Tracerco
Insight through innovation

Subsea CT Scanning

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Agenda

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01 Technology overview
02 Qualification
03 Internal corrosion
04 External corrosion
05 Overstress or fatigue
06 Flow assurance
07 Recent developments
08 Questions

Technology overview

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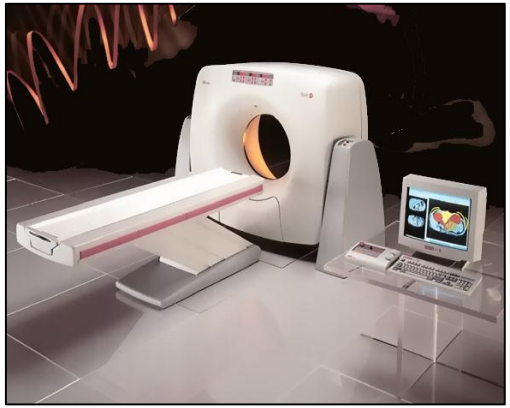
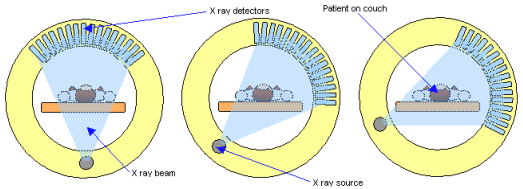
- Same principle as medical CT scanner
  - Reconstruct image from a series of line measurements
- One key difference
  - Target is mostly steel, not body tissue (~water)
- Therefore using gamma rays instead of X rays
- Huge knock-on on physics and engineering





Technology overview

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- Truly non-intrusive technology
  - Scan through any coating
  - No coating damage
  - No interference to production
- Integrity and Flow Assurance data in a single scan
- Real time data
- .03g/cc density resolution
- 10,000’ water depth
- 6”-26.5” Total OD capabilities
- Work class ROV

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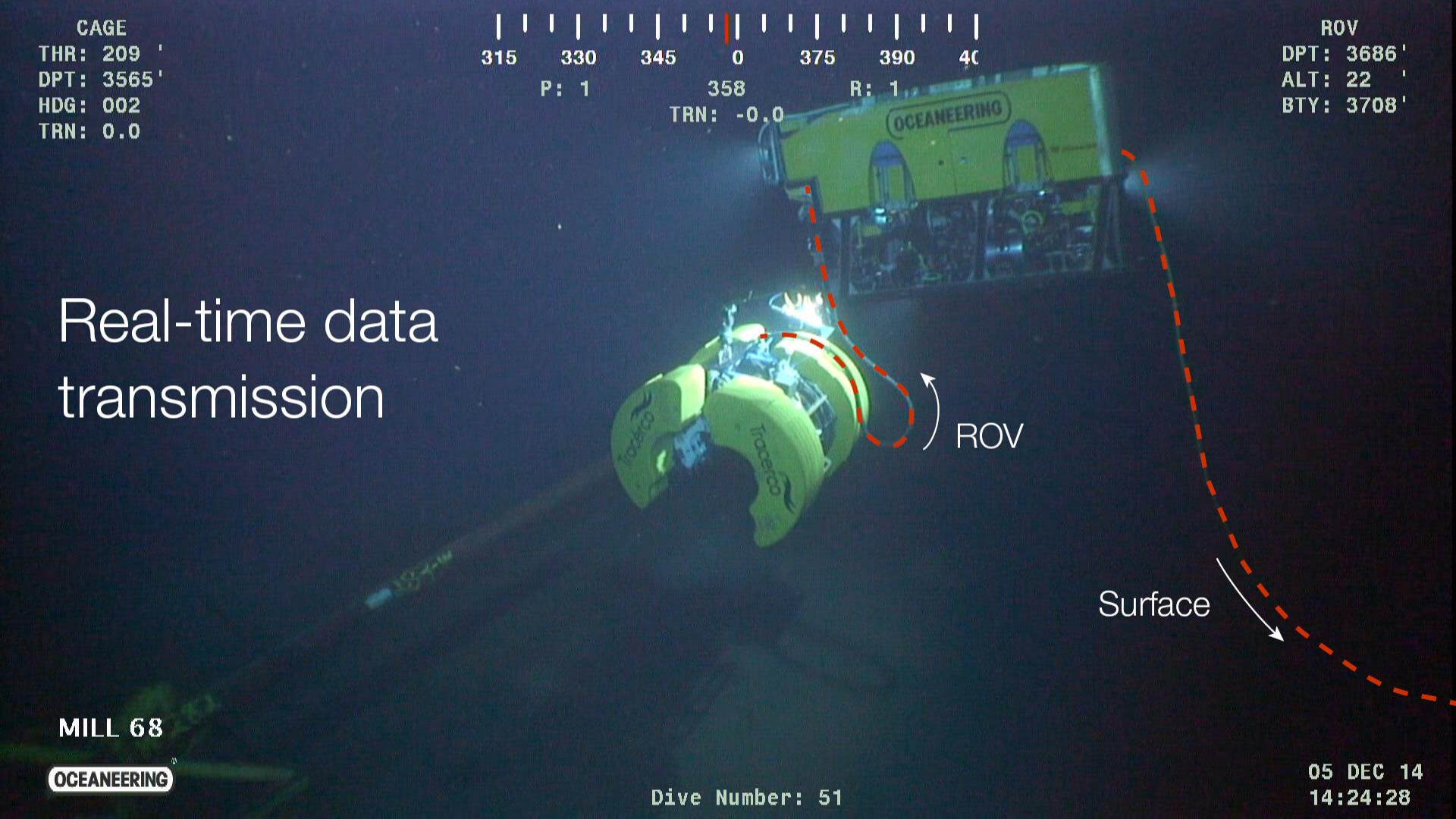
CAGE
THR: 209 '
DPT: 3560'
HDG: 004
TRN: 0.0
315 330 345 0 375 390
P: 0 357 R: 1
TRN: -0.0
ROV
DPT: 3683'
ALT: 25 '
BTY: 3708'
OCEANEERING
MILL 68
OCEANEERING
Dive Number: 51
05 DEC 14
14:24:15



Real-time data transmission

Qualification

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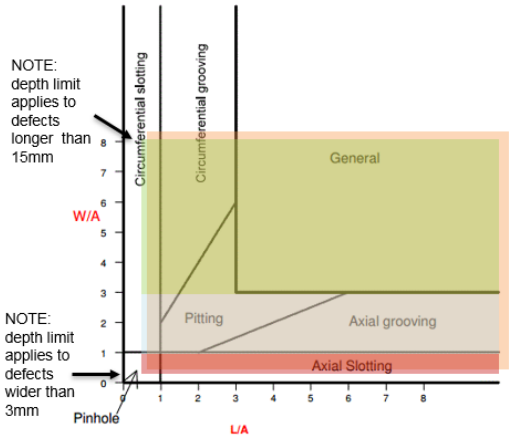
- System has completed a recognised qualification program
- Equivalent capability to MFL Inline Tools in terms of POD and Sizing Accuracy
- Particularly of value in the following use cases:
  - Cross checking ILI findings
  - Local Inspection of unpiggable lines
  - Challenging or complex systems such as thick coatings, bundles, PIPs



The geometrical parameter A is linked to the NDE methods in the following manner:

- If t < 10 mm then A = 10 mm
- If t ≥ 10 mm then A = t

Figure 2: Graphical presentation of metal loss anomalies per dimension class.

Metal Loss Anomaly classification based on POF Specification 2016 / API 1163

Group 3 Depth limit 90%POD, 95%CI = 1.2mm	For all Groups Depth limit 90%POD, 95% confidence interval = 2.0mm
Group 2 Depth limit 90%POD, 95%CI = 1.2mm	
Group 1 Depth limit 90%POD, 95%CI = 2.0mm	

- Shell, Chevron, DNV, LLOG, CNOOC, Hess, Lloyd's, Talos, Fieldwood, ConocoPhillips

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Internal corrosion

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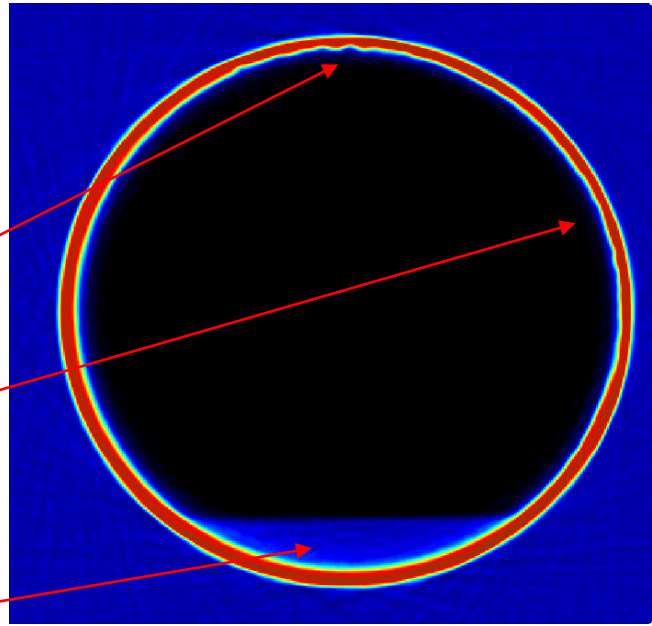
- Large diameter gas line
- Major wall loss observed in multiple locations around the pipe
- Condensate in the pipe - a possible contributing factor to internal corrosion



Severe wall loss

Condensate

Internal corrosion

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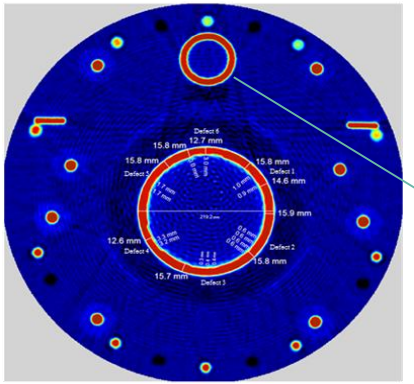
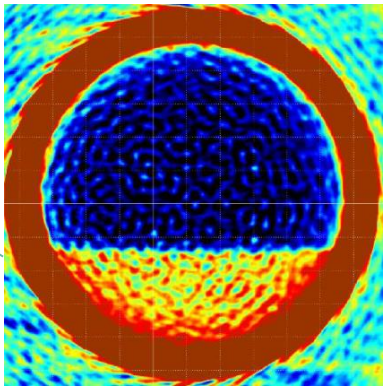
- Main export line
- Inspection of the piggyback line was not part of the work scope
- Sometimes you don’t know what you don’t know – condensate was detected in sections of the gas lift line





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Internal corrosion

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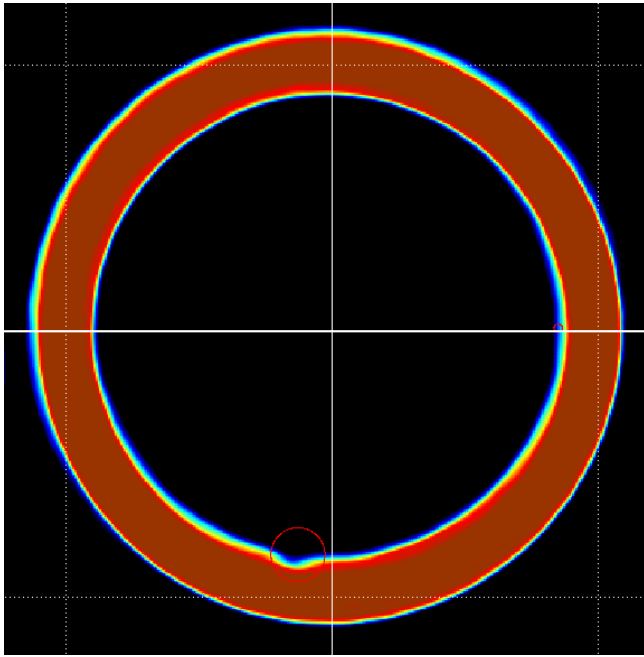
- Bacteria / Microbial induced corrosion
- Potential corrosion hot-spots can be identified through modelling
- Localized inspection was used to check for pitting corrosion



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Internal corrosion

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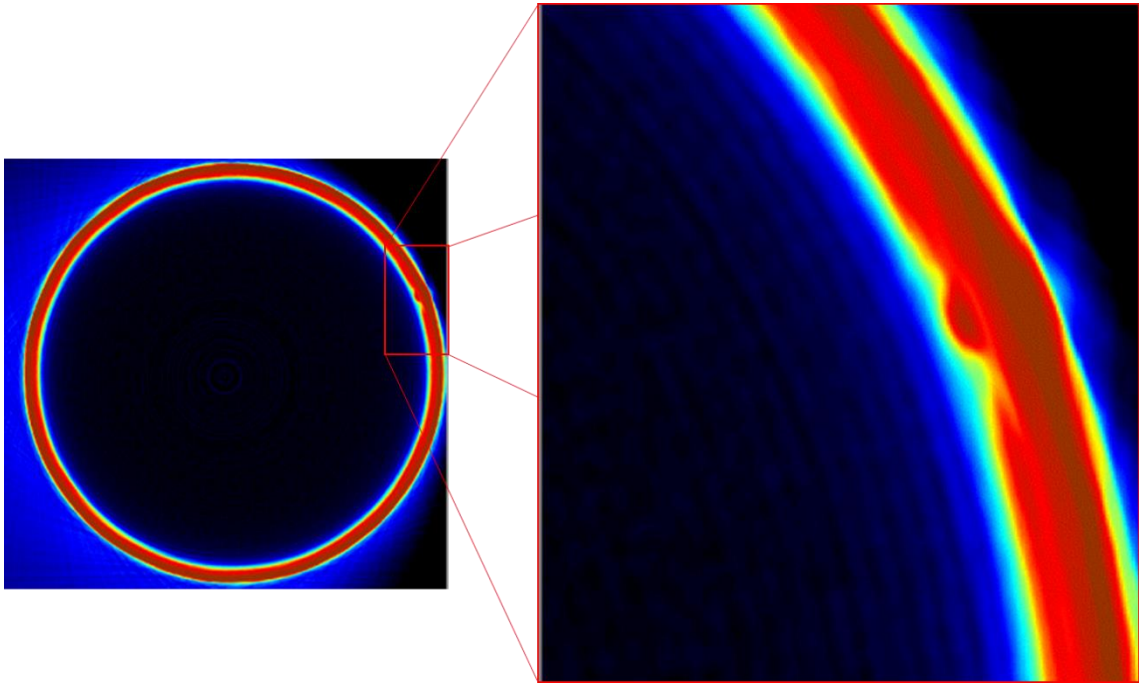
- Preferential weld corrosion (PWC) is a threat to welded joints
- Localized inspection was used to check a seam welded pipe for evidence of PWC
- Results used to determine pipeline life extension



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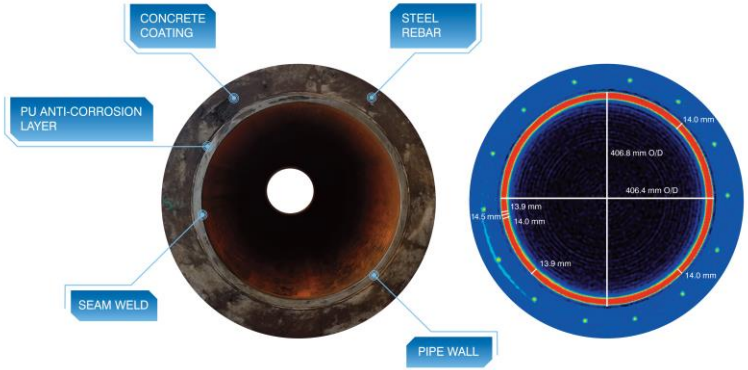
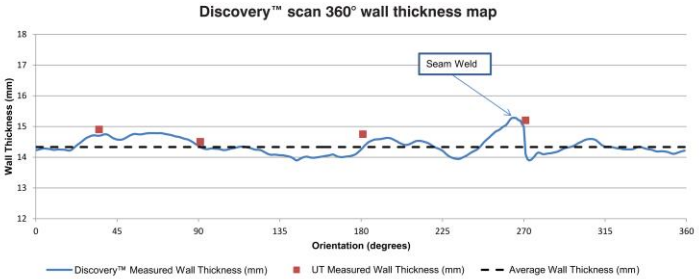
Internal corrosion

- 16” concrete weight coated pipeline (5mm polyurethane under 63mm concrete)
- Consistent wall thickness of approximately 14mm obtained
- No requirement to remove coating or rebars to obtain the data





Internal corrosion

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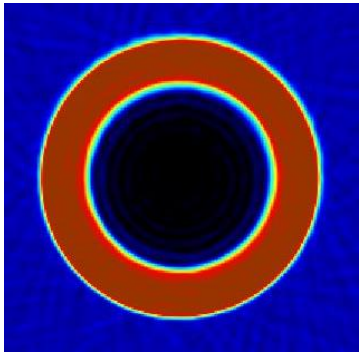
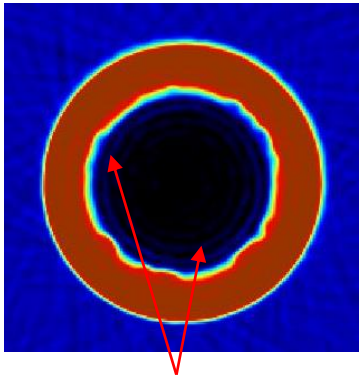
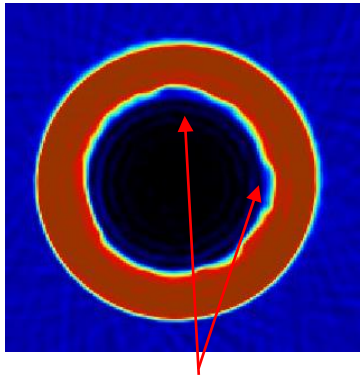
- Riser integrity – corrosion
- Major wall loss observed in two sections of the pipe



Good condition



Major wall loss



Major wall loss

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External corrosion

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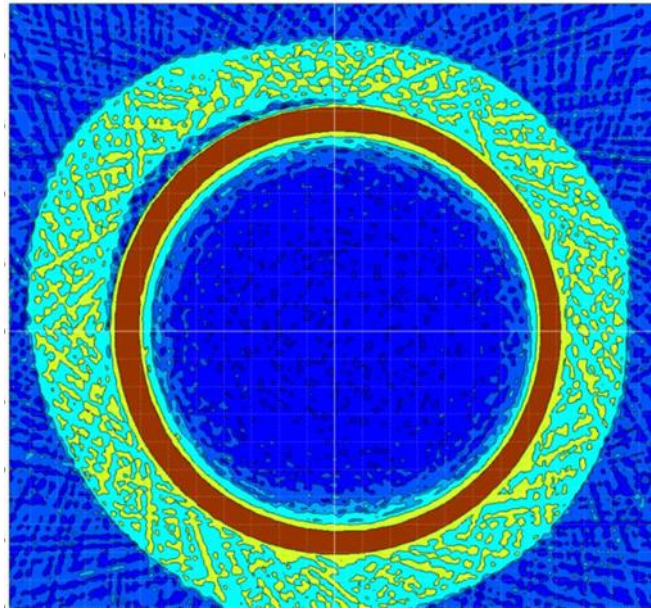
- Coating integrity threats are identified through GVI
- Void within asphalt/mastic field joint coating
- Extends over full length of field joint
- No evidence of associated external corrosion



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Overstress or fatigue

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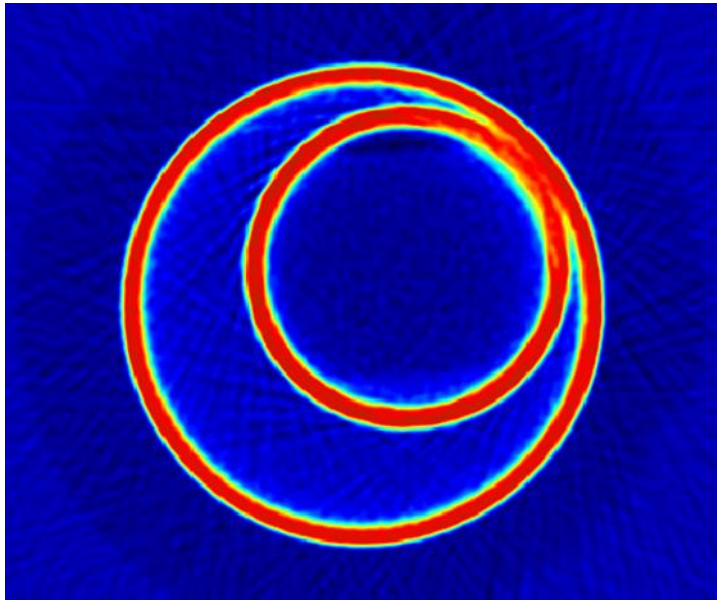
- Thermal expansion can overstress a flowline
- Ineffective thermal expansion design can also cause flow assurance issues
- In this case local inspection was used to check the effectiveness of the thermal expansion design



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Overstress or fatigue

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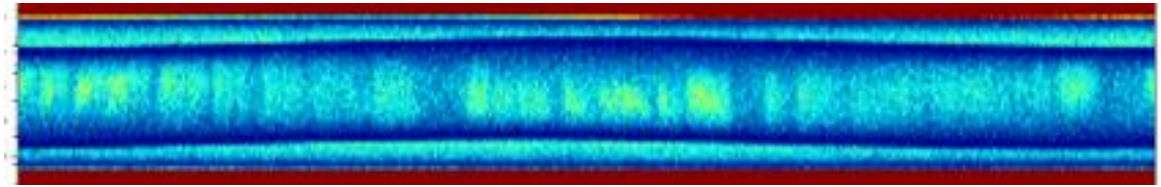
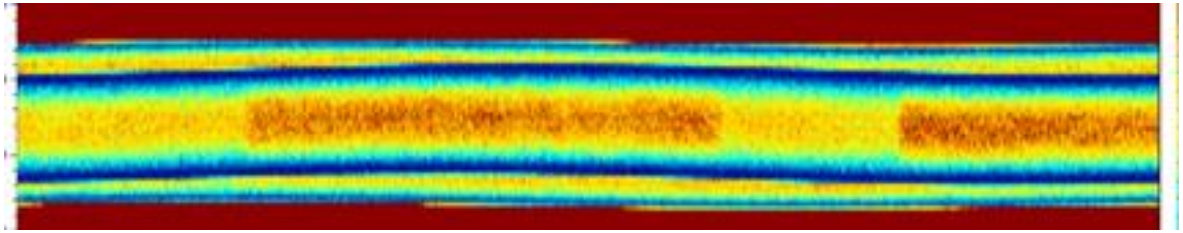
- Sensors (strain gauges) can be used to identify potential overstress situation in a riser system
- These are caused by flow regime (e.g. slugging) which was characterized in this case using local inspection





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Flow assurance

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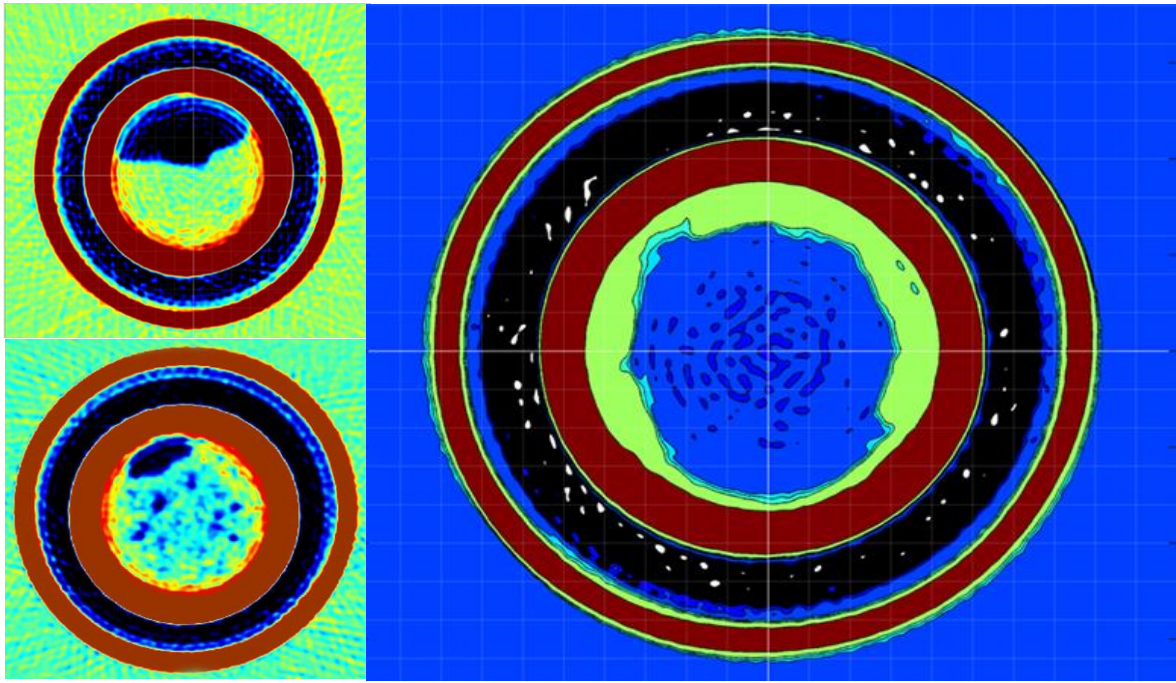
- Determine the exact location of any build-up
- Quantify and characterize deposition build up (asphaltene, sand, scale, hydrate, wax)
- Select the correct remediation approach first time



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New developments – fast screening

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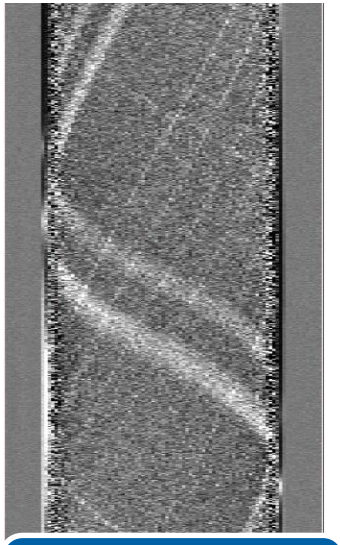
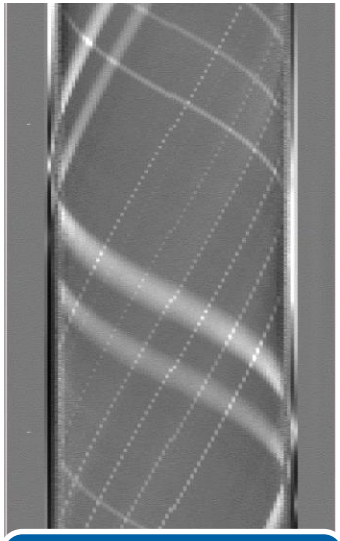
Raw data after 1 full lap



- Real time visualisation of raw projection data enables the operator to detect presence of metal loss anomalies
  - Even after just one lap!
- Where an anomaly is detected the scan continues to increase the signal-noise ratio to acceptable level to enable image reconstruction
- If no anomalies are identified the instrument quickly steps on

Raw data after >20 full laps



Anomalies detected in raw data → Continue scanning → Sufficient data acquired for image reconstruction

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Fast screening – case example

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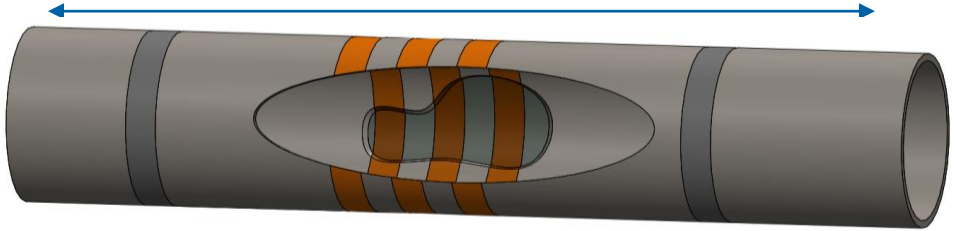
- In total, 4 locations were inspected following a typical fast screening approach as shown below:
- Minimum 1 full duration scan per 20 screening scans

Inspection station (e.g. up to 4m long)



Occasional full duration scans for general wall thickness measurements and deposit assessment

Full duration scans wherever an anomaly is identified

Quick screening scans; instrument quickly steps on if no anomalies are identified

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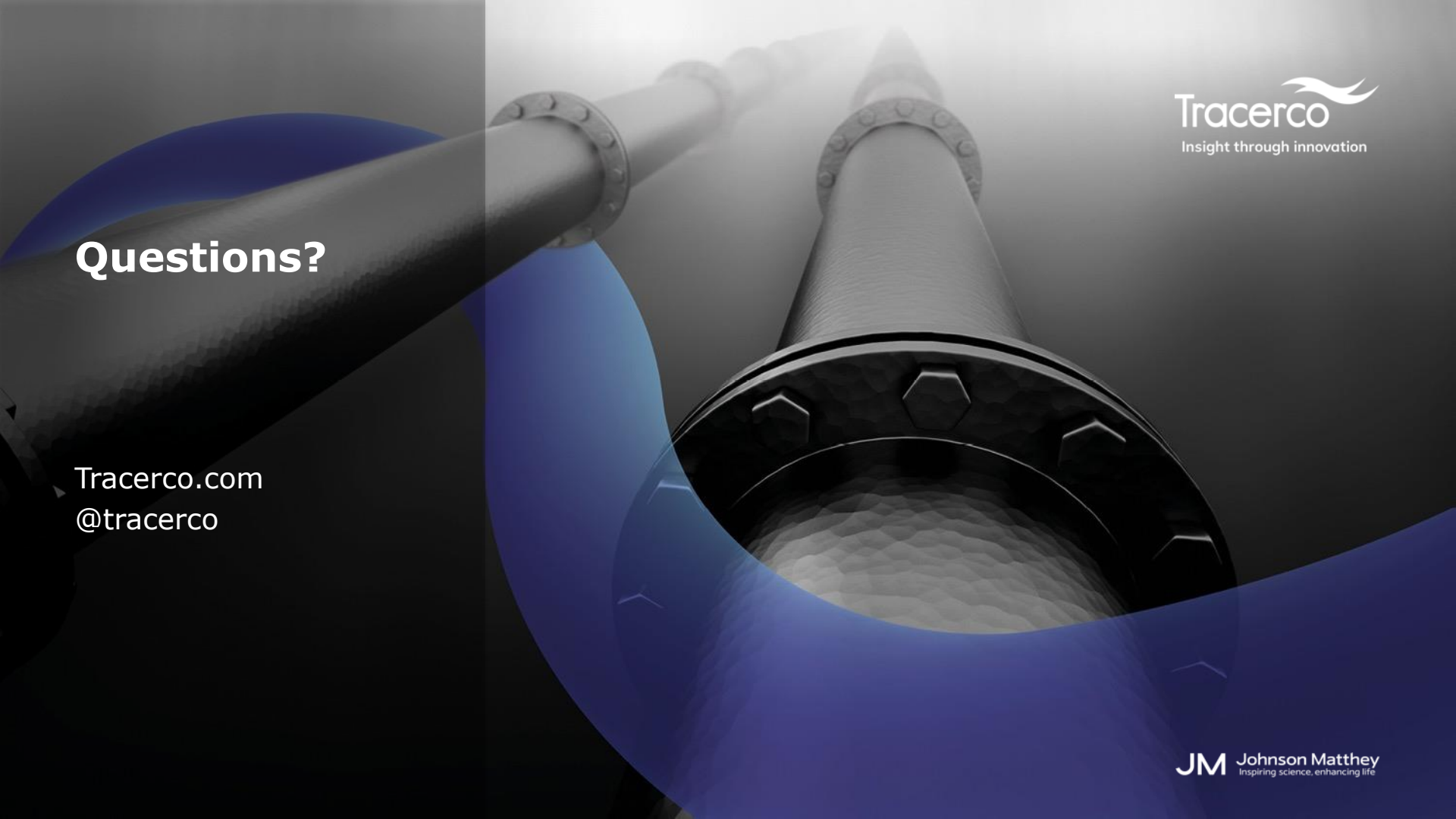

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Questions?

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