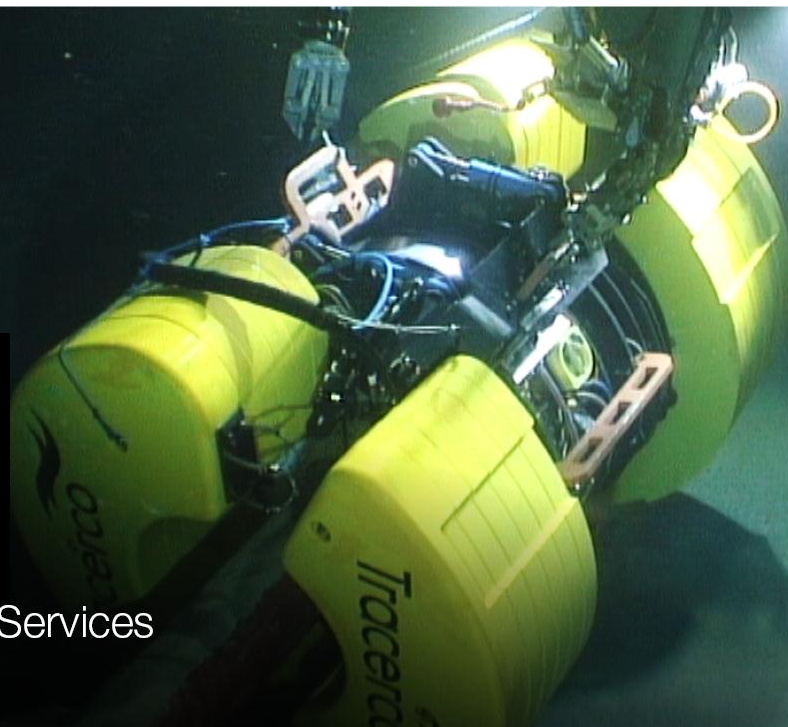


Discovery™

Subsea CT Scanner for
pipeline integrity and flow
assurance visualisation

Lee Robins, Head of Subsea Services



 **PIGGING PRODUCTS &
SERVICES ASSOCIATION**

Operational Pipeline
Pigging Seminar

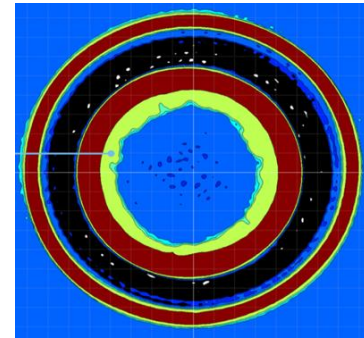
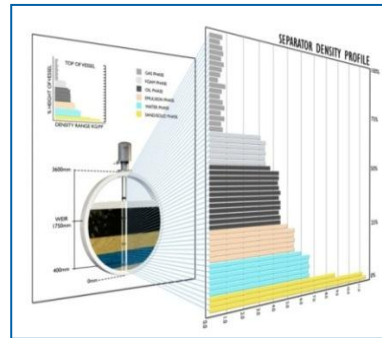
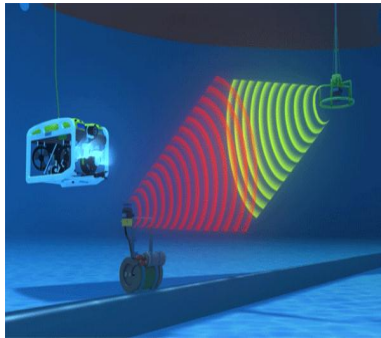
18th November 2015
Aberdeen

A world leading technology company providing unique and specialised measurement solutions to our customers

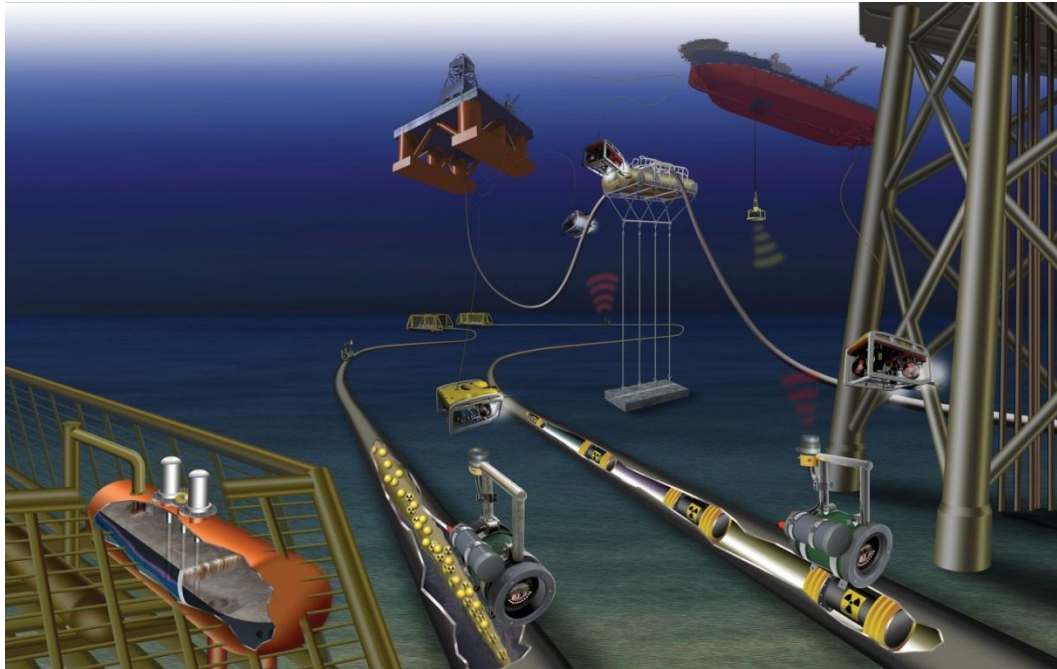


Tracerco

A world leading technology company providing unique and specialised detection and measurement solutions to our customers



Tracerco Subsea Process and Integrity Services



- Integrity Inspection
 - Pipelines
 - Flooded Member
 - Mid-water Arches & Buoyancy Tank
- Flow Assurance Inspection
 - Deposition Studies
 - Stuck Pig Location
- PIG Tracking/Detection
- Density Profiler
- Radiation Monitoring

A Familiar Problem

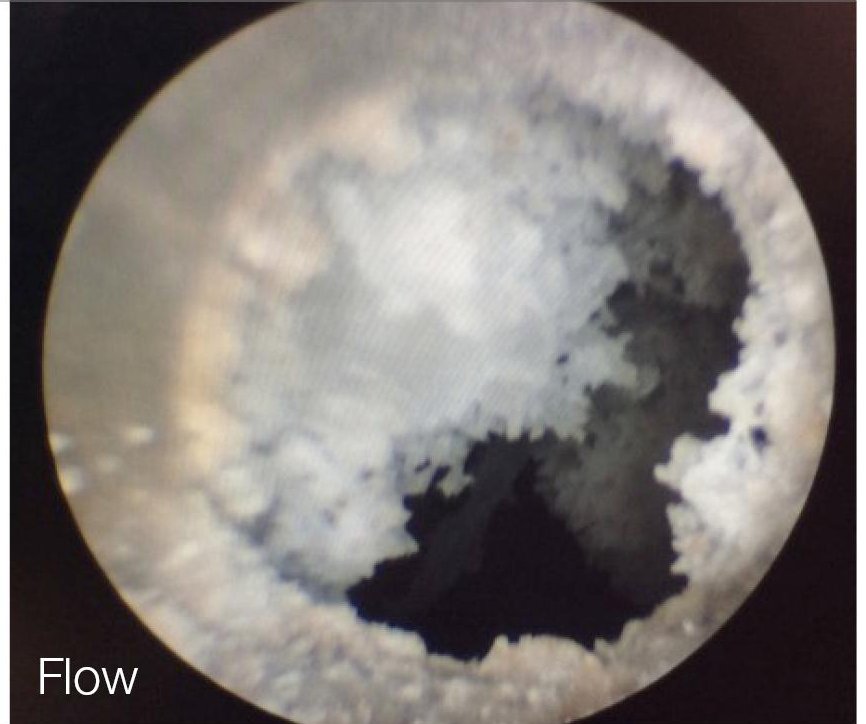
“It is believed that up to 40% of the world oil and gas pipelines are deemed to be unpiggable.”¹

1. www.europeanoilandgas.co.uk/article-page.php?contentid=5132&issueid=197 (2008)

A Familiar Problem

There are no reliable subsea detection tools to accurately detect and characterise hydrate, wax, scale and asphaltene blockages

A Familiar Problem



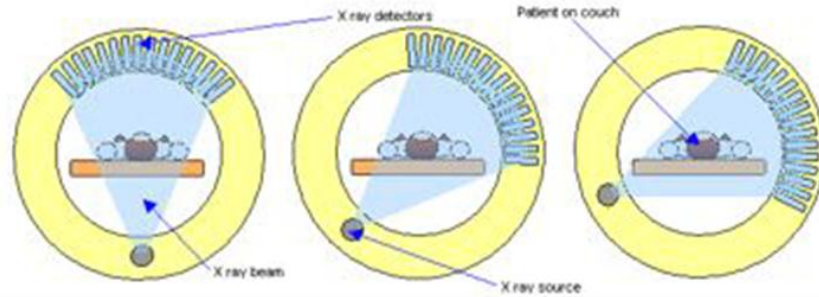
Two New Pipeline Inspection Technologies

Tracerco Explorer™ – a fast screening technology to highlight Flow Assurance and Integrity issues for further detailed investigation by Discovery™

Tracerco Discovery™ - the world's first Subsea CT Scanner

Tracerco Discovery™ – Subsea CT Scanner

- Based upon medical Computed Tomography principles



Tracerco Discovery™ – Subsea CT Scanner

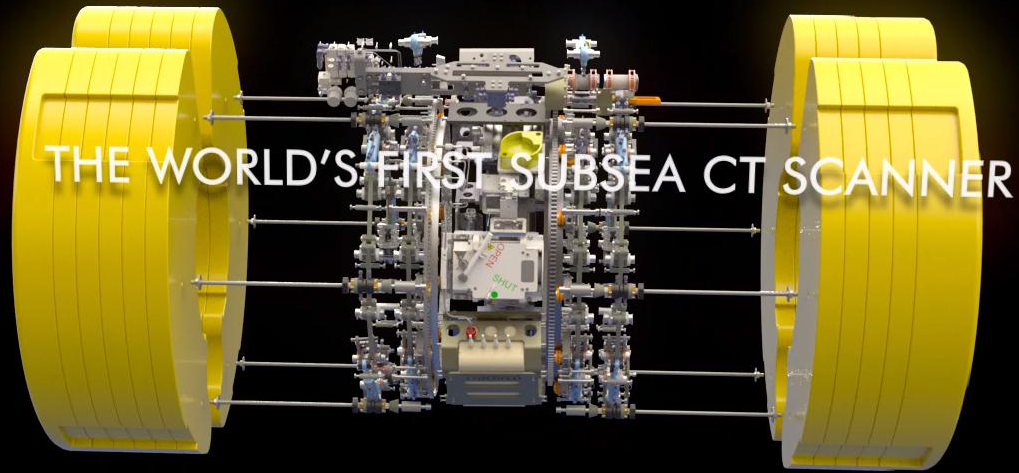
- Based upon medical Computed Tomography principles
- A non-intrusive technology for inspection of subsea pipelines
- Inspection of ‘difficult to pig’, ‘challenging’ and ‘unpiggable’, coated or uncoated pipelines
- Inspection of complex pipeline systems:
 - ✓ pipe bundles, pipe-in-pipe, flexibles, CRA lined, plastic lined

Why use Discovery:

Obtain integrity and flow assurance data online and non-intrusively to enable critical decisions to be made and reduce operational intervention time

Applications

Asset Integrity	Life Extension	Flow Assurance	Decommissioning
<p>Integrity inspection without production interruption, meaning you don't have to reduce or defer production.</p> <p>Post-ILI verification of defect size.</p>	<p>Cost effective life extension inspection projects by removing the requirement to modify unpiggable lines for inline inspection, or remove coatings for other external inspection technologies.</p> <p>The only solution for full integrity assessment of entire pipeline structure and contents.</p>	<p>Characterize pipeline contents, and learn if your deposit or restriction is hydrate, wax, asphaltene or scale.</p> <p>Exact knowledge allows you to select accurate remedial action first time, eliminating the cost of ineffectual remediation.</p> <p>Run a progressive pigging campaign with confidence.</p>	<p>Reduce the risk of environmental issues during decommissioning activities by getting a full picture of exact pipeline contents and condition.</p>

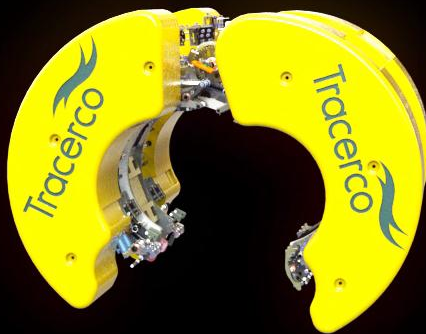


THE WORLD'S FIRST SUBSEA CT SCANNER

CAGE
THR: 209 '
DPT: 3562 '
HDG: 005
TRN: 0.0

330 345 0 60

ROV
DPT: 3687 '
ALT: 21 '
BTY: 3708 '



FULLY OPERATIONAL IN 2015

MILL 68

OCEANEERING

Dive Number: 51

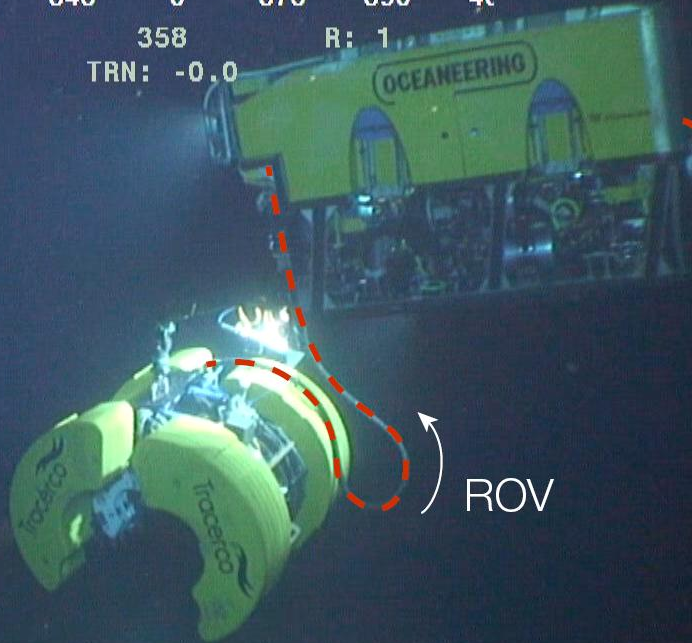
05 DEC 14
14:24:47

CAGE
THR: 209 '
DPT: 3565 '
HDG: 002
TRN: 0.0

315 330 345 0 375 390 40
P: 1 358 R: 1
TRN: -0.0

ROV
DPT: 3686 '
ALT: 22 '
BTY: 3708 '

Real-time data
transmission



ROV

Surface

MILL 68



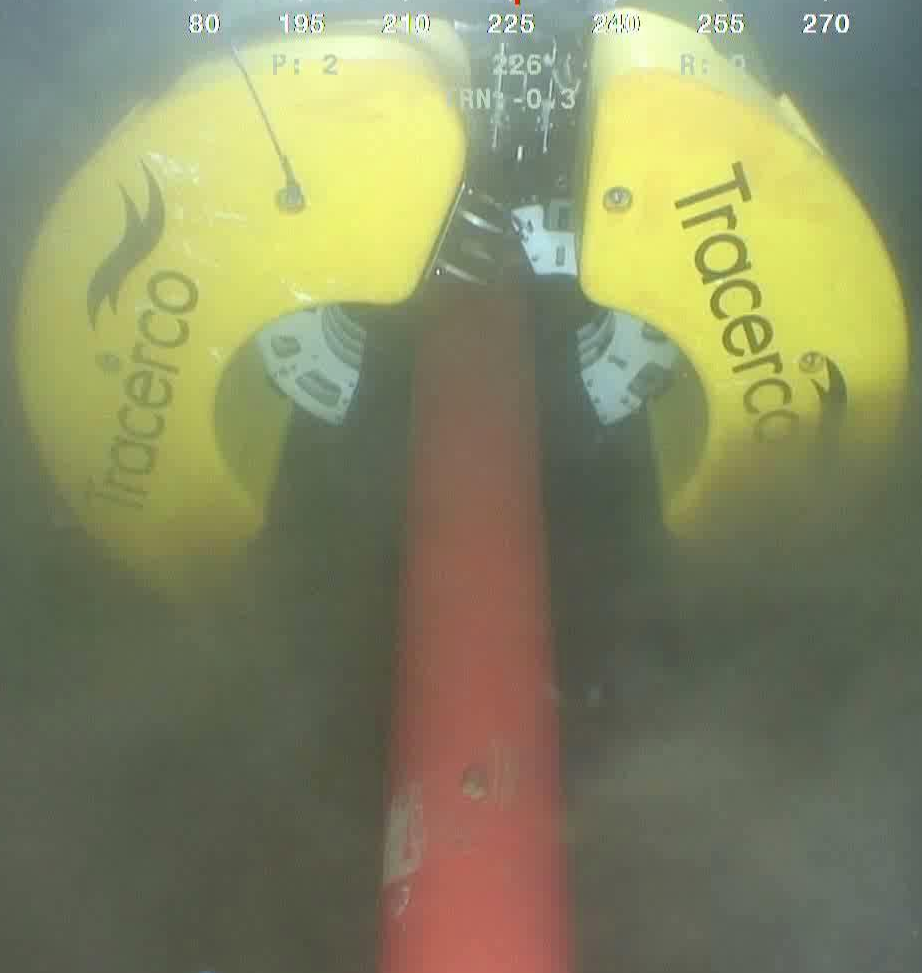
Dive Number: 51

05 DEC 14
14:24:28

CAGE
THR: 264'
DPT: 3713'
HDG: 296
TRN: -0.2

80 195 210 225 240 255 270
P: 2 226° R: 0
RN: -0.3

ROV
DPT: 3869'
ALT: 4'
BTY: 3873'

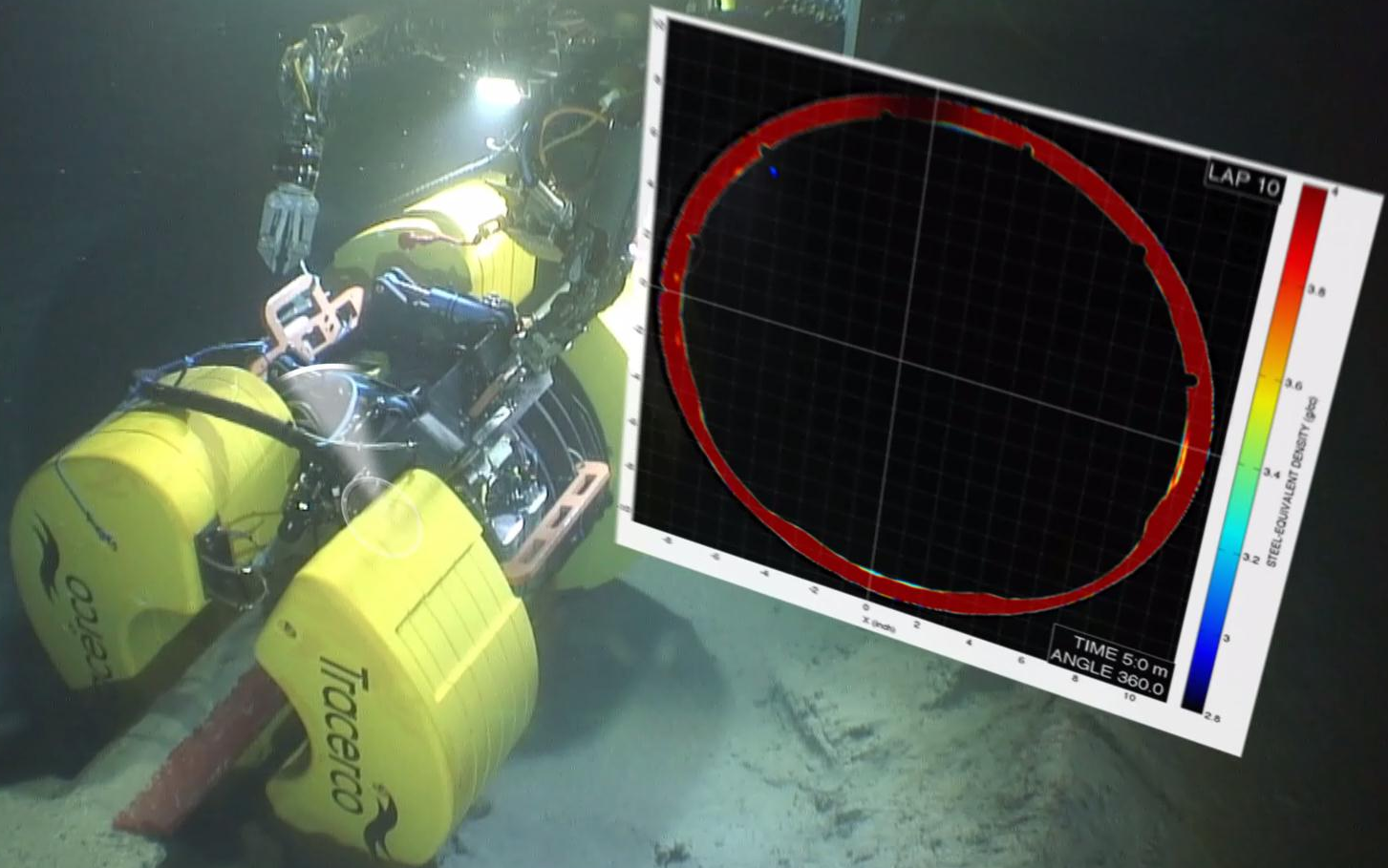


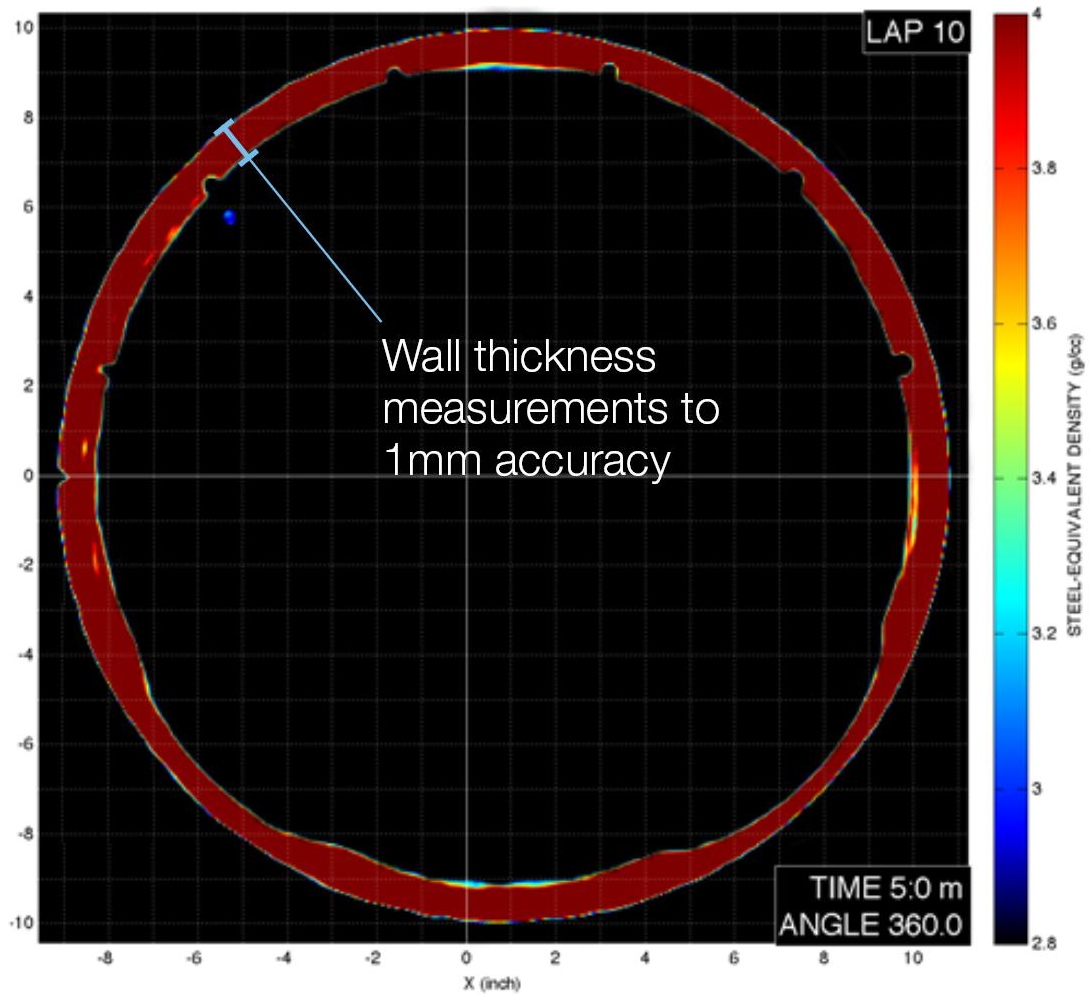
MILL 68

OCEANEERING

Dive Number: 49

03 DEC 14
23:36:58





Discovery™ – A unique solution

- Provides integrity images to approximately 1mm wall thickness accuracy
- Any type of pipeline
- No need to remove any type of coatings
- No interruption to normal pipeline operations and production
- Fully Operational and Field Proven–TRL 7
- DNV RP-A203 Certified
- 3000m Water Depth rated
- Diameter range currently 2” to 26” (can be increased)

Discovery™ - Flow Assurance Application

Verify pipeline contents and **KNOW the exact amount, structure and type of deposits prior to operational pigging and progressive cleaning campaigns**

Why rely on historical and often inaccurate data, such as temperature profile, pressures, flow rates, product chemistry, pipeline geometry features and any operational pigging history to create a 'best guess' picture of what may be in the line?

Carry out a pipeline survey so that operational pigging and progressive pigging cleaning campaigns proceed with confidence.

Discovery™ - Flow Assurance Application

Verify pipeline contents and **KNOW** the exact amount, structure and type of deposits

High percentage of remediation campaigns are ineffectual due to lack of accurate information; wasting millions of dollars and losing months of production time



Reduce operational downtime – **lost production savings**

Accurately plan an effective and efficient cleaning campaign – **big OPEX savings**

Discovery™ - Flow Assurance Application

Pre-deployment trial – proof of concept

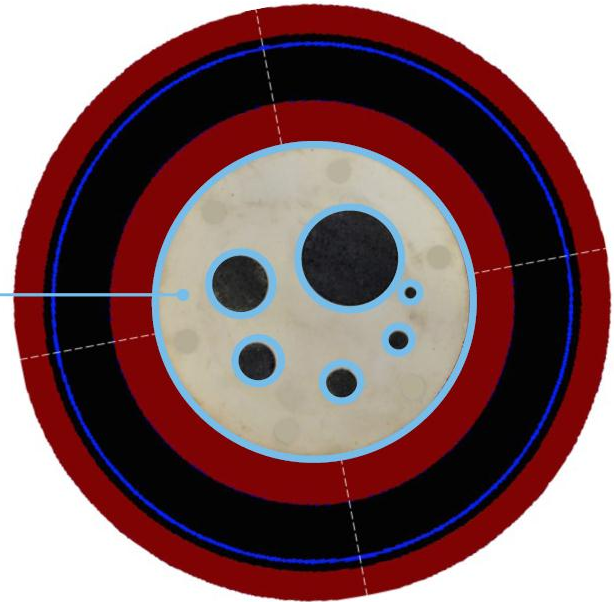
8" in 12" pipe in pipe



Discovery™ - Flow Assurance Application

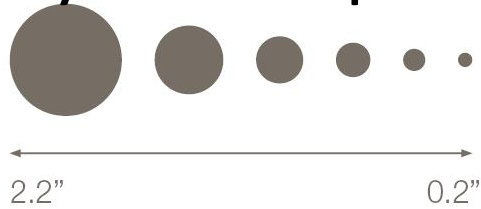
Pre-deployment trial – proof of concept

Wax or Asphaltene blockage as density-equivalent plastic

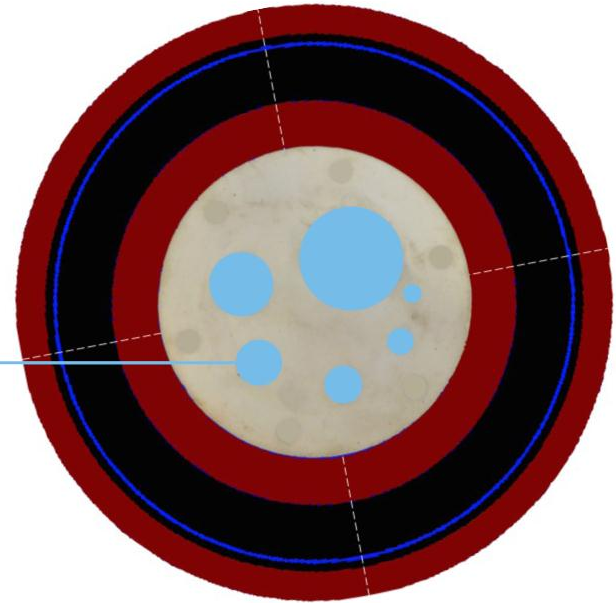


Discovery™ - Flow Assurance Application

Pre-deployment trial – proof of concept



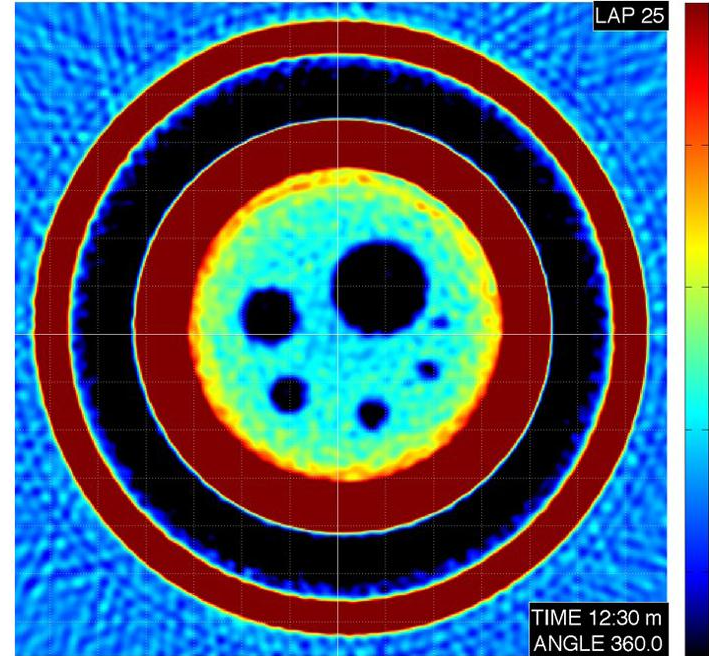
Gas pockets as density-equivalent plastic



Discovery™ - Flow Assurance Application

Pre-deployment trial – proof of concept

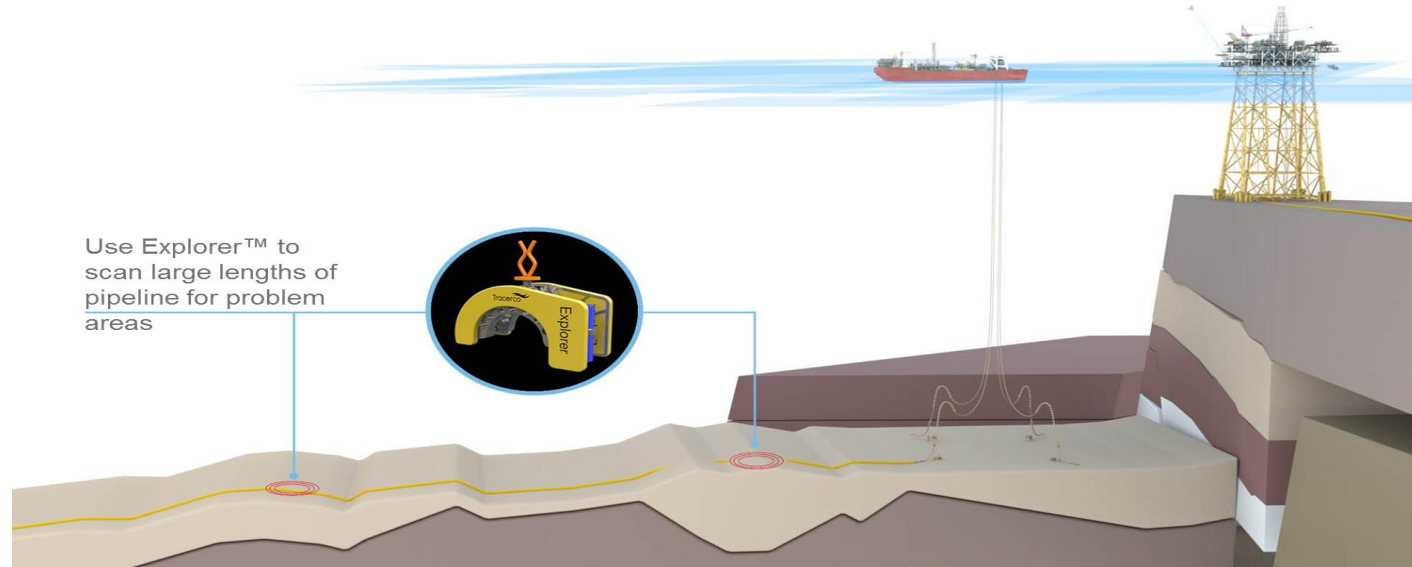
- All 6 Channels clearly detected
- Proof of required detection resolution
- Provides confidence to proceed with the offshore inspection campaign



Discovery™ - Flow Assurance Application

Four steps to cost effective remediation

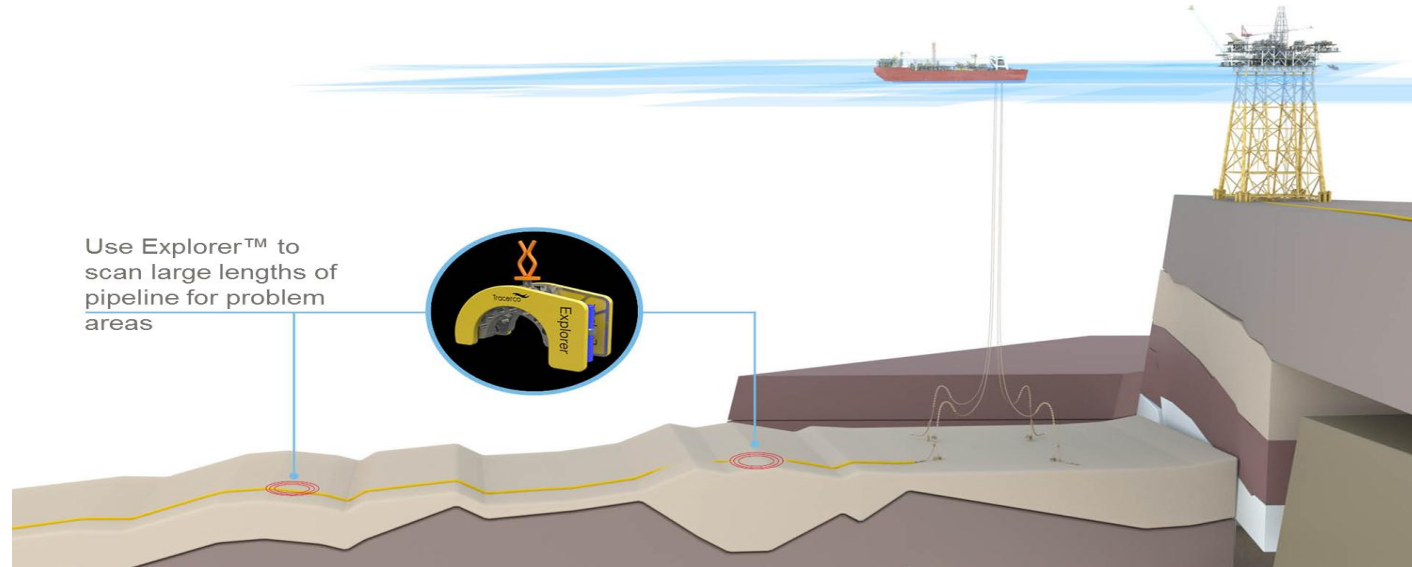
1. **Locate deposits:** Use Explorer™ to scan and identify the position – know **WHERE** it is



Discovery™ - Flow Assurance Application

Four steps to cost effective remediation

1. **Locate deposits:** Use Explorer™ to scan and identify the position – know **WHERE** it is



Discovery™ - Flow Assurance Application

Four steps to cost effective remediation

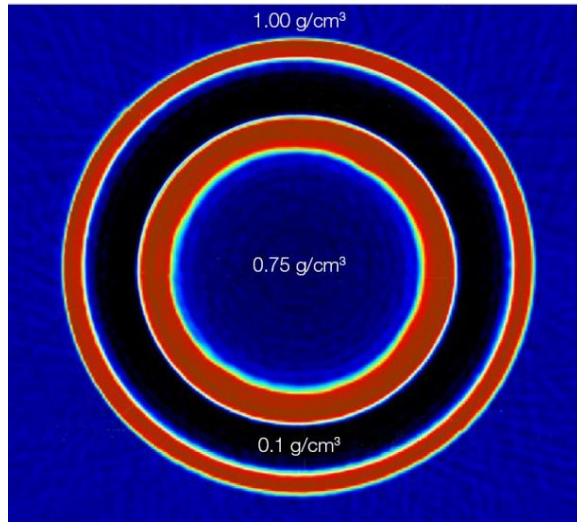
1. **Locate deposits:** Use Explorer™ to scan and identify the position – know **WHERE** it is



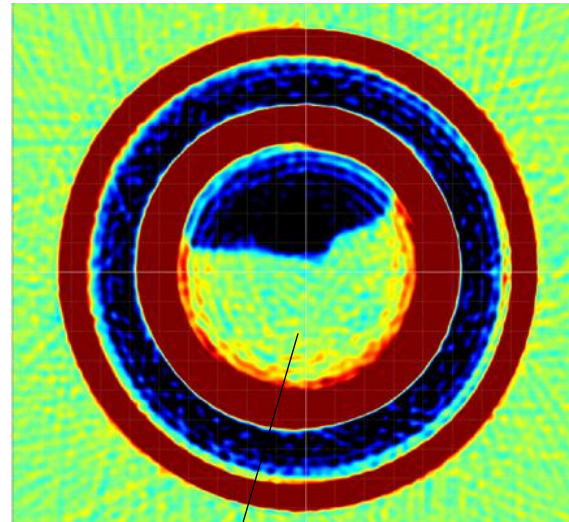
Discovery™ - Flow Assurance Application

Four steps to cost effective remediation

2. Quantify and characterise it: use Discovery™ to identify the type and nature of the deposition – know **WHAT** it is



Discovery image of a clean PiP line

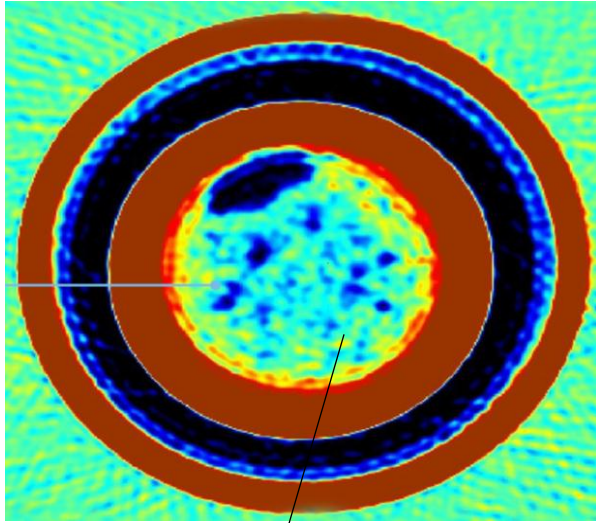


Asphaltene @1.2g/cc

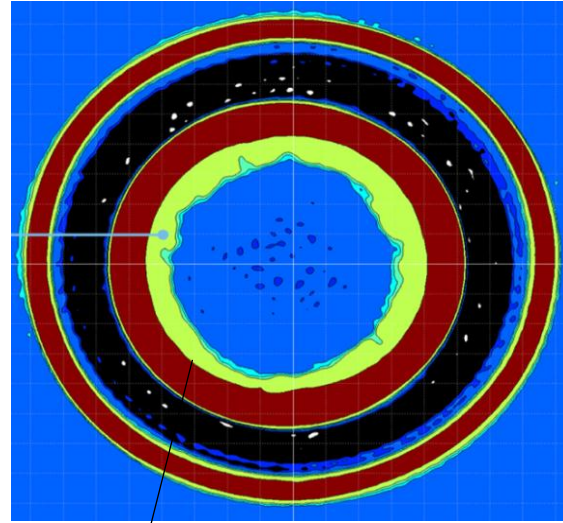
Discovery™ - Flow Assurance Application

Four steps to cost effective remediation

2. Quantify and characterise it: use Discovery™ to identify the type and nature of the deposition – know **WHAT** it is



Asphaltene @1.2g/cc



Scale @2.3g/cc

Discovery™ - Flow Assurance Application

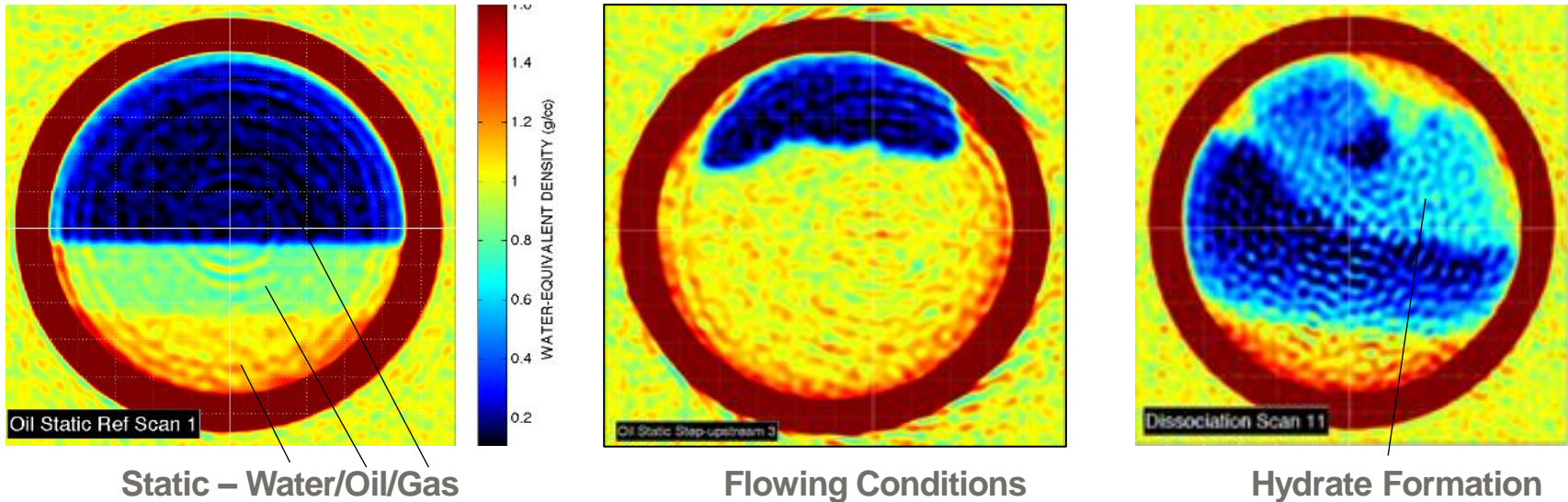
Four steps to cost effective remediation

3. Remediate efficiently and cost-effectively

**Choose the correct remediation method and plan
the campaign with confidence**

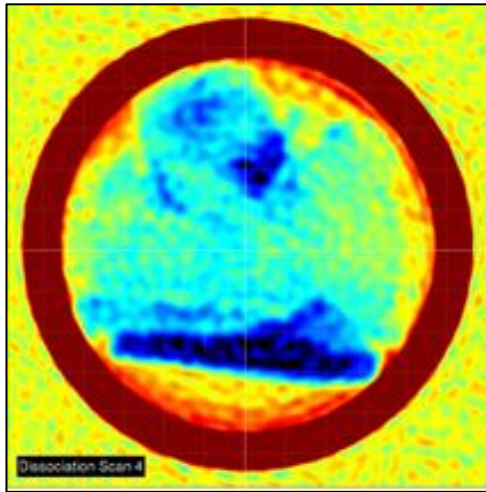
Discovery™ - Flow Assurance Application

4. Monitor the effectiveness of the Remediation: use Discovery™ to monitor effectiveness and optimize cleaning operations

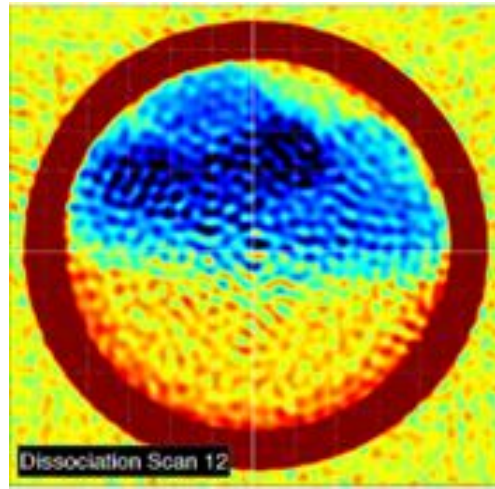


Discovery™ - Flow Assurance Application

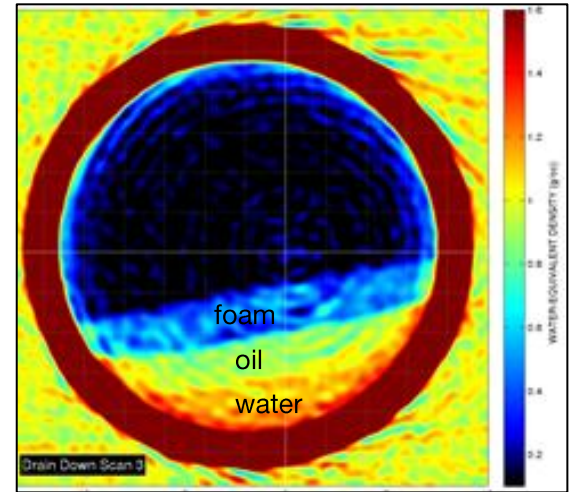
4. Monitor the effectiveness of the Remediation: use Discovery™ to monitor effectiveness and optimize cleaning operations



Hydrate Blockage



Hydrate Dissociation



Hydrate Removed

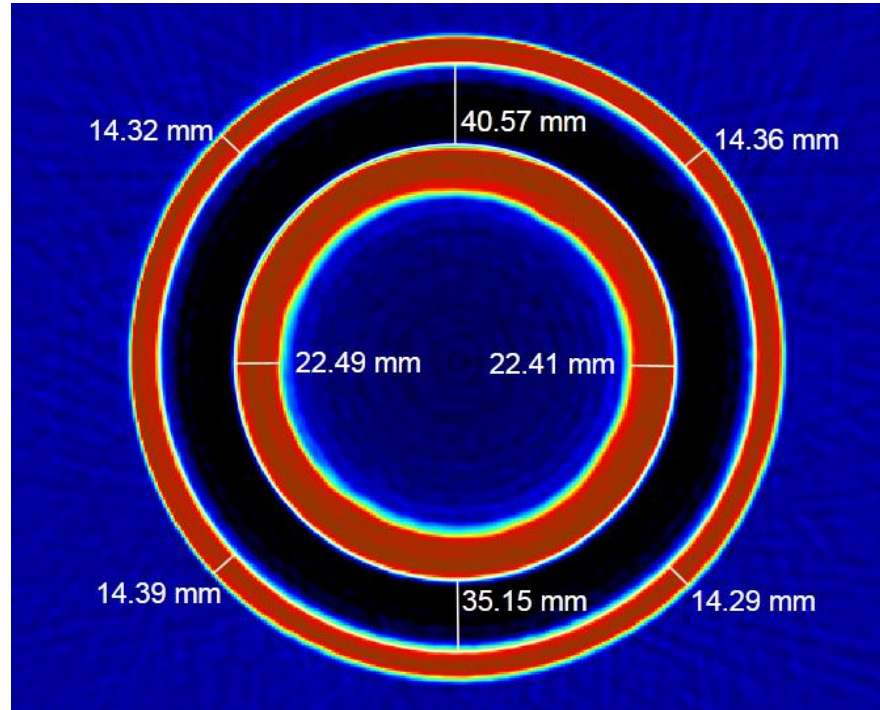
Discovery™ – Pipeline Integrity Application

Validate and accurately measure defects detected from ILI campaigns

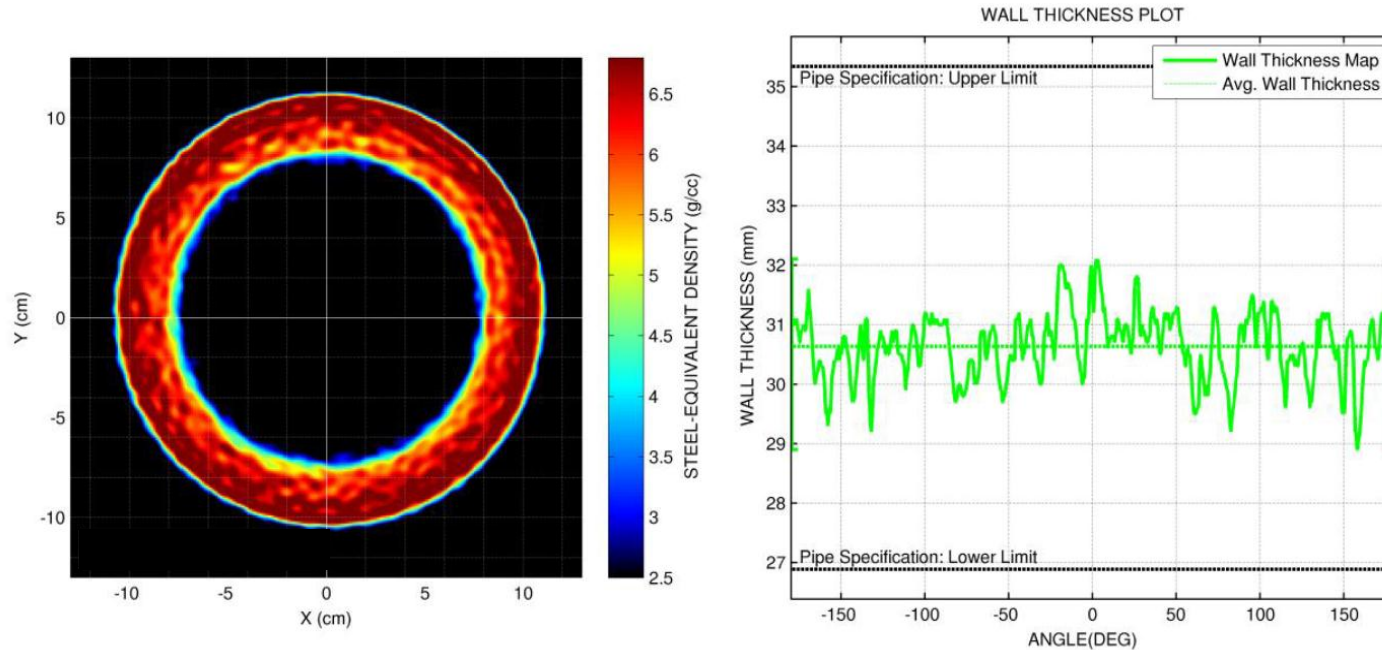
- **No need to remove/replace any type of coatings**
- **Inspect online – no production losses**
- **Use on pipe-in-pipe systems and bundles**

Cost effective solution for **Lifetime Extension of any type of ‘unpiggable’ and ‘difficult to pig’ lines**

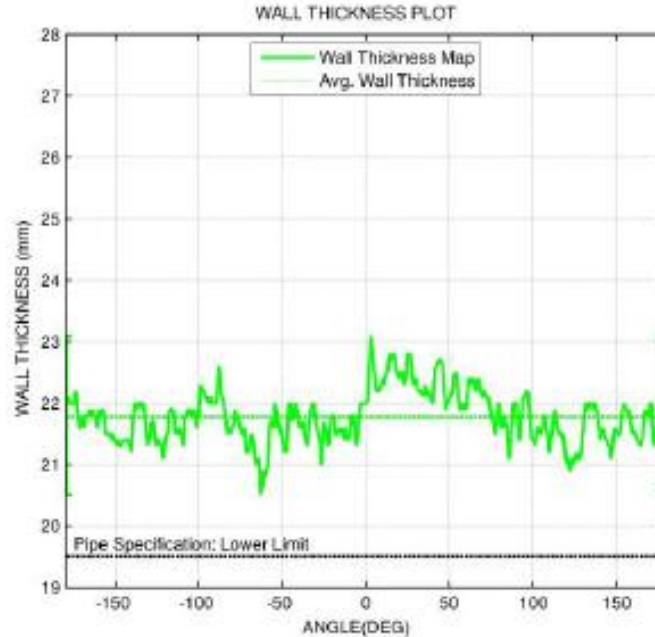
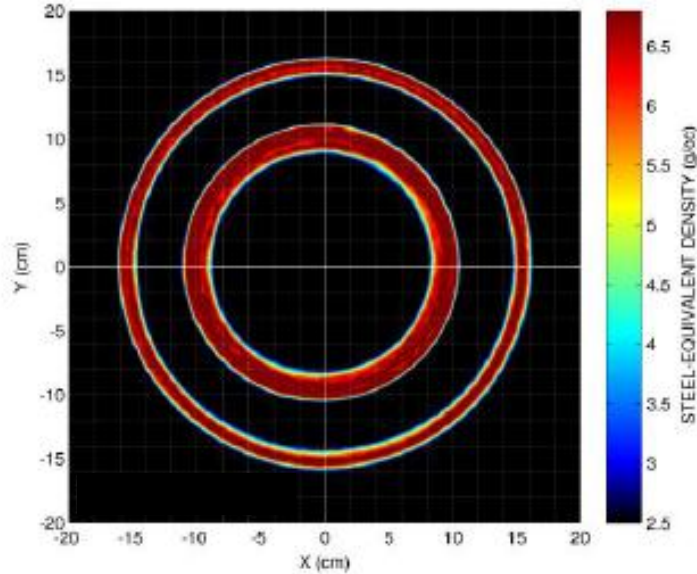
Discovery™ – Pipeline Integrity Application



Discovery™ – Pipeline Integrity Application



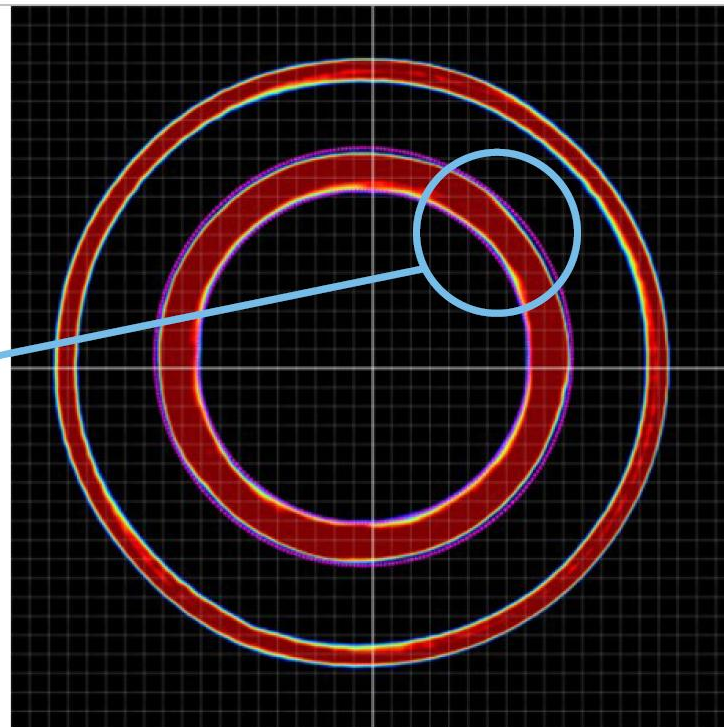
Discovery™ – Pipeline Integrity Application



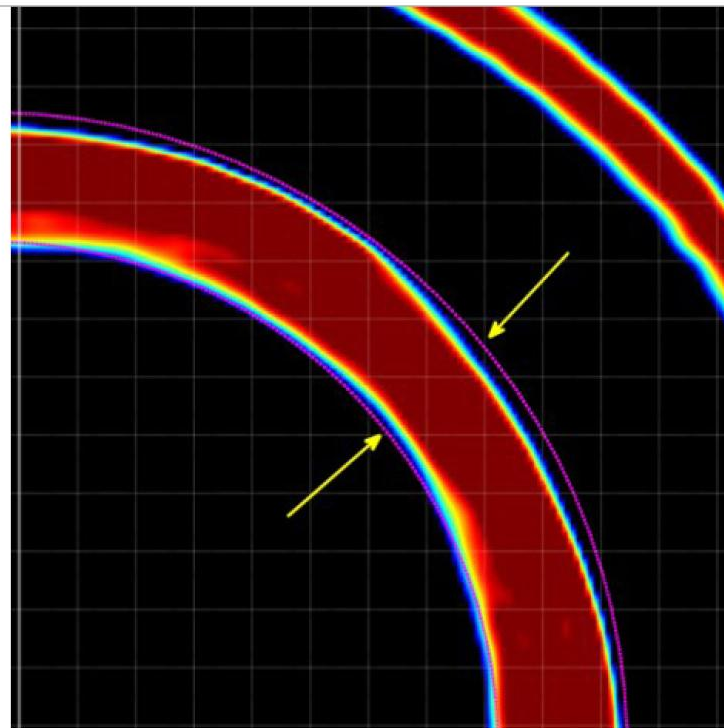
Discovery™ – Pipeline Integrity Application



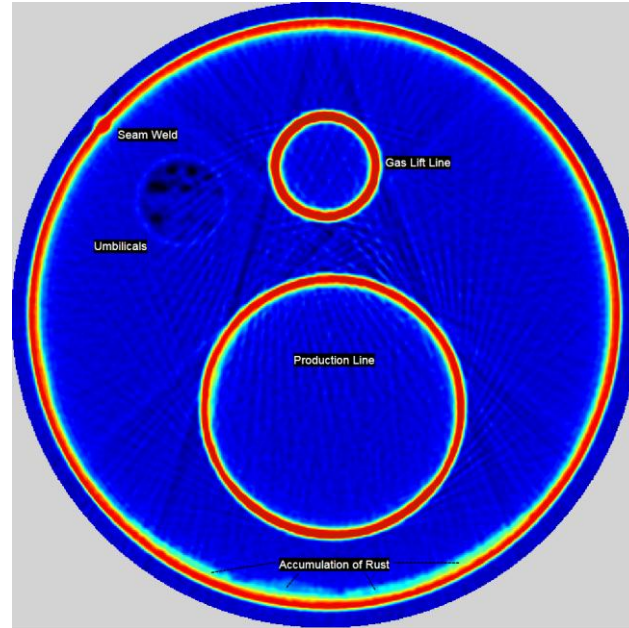
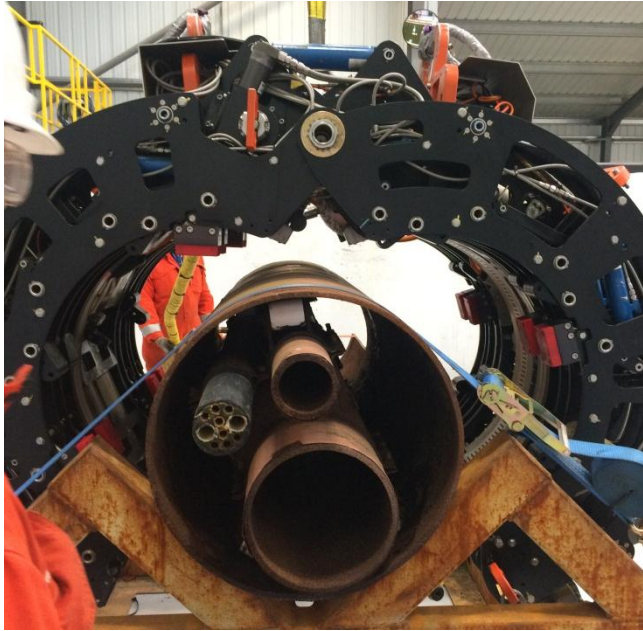
Discovery™ – Pipeline Integrity Application



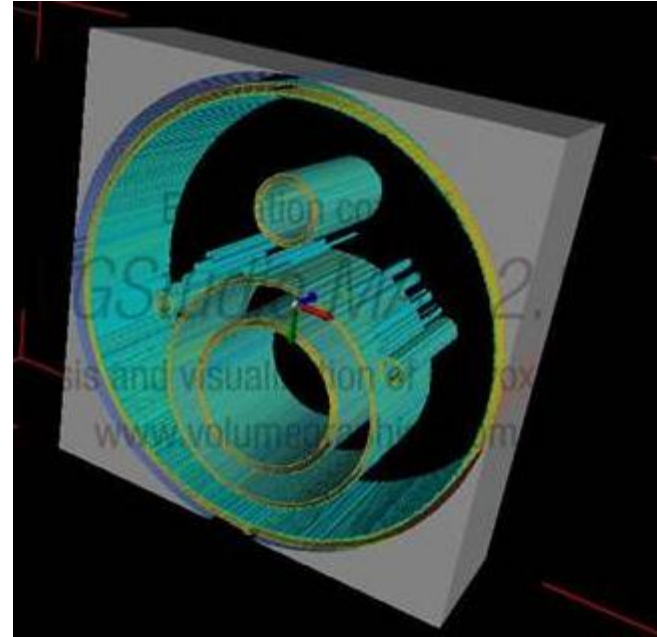
Discovery™ – Pipeline Integrity Application



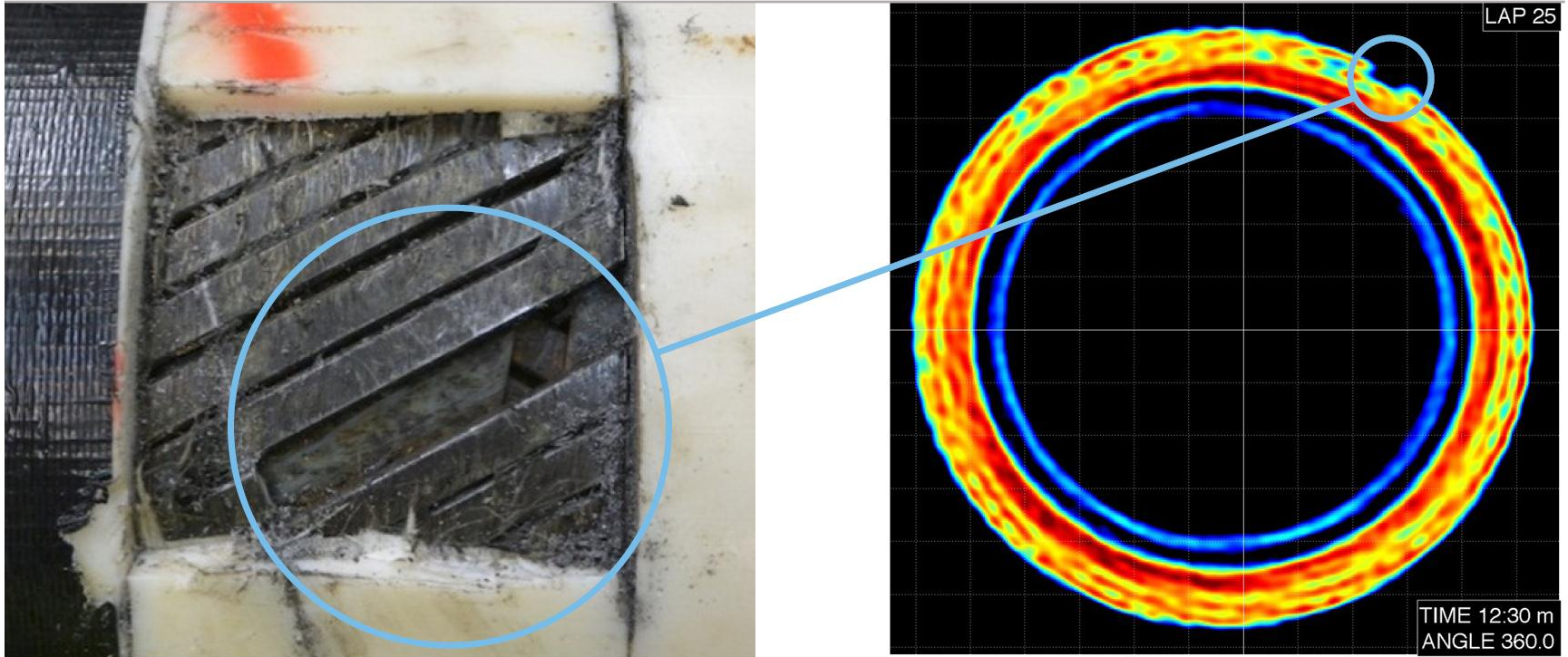
Discovery™ – Pipe Bundle Integrity



Discovery™ – Pipe Bundle Integrity



Discovery™ – Pipeline Integrity – Flexible



Explorer™ – Flexible Integrity

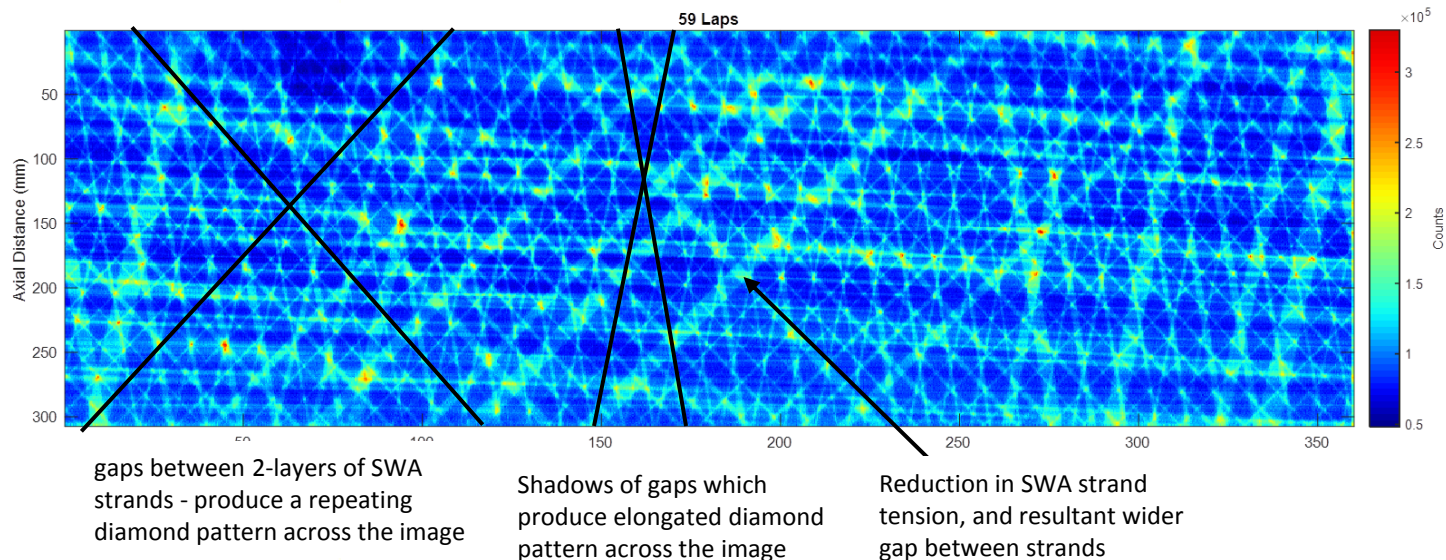
Fundamental principles:

Tracerco Explorer™ (patent pending) is a new innovation that is far superior to existing Digital Radiography techniques, allowing fast inspection of flexible risers.

- External clamp-on device
- Crawler mechanism
- Better resolution than DR
- Fast inspection speed of 0.5 metres/minute

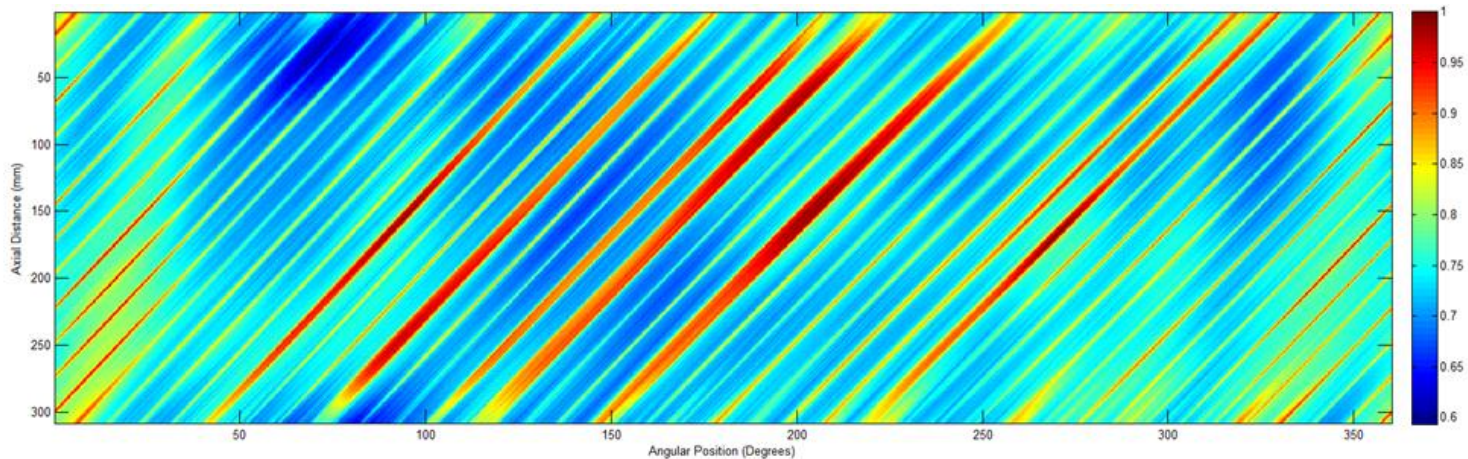
Explorer™ – Flexible Integrity

360 degree image of both inner and outer SWA layers



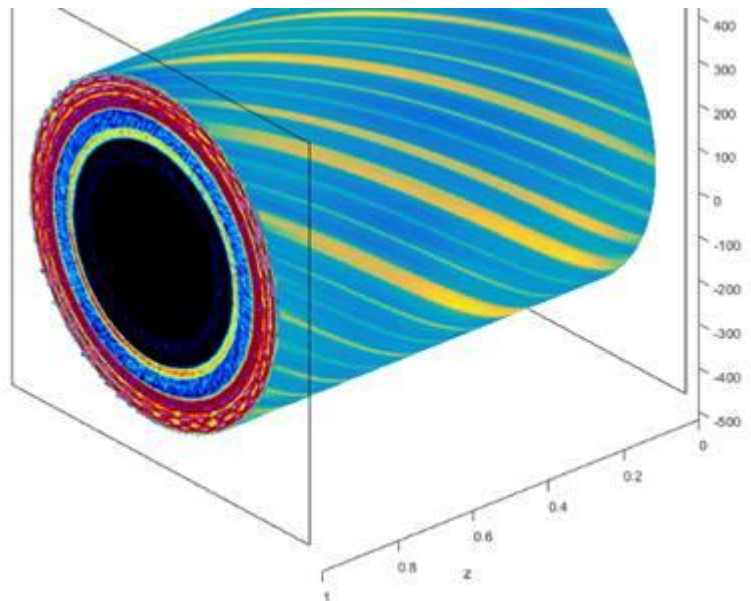
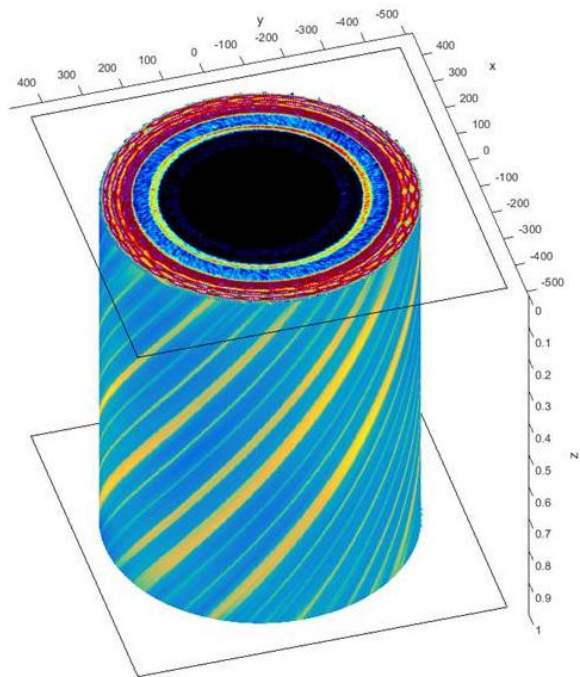
Explorer™ – Flexible Integrity

360 degree image filtered to show just one of the SWA layers



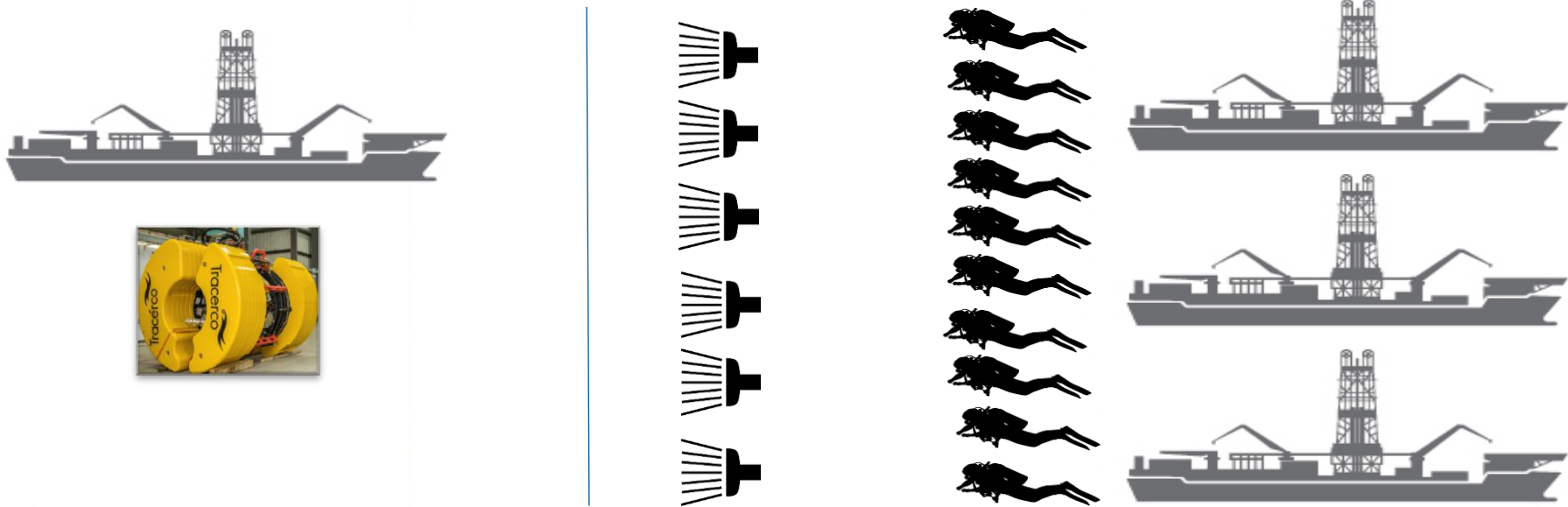
Slippage of the SWA where gaps have opened up between strands are clearly visible. Broken and cracked strands will also be clearly visible.

Explorer™ + Discovery™ – Flexible Integrity



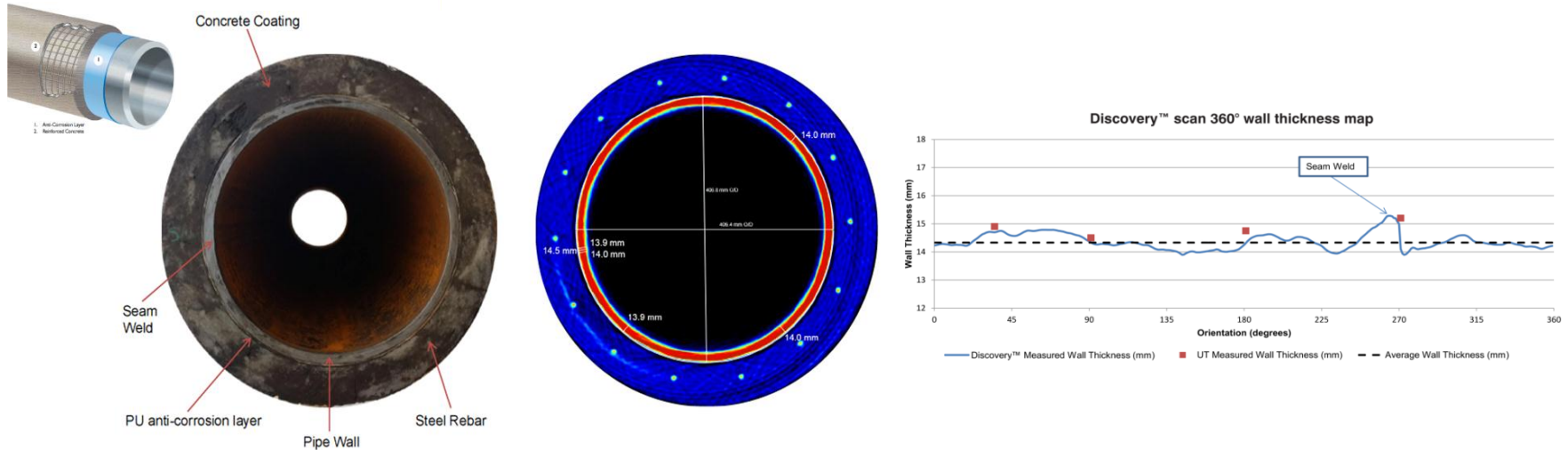
Life Extension – Unpiggable Lines

Save as much as **35%** on the total **cost of life extension** inspection projects by scanning through coatings



Life Extension – Unpiggable Lines

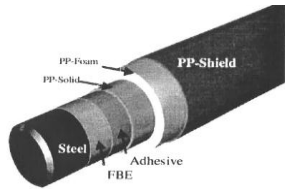
Get close to 1mm resolution data on a variety of integrity issues including wall thinning, pitting, and corrosion.



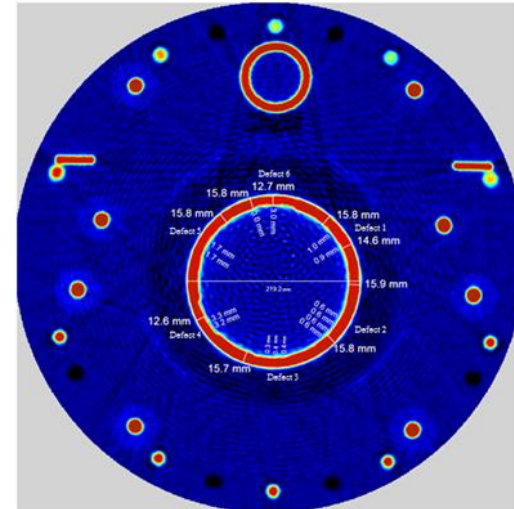
Eliminate the risk of damaging the pipeline during coating removal.

Life Extension – Unpiggable Lines

Get close to 1mm resolution data on a variety of integrity issues including wall thinning, pitting, and corrosion.



5-layer PP
Insulated Pipe
with Piggyback
Line



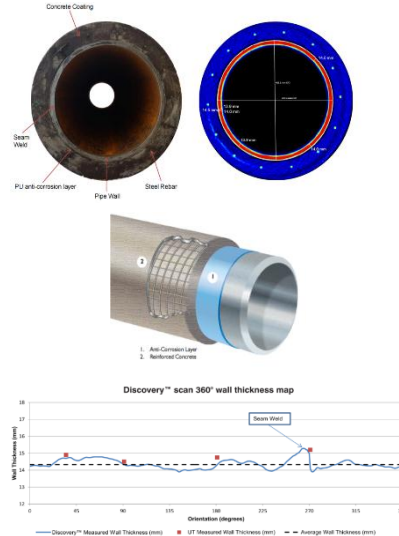
Solution Engagement

Understanding the perceived challenges;

- Develop the IRM solution
- Develop the process understanding
- Enable Decisions and mitigate risk



Tested, verification ready for mobilisation



Engagement with our customers at the front end operational engineering stage, to understand the operational challenges, and enabling us to provide the most effective solutions.

Summary

Provides detailed images of all pipe walls and contents without need to remove coatings

Reduce costs on Remediation campaigns:

Verify pipeline contents and KNOW the exact amount, structure and type of deposits prior to operational pigging and progressive cleaning campaigns

Validate and accurately measure defects detected from ILI campaigns

No interruption or risk to production

No coating removal/replacement

Reducing intervention costs and duration

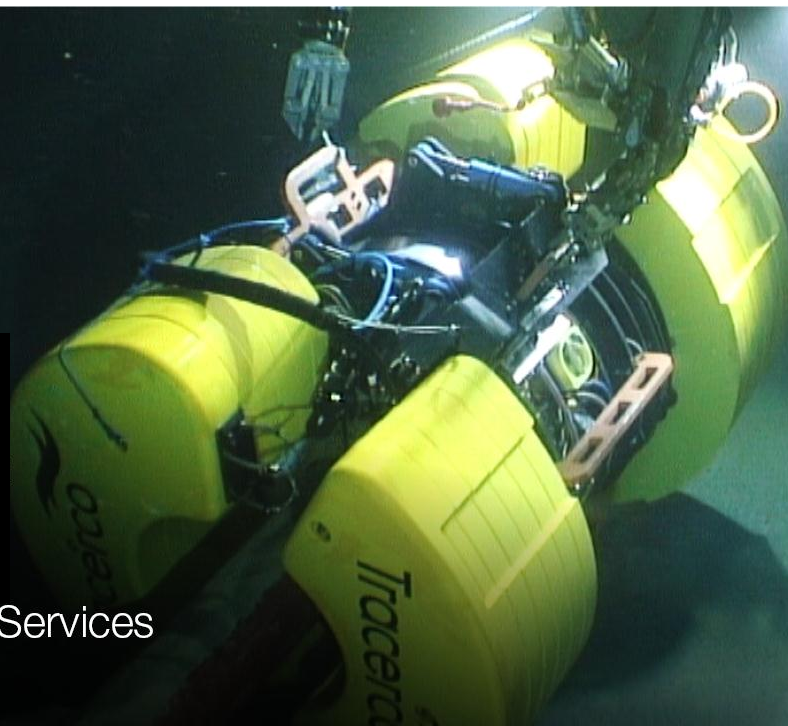
SpotlightSM
on new
TECHNOLOGY



Discovery™

Subsea CT Scanner for
pipeline integrity and flow
assurance visualisation

Lee Robins, Head of Subsea Services



 **PIGGING PRODUCTS &
SERVICES ASSOCIATION**

Operational Pipeline
Pigging Seminar

18th November 2015
Aberdeen