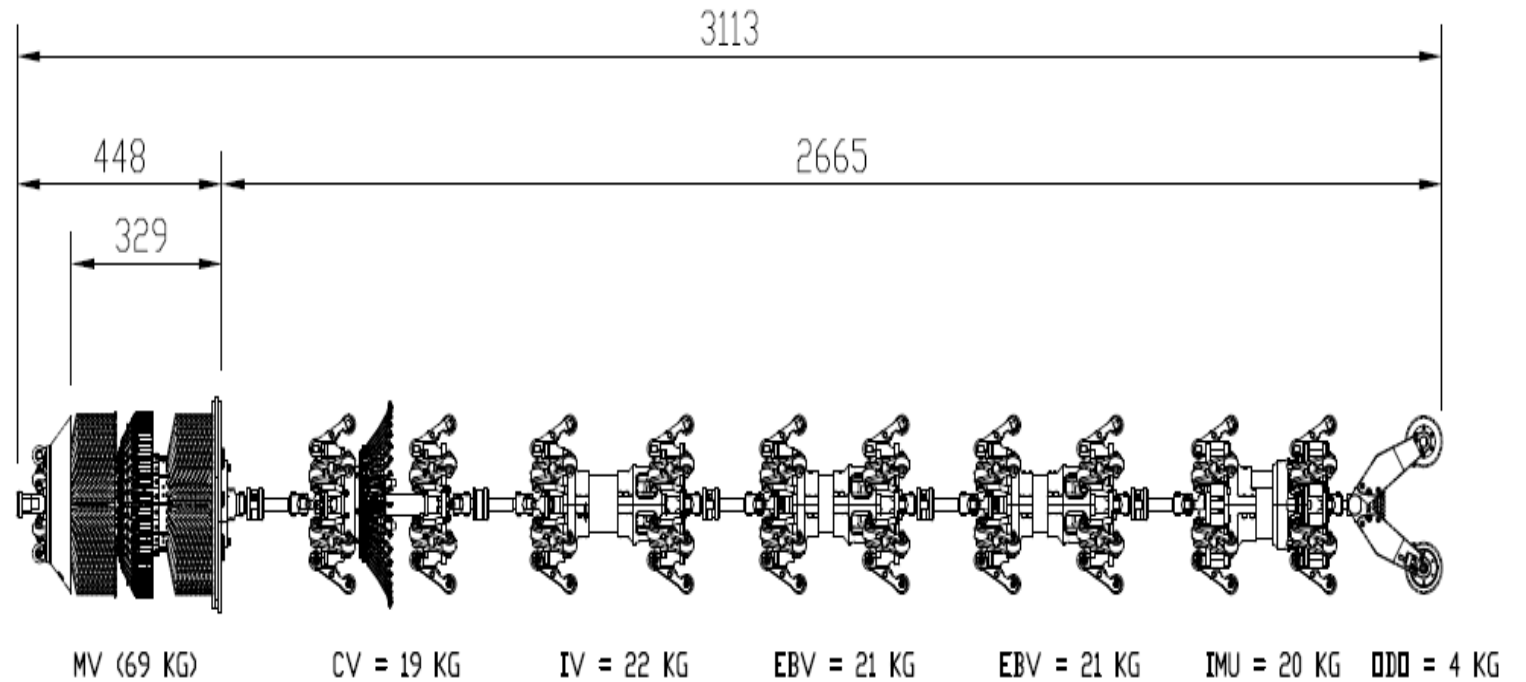
6. Minimum ID restriction

Conclusions

- Line length
- Steel grade
- Manufacture type
- Bend Radius
- Wall Thickness (WT)
- ID/OD
- Temperature
- Pressure
- Previous ILI data
- Trap data
- Min/Max bore

# 2017 Inspection preparation – Tool build

## IKM tool build 10" MFL4 Inspection Train



**MV** Magnetizer Vehicle  
**CV** Caliper Vehicle  
**IV** Instrumentation Vehicle  
**EBV** Extra Battery Vehicle  
**IMU** Inertial Mapping Unit

# Execution of ILI Operations

## ➤ Delivery of ILI tool and support equipment

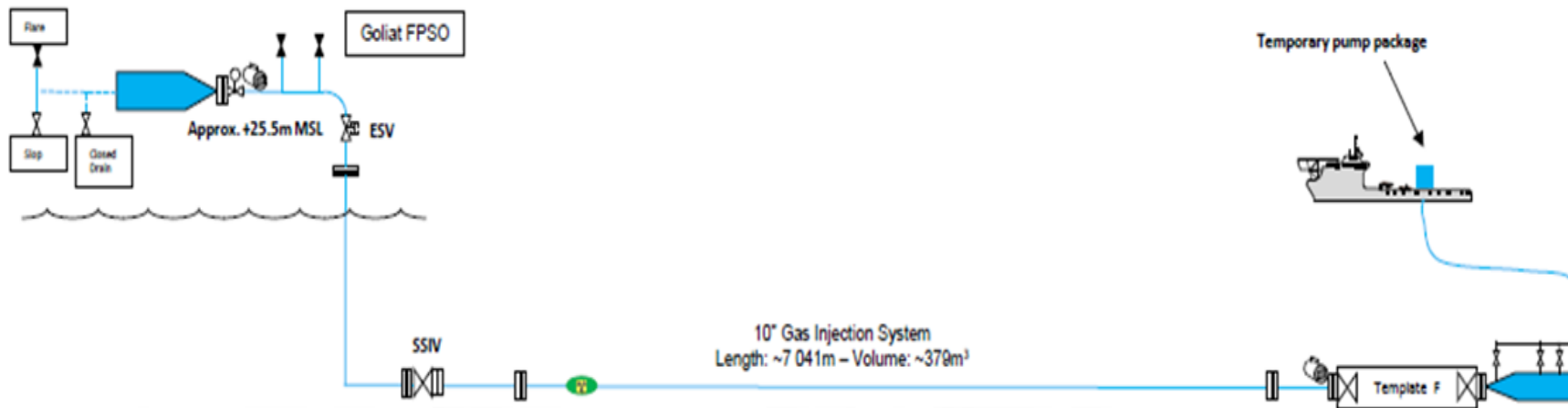
- To IKM Testing onshore facility at Hammerfest
- ILI loaded onto Deep Ocean vessel Edda Fauna
- Receive equipment mobilized to Goliat FPSO

## ➤ Launch and receiver co-ordination (MFL)

- Subsea PLR pre-loaded with MFL inspection vehicle
- PLR lowered and connected to subsea manifold

## ➤ Key Challenges

- Logistics
- Support vessels
- Operations window
- Parallel operations
- Two inspection vehicles
- Weather





# 2017 Gauge Run



## ➤ Critical analysis of gauge plate results – 2017

- 215mm diameter aluminium – 4mm thick (segmented)
- Minimum diameter measured at 211.18mm
- 211.18mm = 24.5% bore restriction
- Operations suspended
- Baker Hughes, IKM & Vår Energi review results

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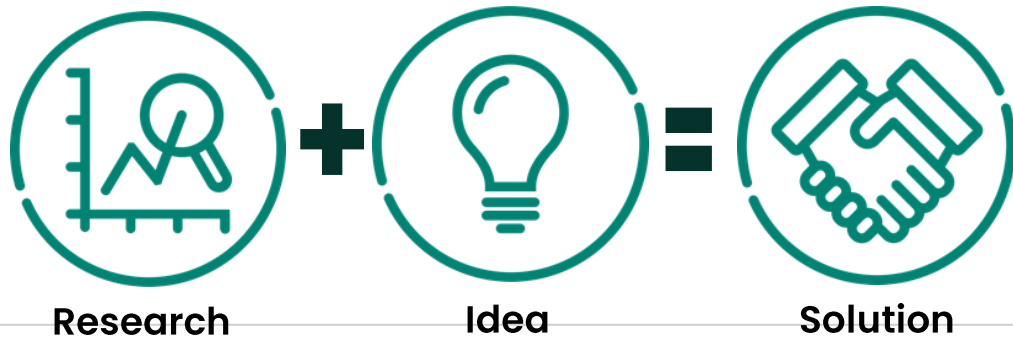
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# 2017 Operational review & collaboration

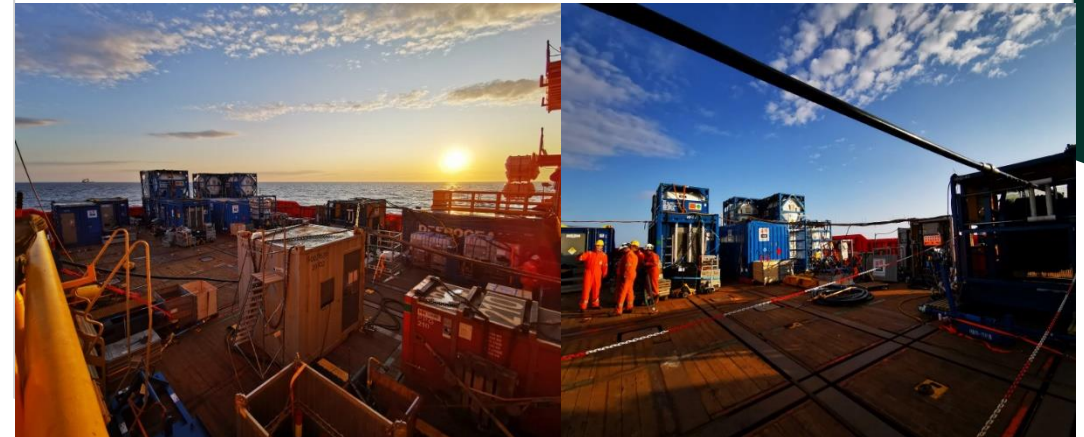
## ➤ Root cause analysis

- Review piggability table
- Consider IDs of each pipeline segment
- Risk review of progressing into unknown
- Demob to consider alternative solution



## ➤ Collaboration

- Baker Hughes & IKM Testing
- Objective to locate, identify and pass the restriction
- Full line inspection data
- Feasibility Study
- Target inspection date August 2019



# Pigging in the Arctic Circle

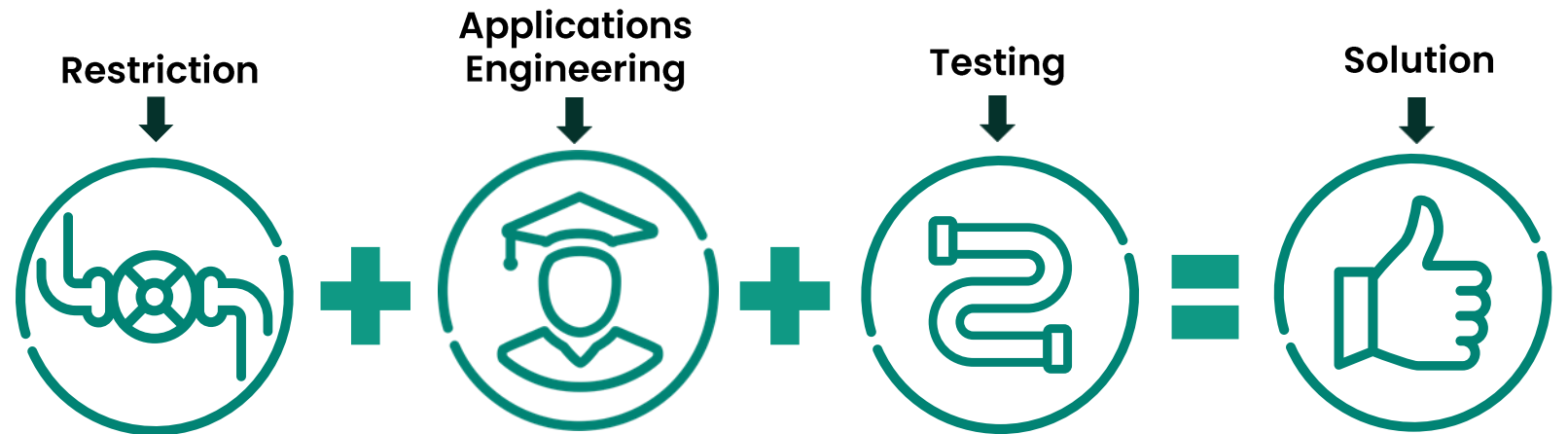
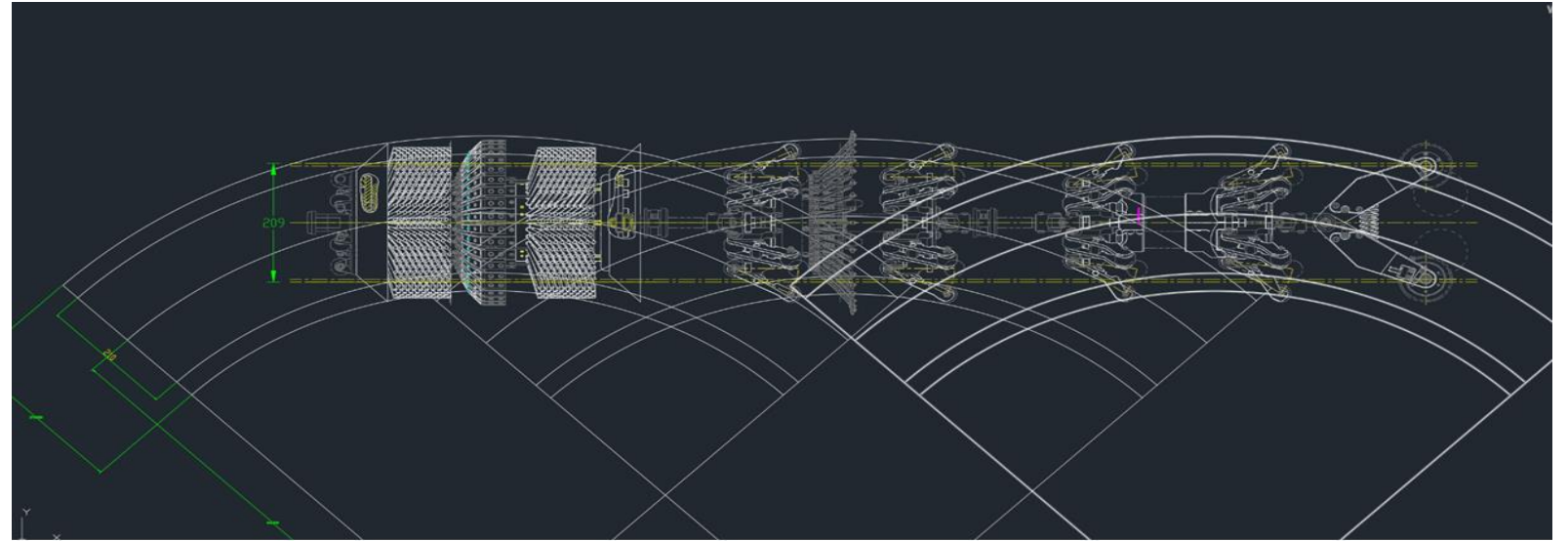


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# Feasibility Study

- CAD modelling
- Applications Engineering
- Reduced bore assembly
- 5D bend of 210mm
- 205mm straight pipe
- Derived Caliper Solution
- Project Management



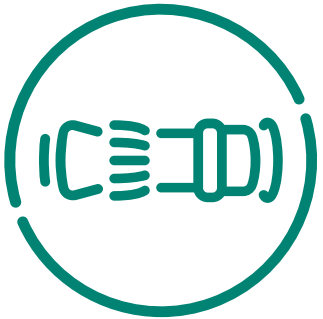
# Testing – objectives

The objectives of the testing phase were two-fold:

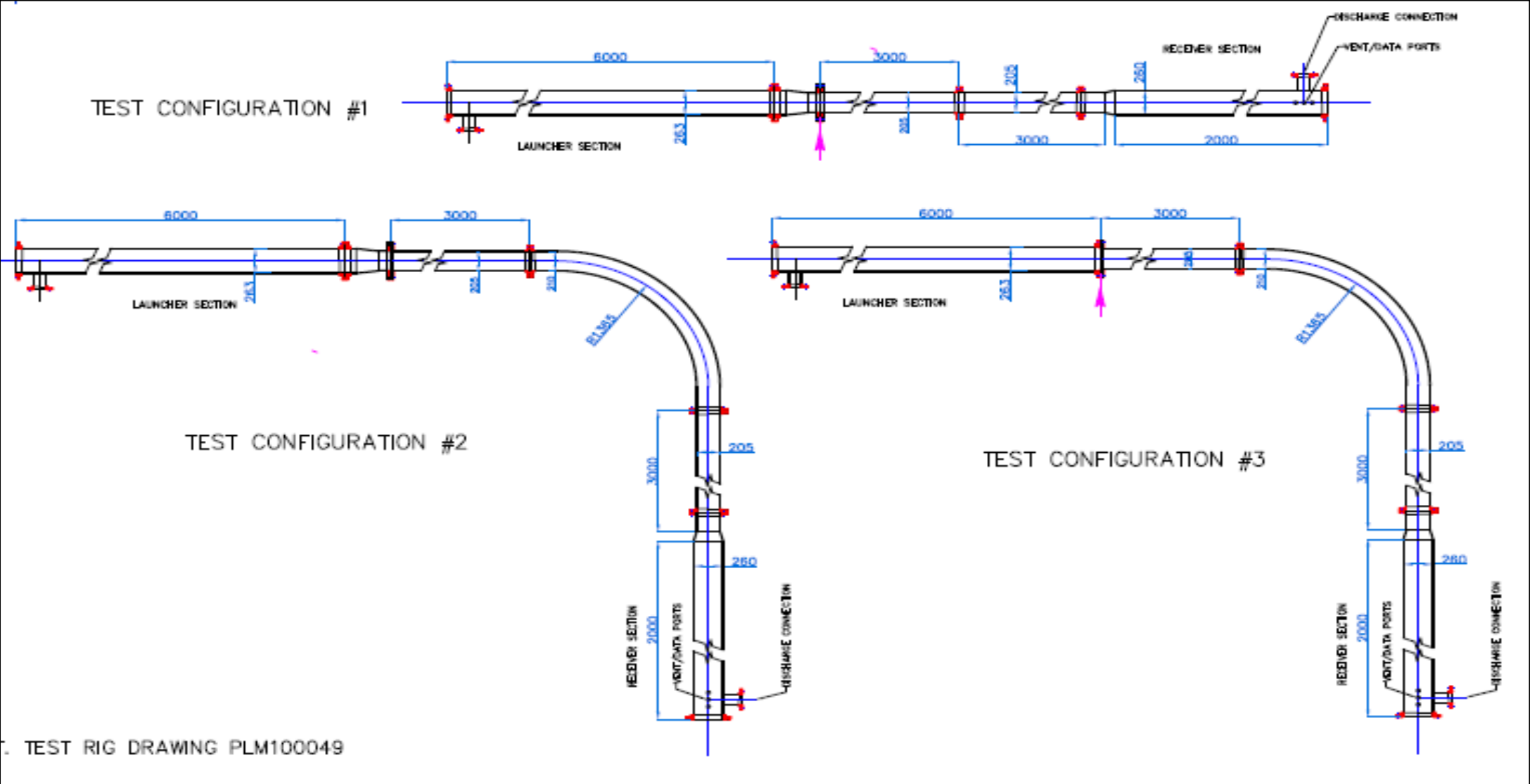
1. To utilise the pull-in equipment to replicate the loading of the PLR (Pig Launcher / Receiver) onboard the dive support vessel



2. Demonstrate a variety of bore passing capabilities restrictions.

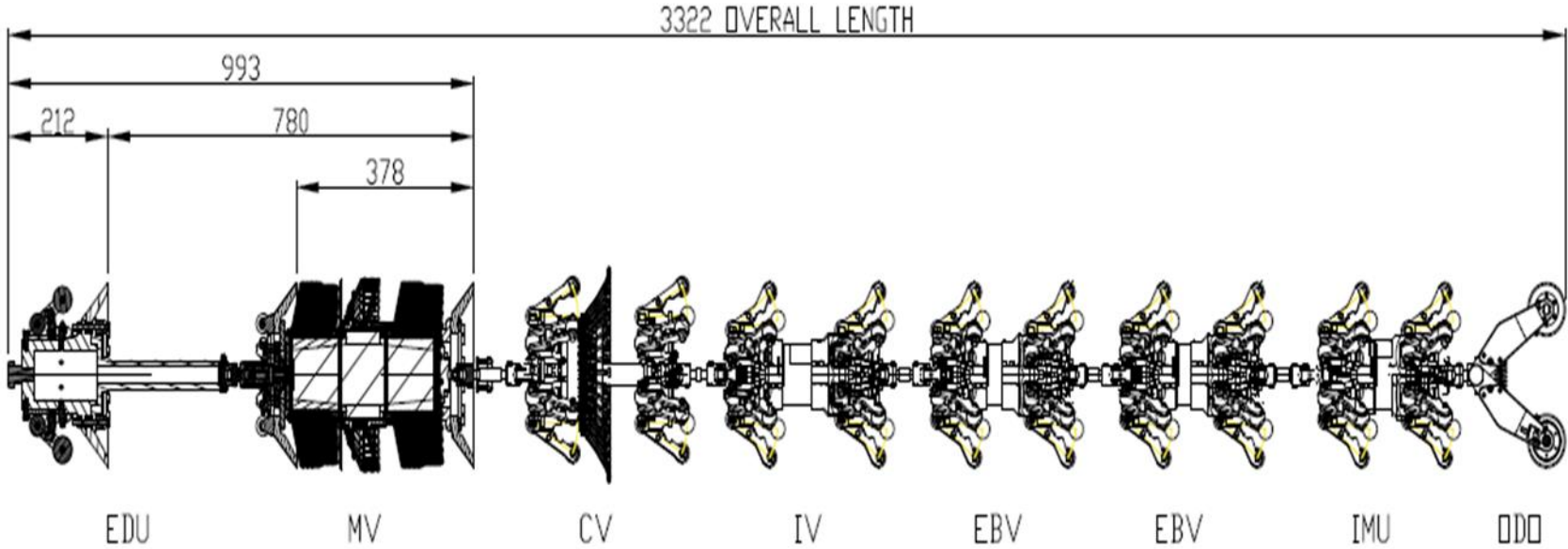


# Test Rig Configuration



# Technical sketch modified MFL train

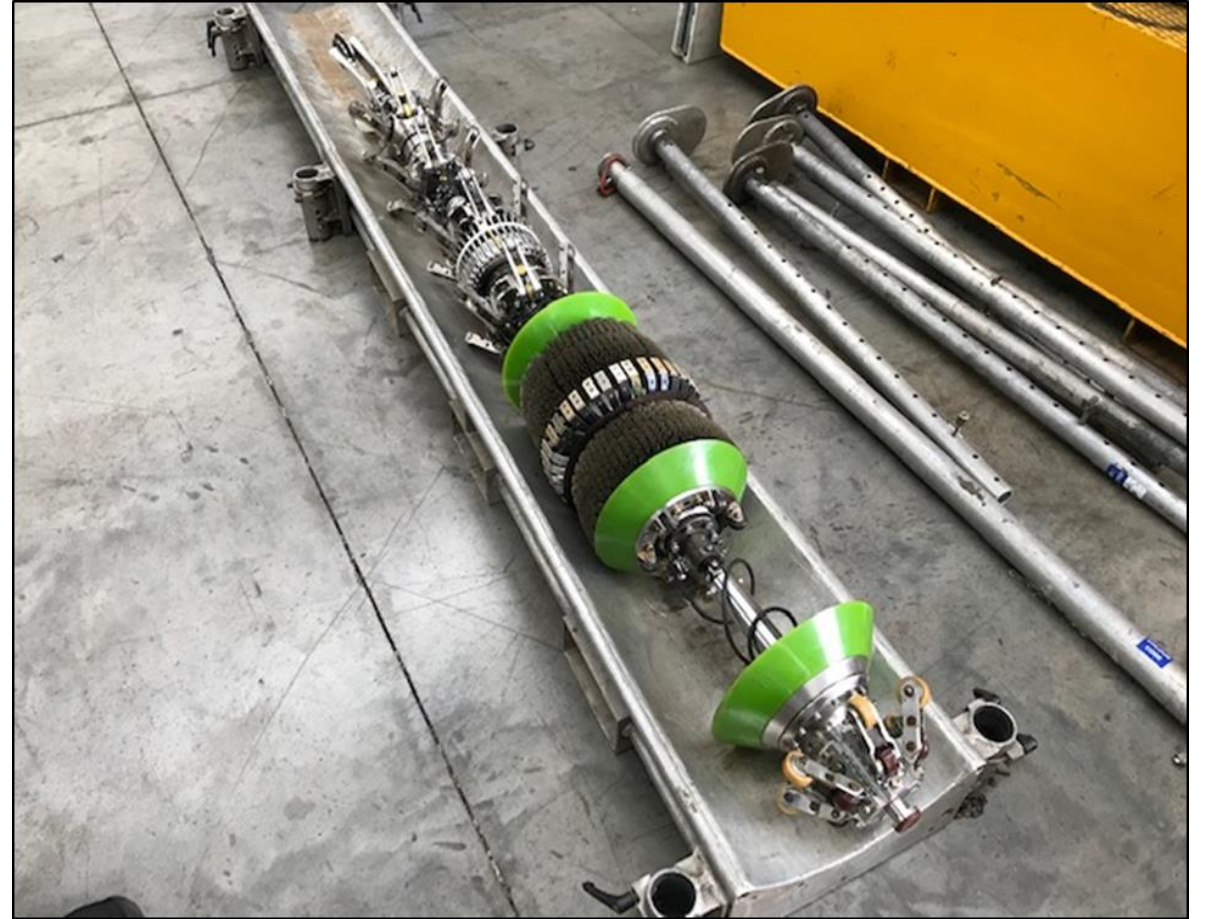
- EXTRA DRIVE UNIT (EDU)
- MAPPING UNIT (IMU)
- EXTRA RANGE BATTERY VEHICLE (EBV)
- SHORT TRAP ASSEMBLY (SHORT TOWBARS)
- 8 MODULES IN TOTAL





# Modified MagneScan MFL Inspection Vehicle

- **Minimum Bore Passing:**
  - 210mm 5D, 205mm in straight pipe
  - Modified bristle rings
  - Suspension modifications
- **Improved Sealing**
  - Guarantee drive in low flow
  - Addition of rear cup
  - Extra drive module to front of the tool
- **Output**
  - Modifications successfully negotiated all sections of test rig
  - Analysis of data confirmed FULL tool functionality



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# 2019 Inspection Program

- **Planning and Preparation as per 2017**
  - **Mobilisation ILI equipment**
  - **Client cleaning + NEW gauge inspection**
  - **Standalone Caliper (optional)**
  - **10" MFL Inspection**
  - **Fast Track Infield Analysis**



# 2019 Gauge Run



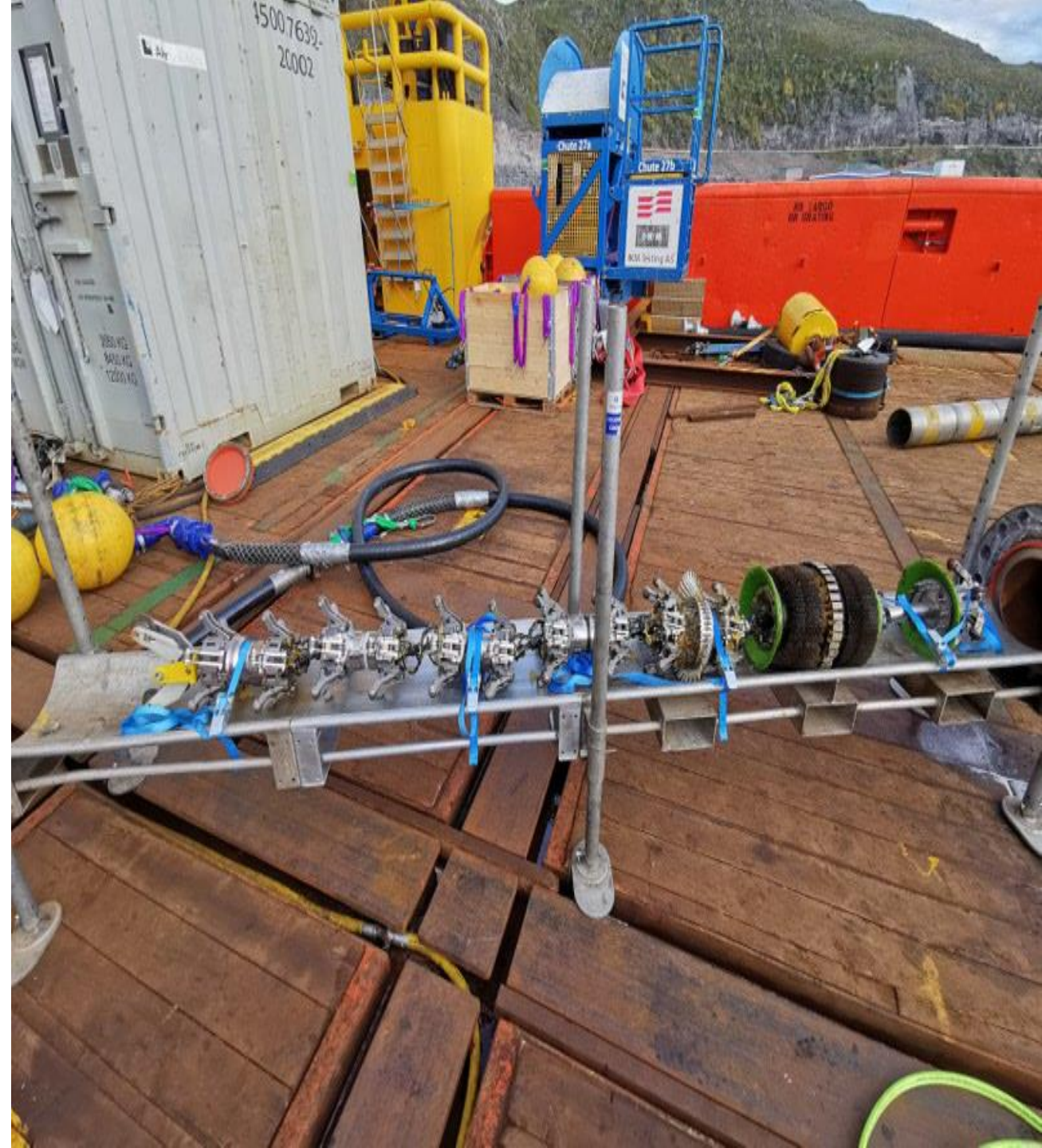
209.96mm



209.63mm

# 2019 MFL Inspection

- Tool launched 11.09.2019
- Run time: 8 hours 7minutes
- Velocity: 0.2 m/s
- Swift infield data analysis confirmed 100% data captured
- Analysis uploaded to Cramlington, UK
- Final inspection report and presentation held at Vår Energi office

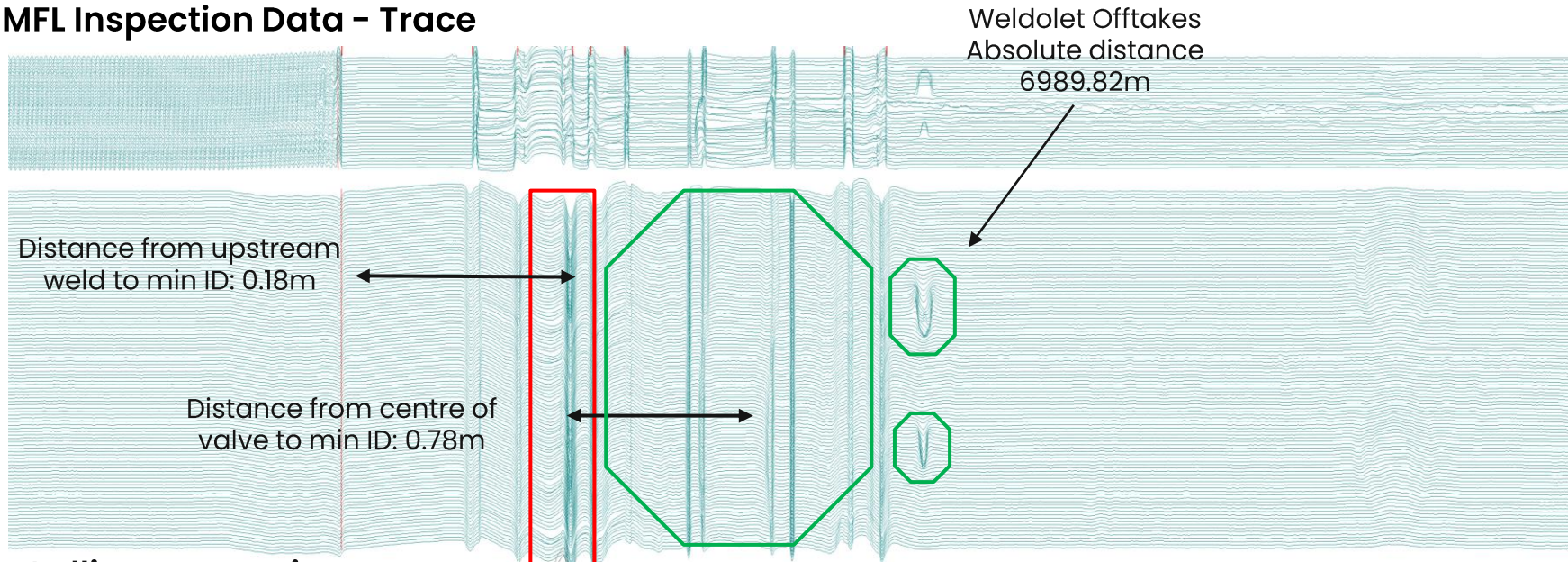


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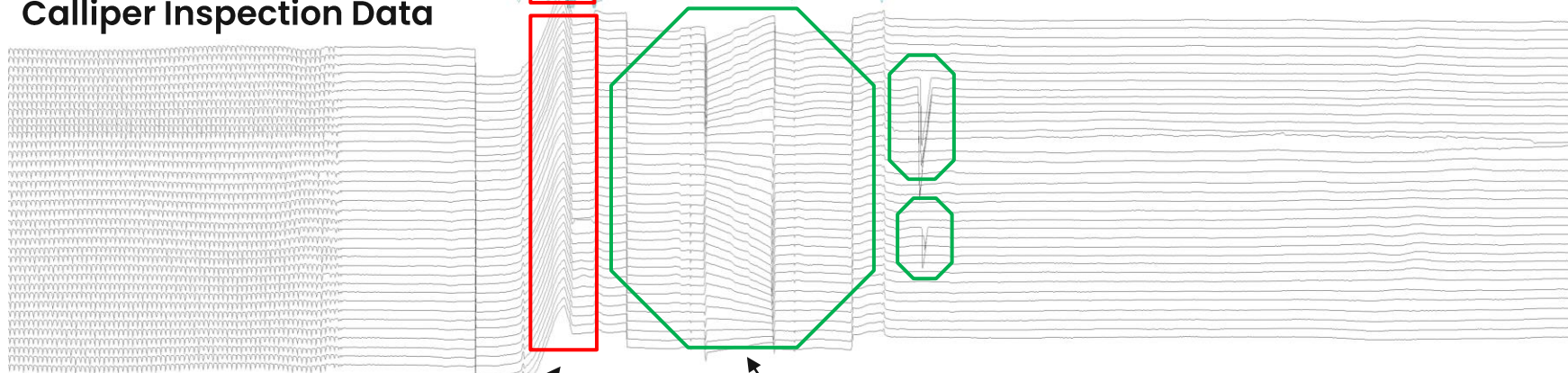
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- 1. Project background
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# Where was “the bore restriction”?

## MFL Inspection Data – Trace



## Calliper Inspection Data



Pipe spool – IKM no 22  
Data spool average ID  
254.24mm  
IKM ID 254.0mm

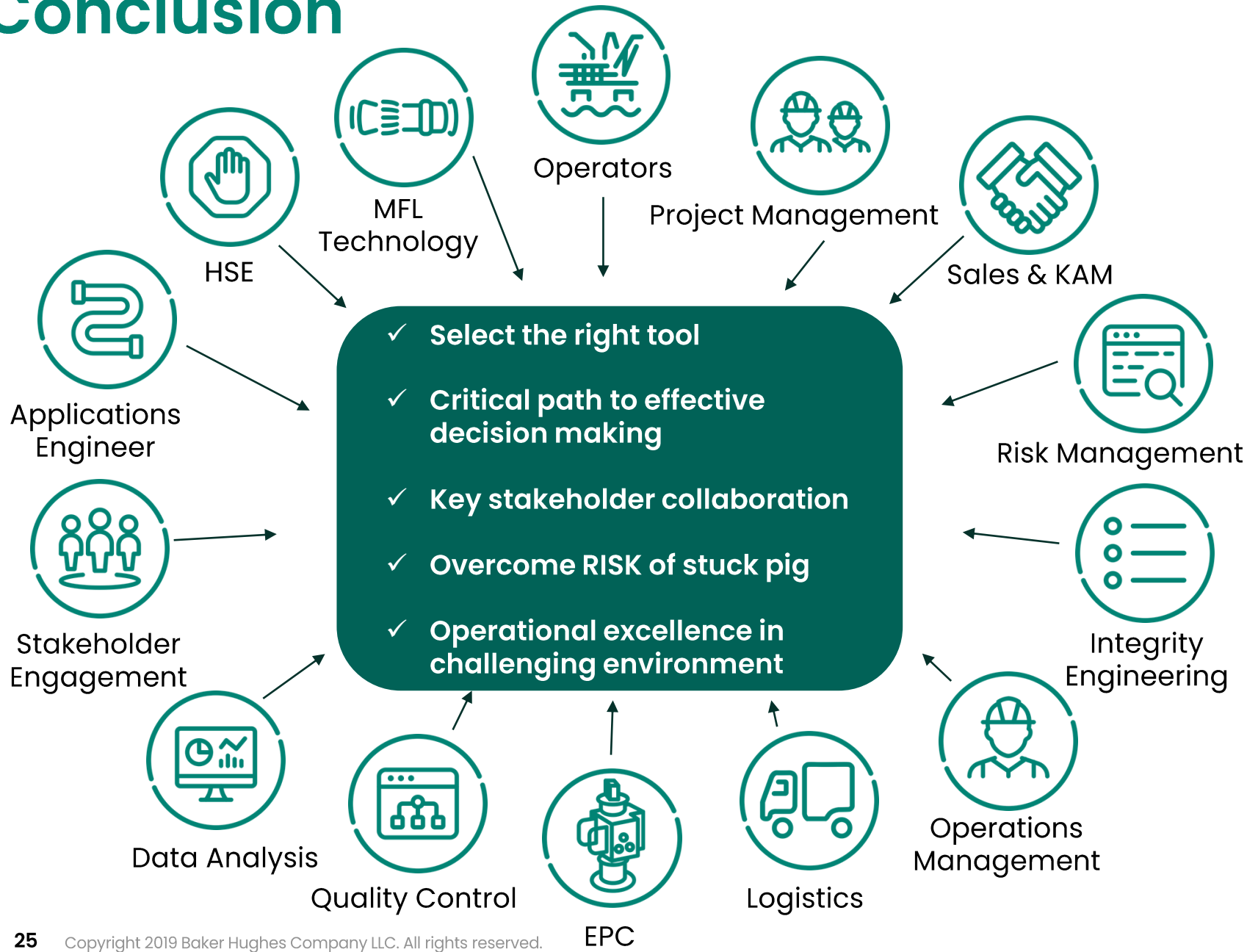
- Benefits of integrated data set
- The minimum ID was measured as 208.2mm
- Located in the receive area of the pipeline, at absolute distance 6988m
- High Resolution

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# Conclusion



- Stakeholder collaboration
- Technology / engineering
- Benefits of testing
- Management of Change
- Robust & proven technology
- Theory validation
- Pipeline intelligence
- Experience
- Lessons learned

Thank You ...

Open to Q&A...