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PIPELINE SERVICES

Using the Latest ILI Technologies to Identify Pipeline Pilferage

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Illegal Tapping

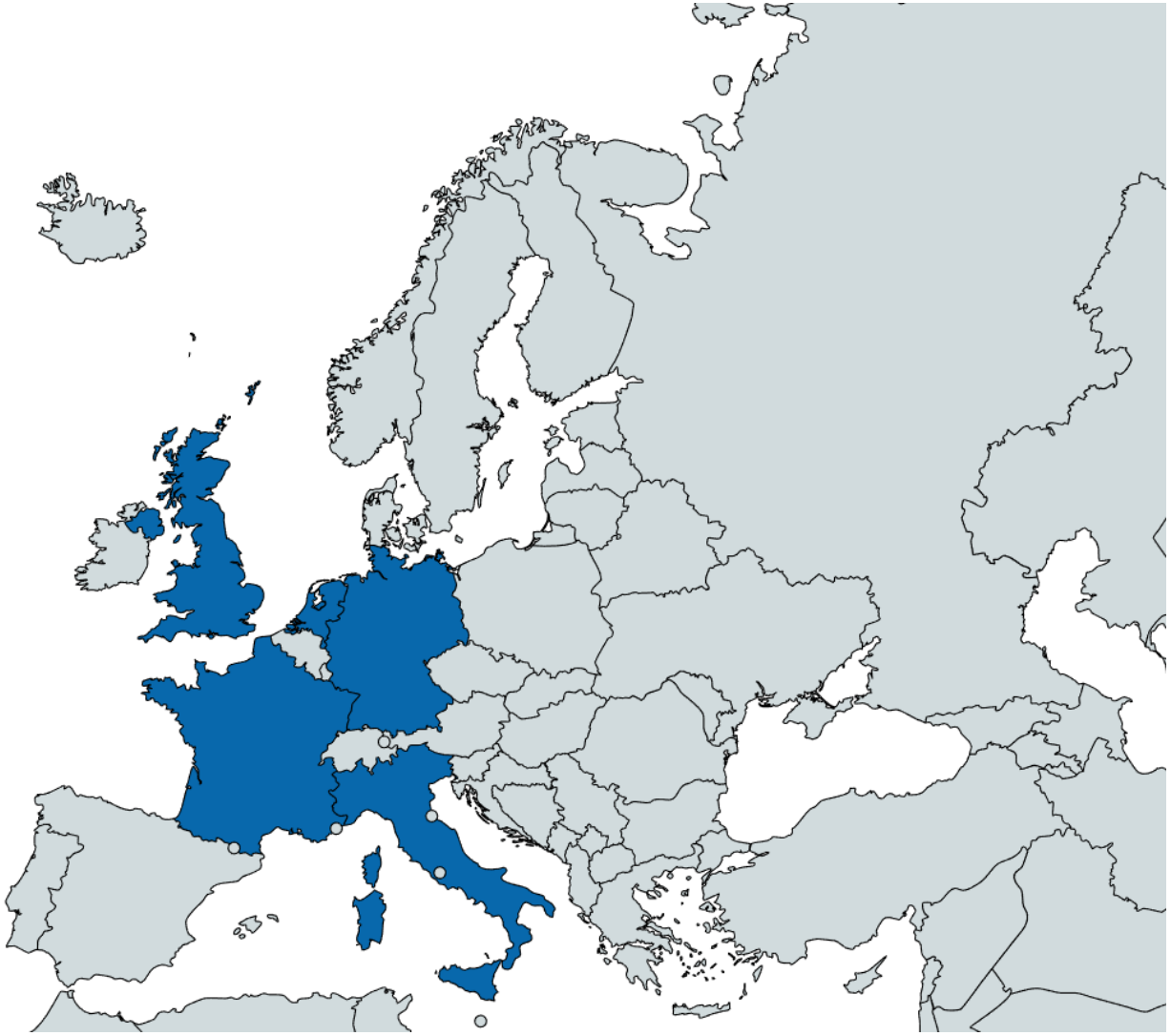
Pilferage activities can cause significant environmental and commercial consequences, potentially leading to:

- Pipeline ruptures or leaks
- Potential human casualties
- Destruction of property / Asset damage
- Damage to the environment

Illegal Tapping in Europe

BHGE Identified Illegal Taps

- Some of the locations BHGE inspections have identified Illegal taps identified in recent years
- Product thefts have steadily increased on European pipelines since late 2013



Identifying Illegal Taps

Alternative approaches are required to assist in the location and identification of both existing and new illegal tap attempts.

An existing pipeline inspection technology, with a proven track record of accurate detection of illegal tap locations, is In-line Inspection (ILI) – specifically **Magnetic Flux Leakage** (MFL) tools.

Identifying Illegal Taps

BHGE has two types of MFL-based inspection vehicles

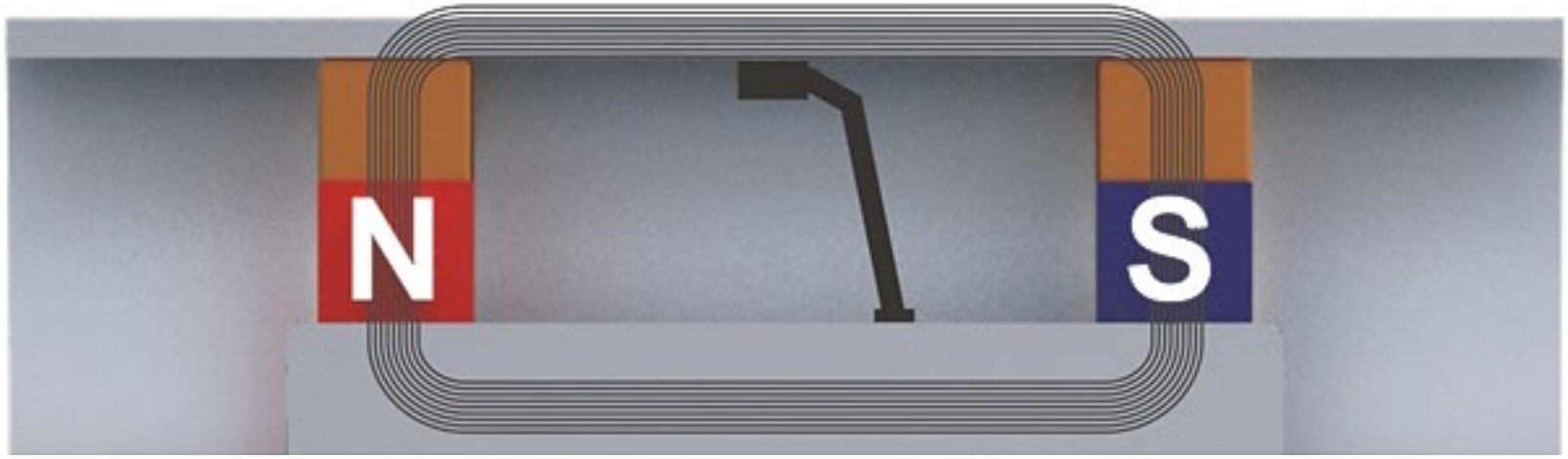
- One which imposes an **axial** magnetic field, parallel to the pipe flow direction - **MagneScan™** and **CPIG™**

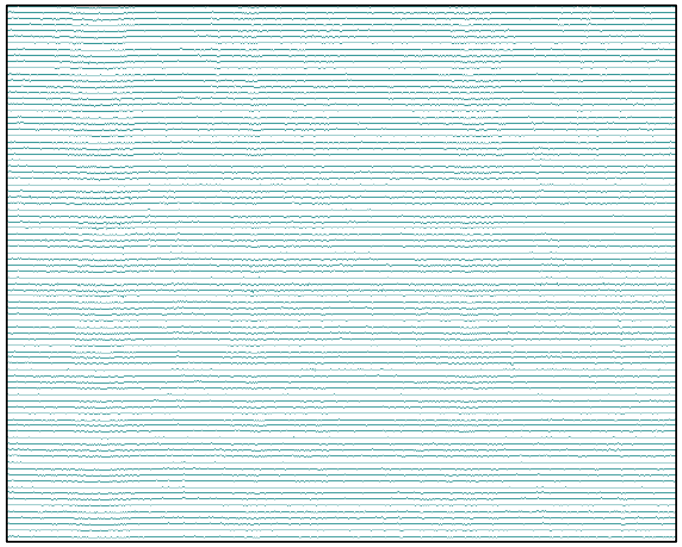
- And one which imposes a **circumferential** magnetic field, around the pipe wall circumference – **TranScan™**

The most utilised technology platforms for this purpose are MagneScan and CPIG, however, BHGE has also employed TranScan, in a unique case.

Axial MFL - The Basics

The magnetic saturation of the pipe wall remains constant and undisturbed in an area with no features or fittings, i.e. plain pipe.

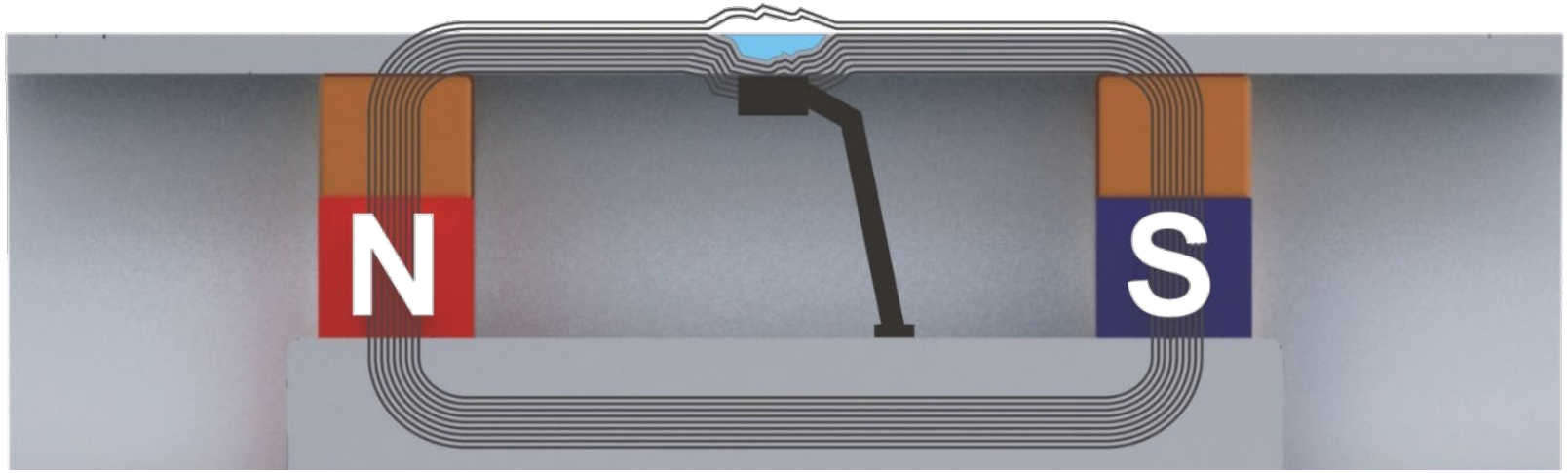


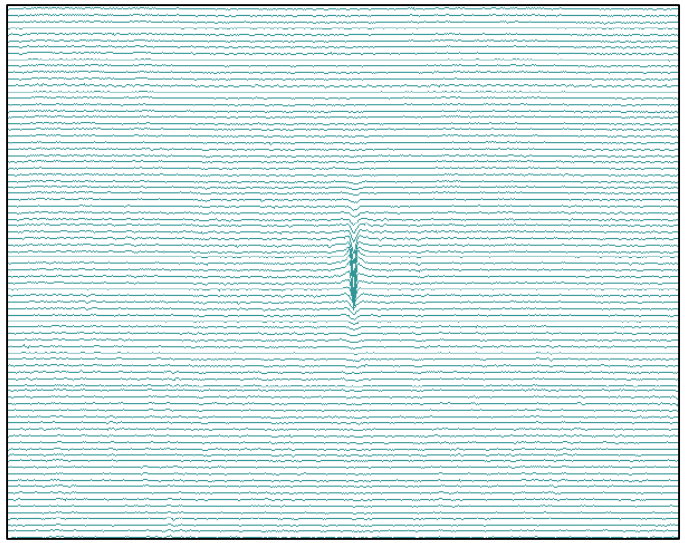


MFL Data Output

Axial MFL - The Basics

Any variation from plain pipe changes the induced magnetic field in the wall at that location.





MFL Data Output

How can MFL Technology be used to Identify Illegal Taps?

From the perspective of being identified by an MFL inspection, illegal taps can be categorised in two ways:

- Those that have a **ferrous component**
- And those that are **non-ferrous**

BHGE has employed the principal detection capabilities of MFL technology to identify and locate illegal taps.

The application of this technology has been verified in testing and practice.

Identifying Ferrous Illegal Taps

The most common form of illegal tap are those with a ferrous component.

The amount of magnetic flux that can be accommodated by the pipe wall and additional material is increased compared to plain pipe.

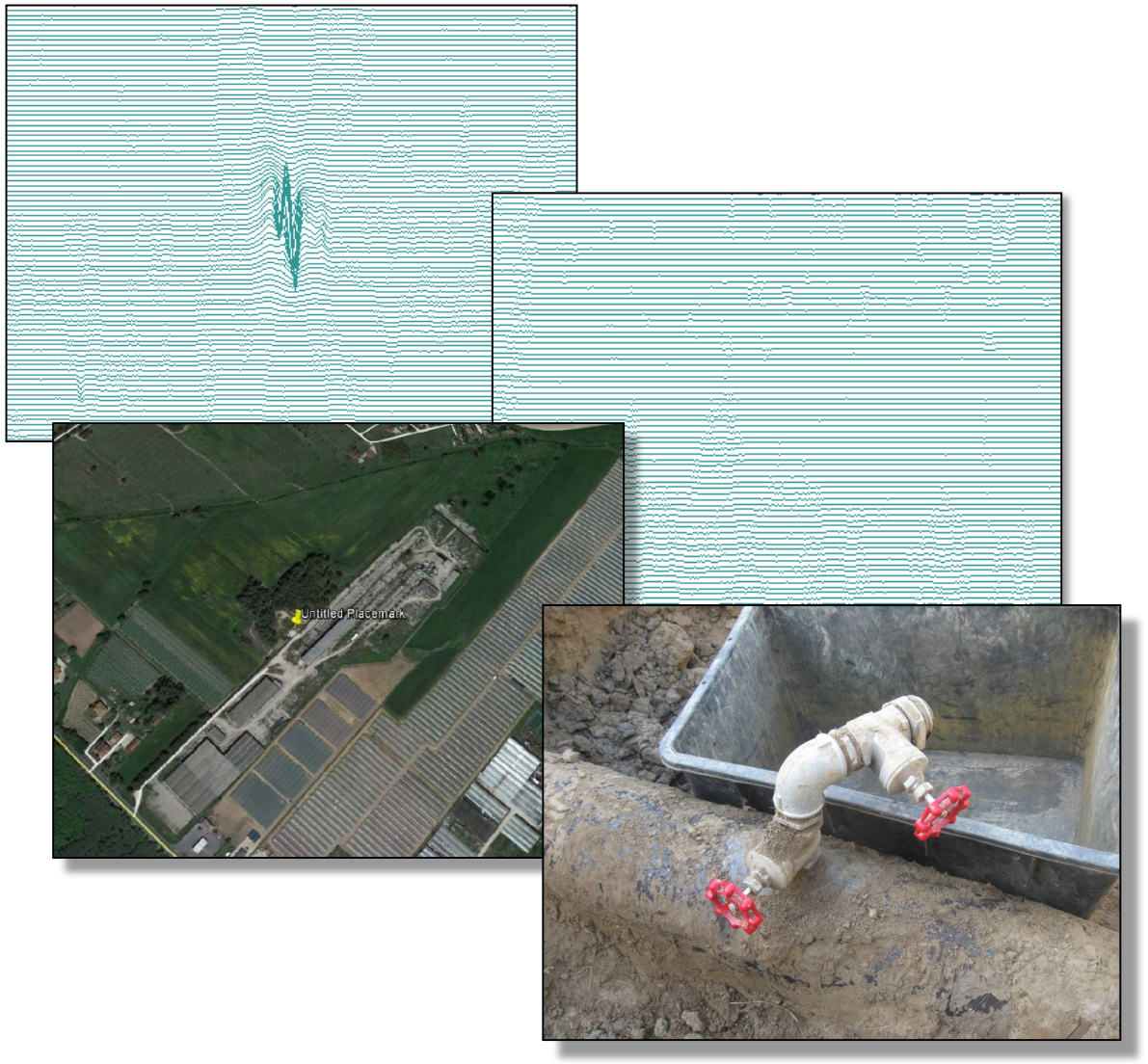
i.e. Less flux is ‘leaked’ from the pipeline at that location. And the illegal fitting is identified.

Identifying Ferrous Illegal Taps

Signals can be compared to known features and fittings on the pipeline to determine if it is new.

The feature is highly likely to be an illegal tap if it is new compared to a previous inspection or is not known to the pipeline operator.

A new feature can be viewed in geographic visualisation software to further assess its likelihood to be an illegal tap.



How can Non-ferrous Illegal Taps be Identified?

The method for identifying Illegal taps without a ferrous component relies on the MFL tool's primary function

– **the ability to detect metal loss.**

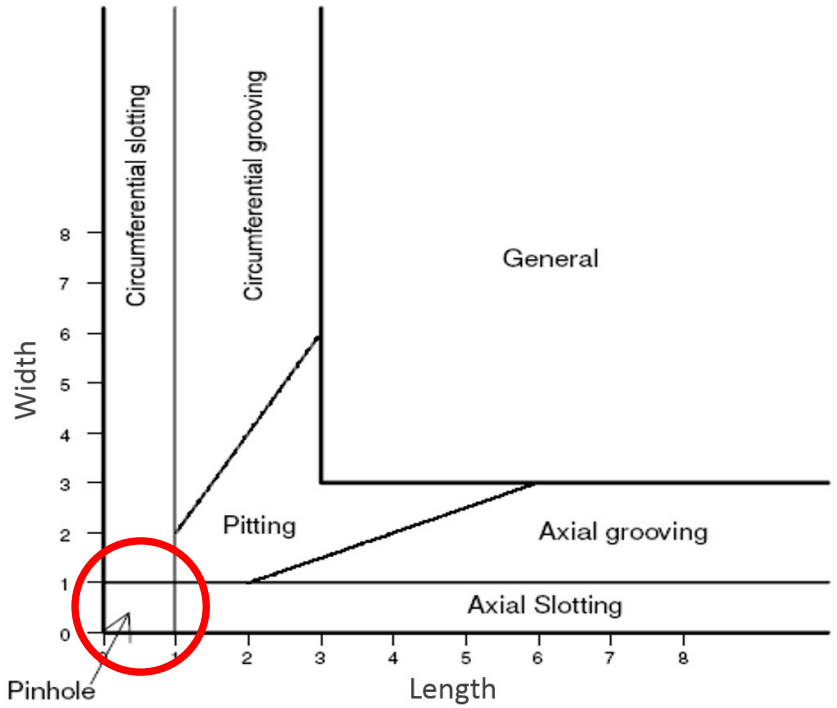
Although the non-ferrous attachment will not be detected **the drill hole from which the product is being released can be detected.**

Identifying Non-ferrous Illegal Taps

Drill hole dimensions used to steal product from a pipeline typically fall into the metal loss classification of pinholes.

The enhanced resolution of BHGE's latest generation MFL technology provides the ability to detect through-wall pinholes down to 2mm in diameter.

The MFL vehicle has the ability to identify non-ferrous illegal taps with drill holes down to 2mm diameter.



Identifying Non-ferrous Illegal Taps and Attempts

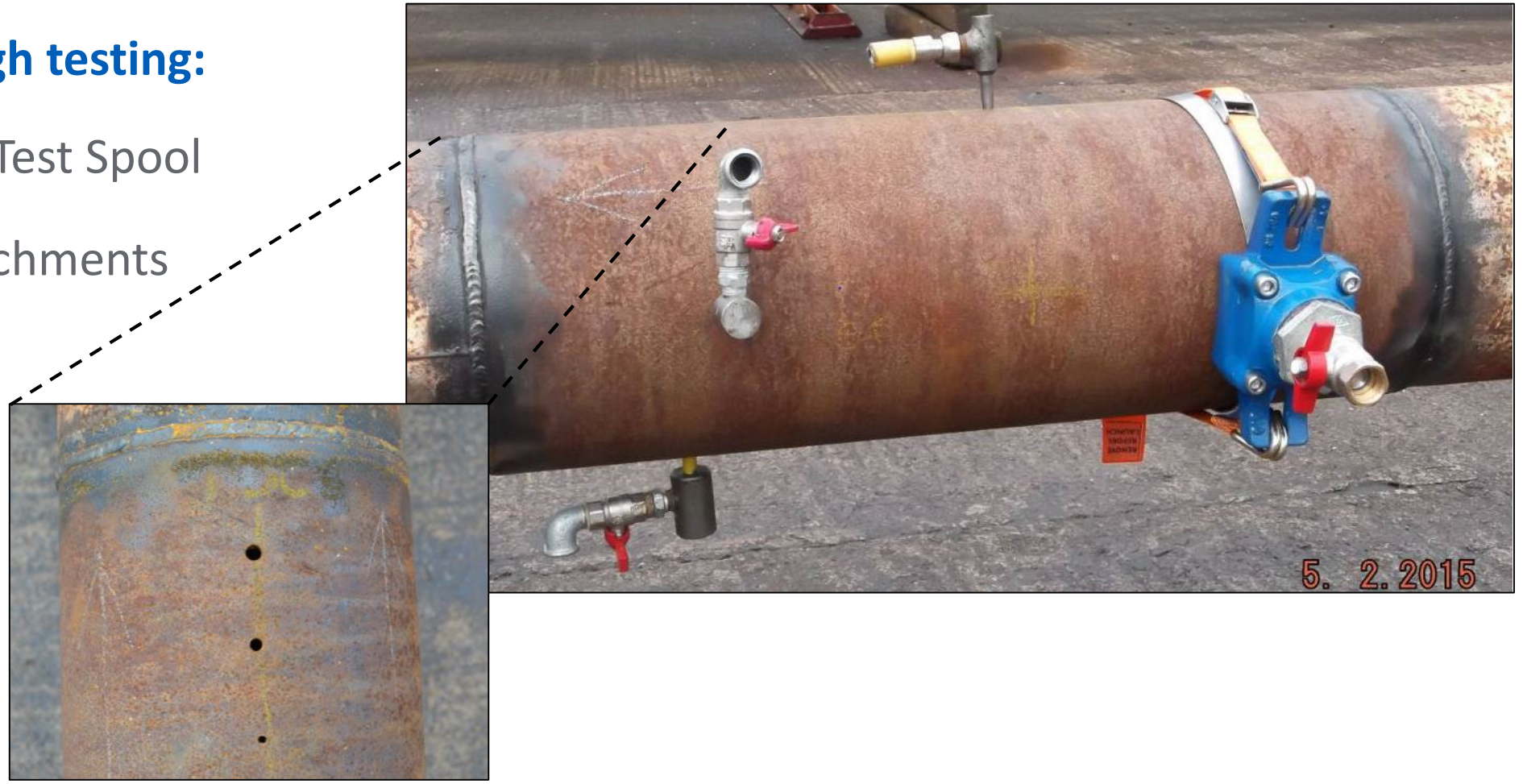
A further advantage of this detection capability means it can detect non-through-wall drilling attempts caused by pilferage activity.

Verifying the Identification of Illegal Taps

2015 Pull-through testing:

Tecma Supplied Test Spool

- 4 Ferrous Attachments
- 3 Drill Holes

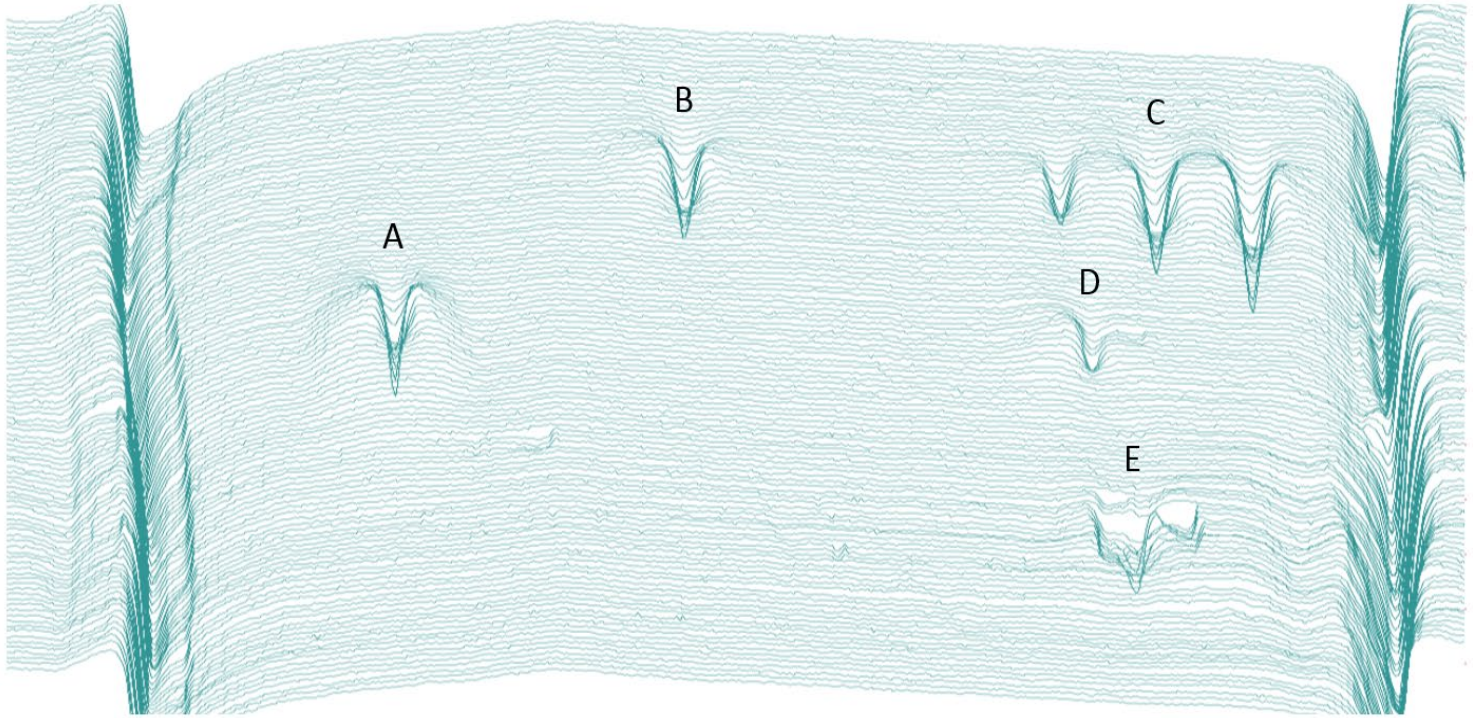


Verifying the Identification of Illegal Taps

Multiple pull-through tests were carried out using BHGE's 10" New MagneScan inspection vehicle to assess the tool's ability to detect the features.

All seven features were identified during each pull-through test.

A. Cast Iron Tap
B. & D. Ferrous Attachments
C. Drill Holes
E. Protruding Attachment



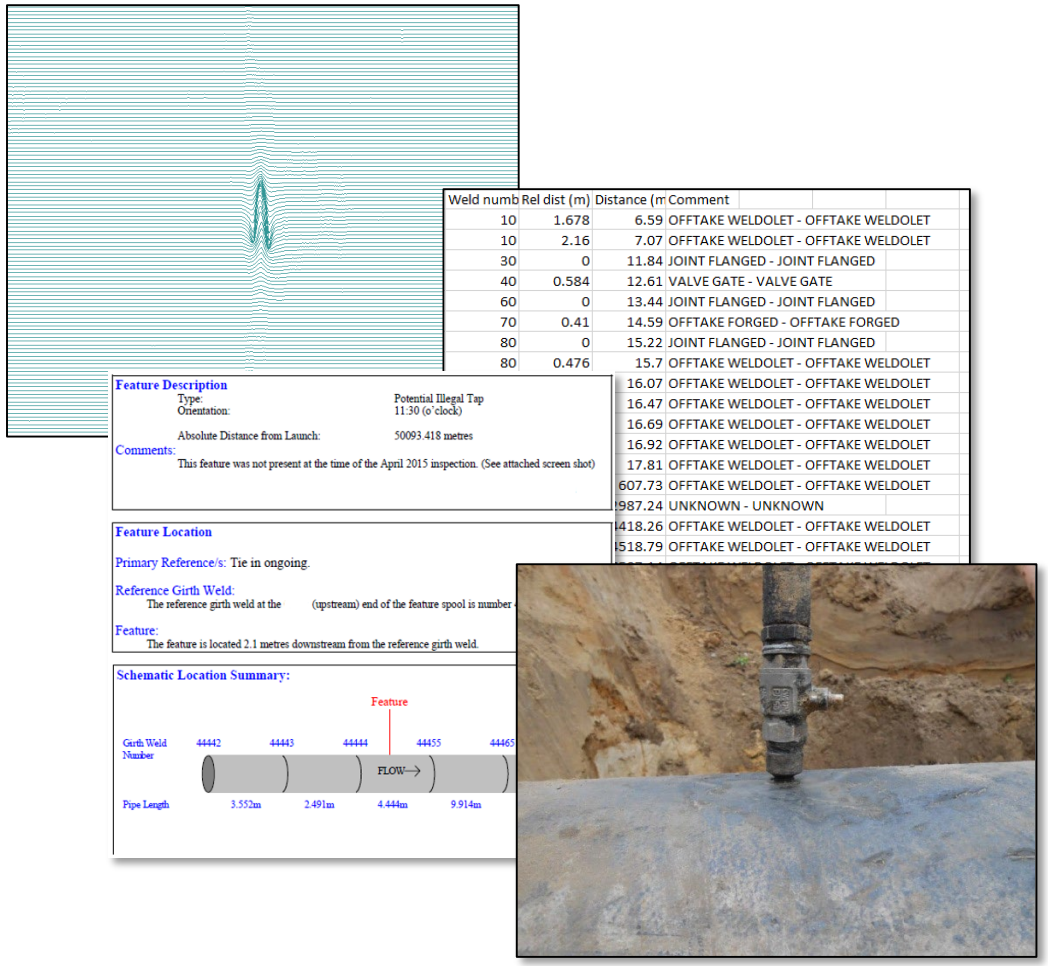
Case Study 1 – Stopping Theft Through Accurate Identification and Reporting

In 2014, a farmer and a storage unit operator separately reported to police suspicious events that led to the discovery of two illegal taps.

BHGE were asked if they could help determine if there were any other illegal taps in the line.

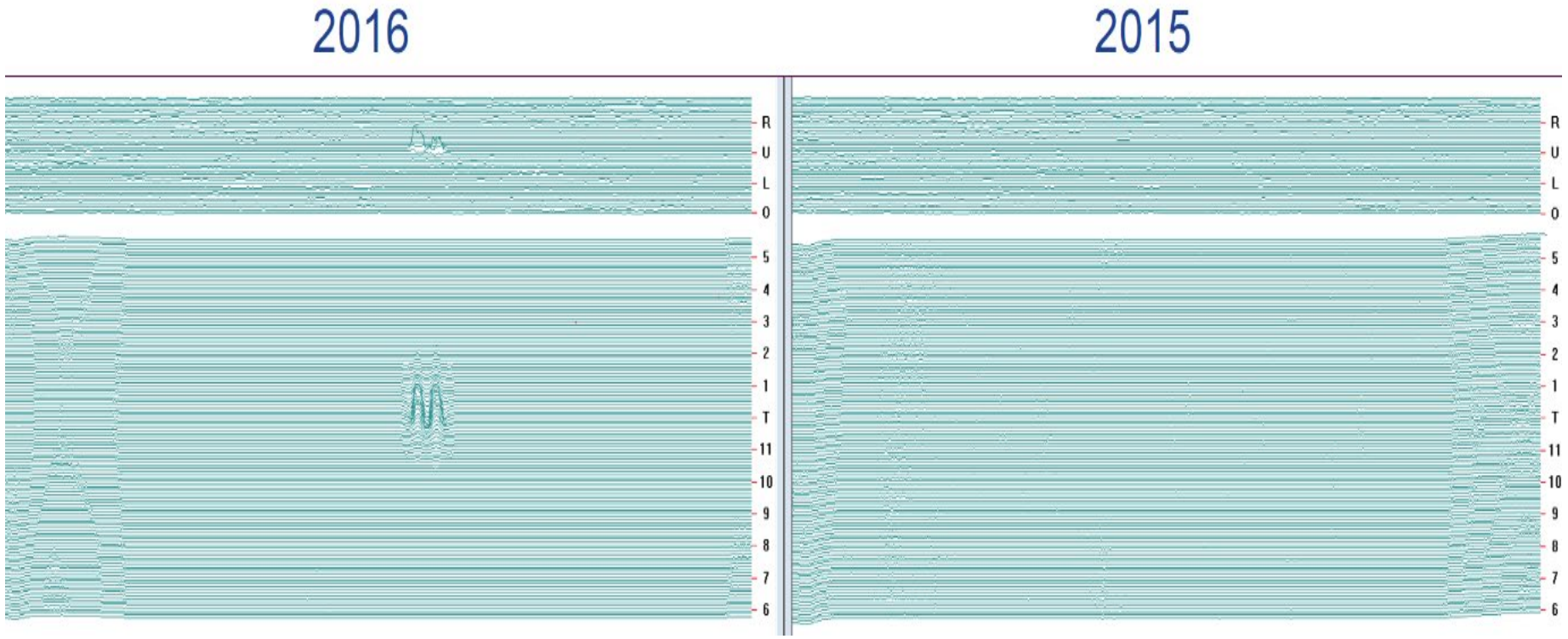
Within seven days a highly-practical Excel-based Change Report was produced.

Nine illegal taps were identified along the >150 km line. Six months later, a second inspection found several new illegal tapping sites.



Case Study 2 – Thieves Developing Techniques to Avoid Visual Detection by Pipeline Operators

Two attachments were identified under a pipeline casing, near to a river crossing. These attachments were new compared to the previous inspection, carried out in 2015.



Case Study 2 – Thieves Developing Techniques to Avoid Visual Detection by Pipeline Operators

The excavation highlighted the elaborate attempts of the thieves to disguise their illegal activity from visual discovery by the pipeline operator or members of the public.

Case Study 2 – Thieves Developing Techniques to Avoid Visual Detection by Pipeline Operators

Despite the thieves' elaborate attempts to avoid detection, the obvious indications between the two inspection data sets allowed the pipeline operator to find these illegal taps, which **may have gone undetected through visual pipeline examination alone.**

Case Study 3 – Thieves Developing Techniques to Avoid Technical Detection by Pipeline Inspection Companies

In some cases, illegal taps stand out in the data during analysis.

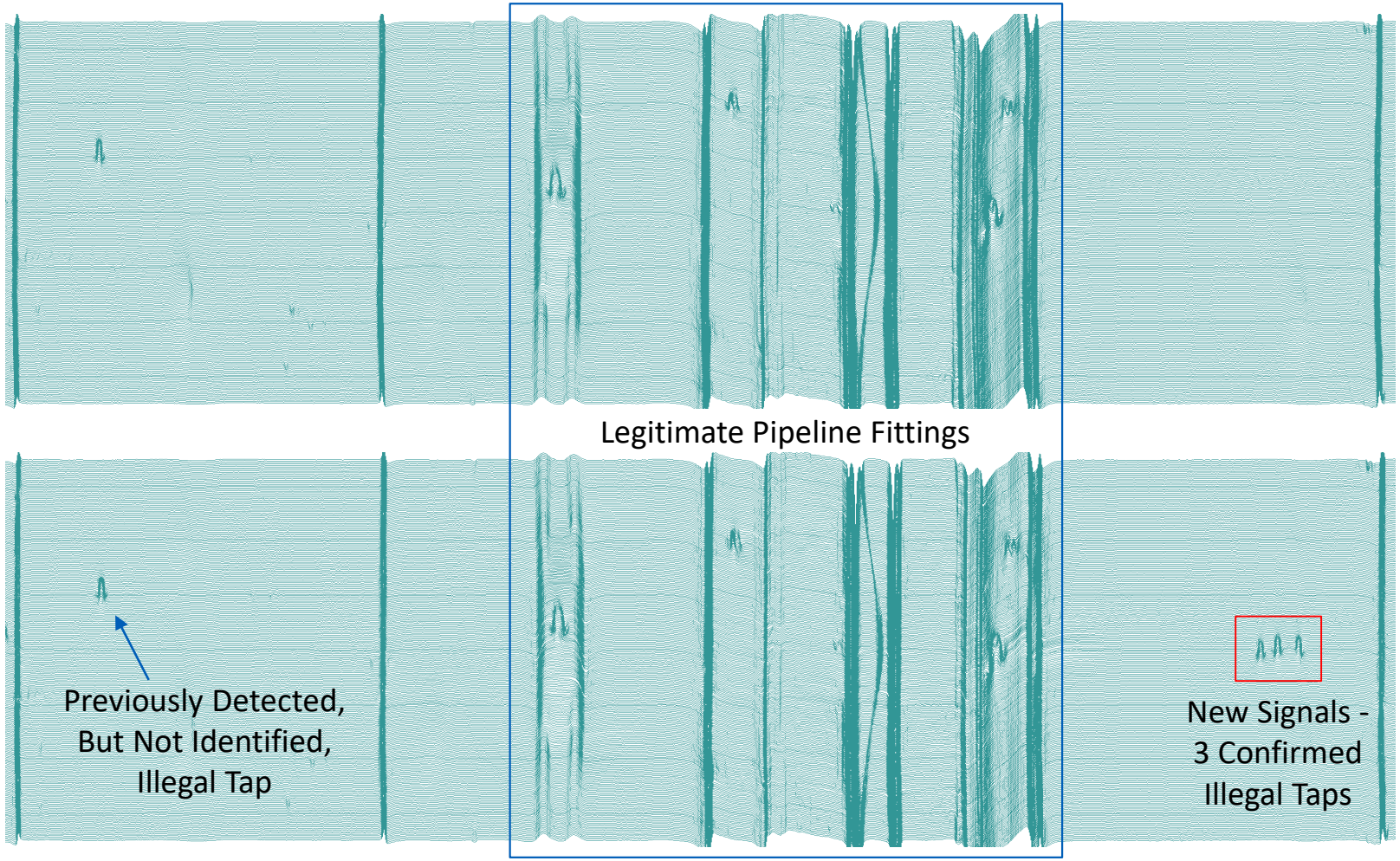
The taps are isolated in the data, away from other pipeline fittings and, given the rather crude nature of the tap itself, are not visually similar to legitimate offtakes on the pipeline, and so can easily be distinguished.

However, thieves are becoming increasingly sophisticated in their attempts to avoid technical detection by pipeline inspection companies.

Case Study 3 – Thieves Developing Techniques to Avoid Technical Detection by Pipeline Inspection Companies

The fitting had been detected, but not identified, during the analysis of the first-time inspection because it did not look out of place.

The implications of this case study are the need for analysts to develop a suspicious mind and for pipeline operators to correlate inspection data with their own pipeline design and layout information.

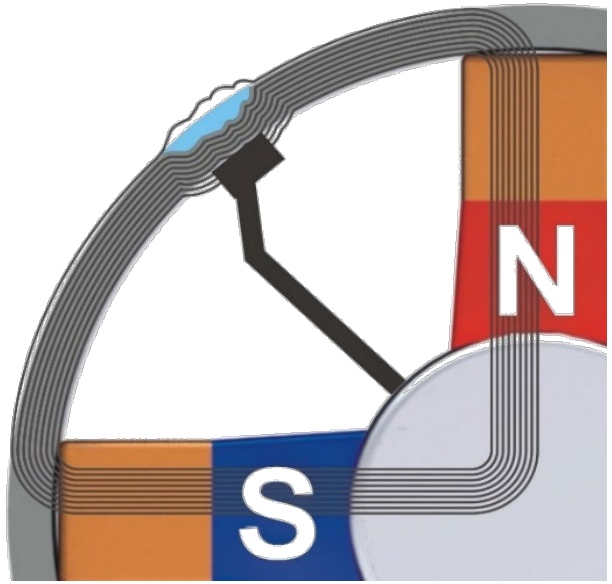


Case study 4 - Identifying Illegal Taps Using TranScan: A Unique Case

Traditionally axial MFL vehicles have been used to identify illegal taps.

BHGE has also completed runs with the purpose of identifying illegal taps using one of its alternative MFL vehicles – the Transverse Field Inspection (TFI) vehicle - **TranScan™**

TranScan induces the magnetic field around the circumference of the pipe, with the aim of detecting and sizing narrow axial corrosion or open axial cracks.



Case study 4 - TranScan Pull-Through Testing

BHGE was contracted by a European operator to undertake pull-through testing of its 12” TranScan vehicle.

The purpose was to investigate if TFI could be used to detect tapping points attached to a test spool.

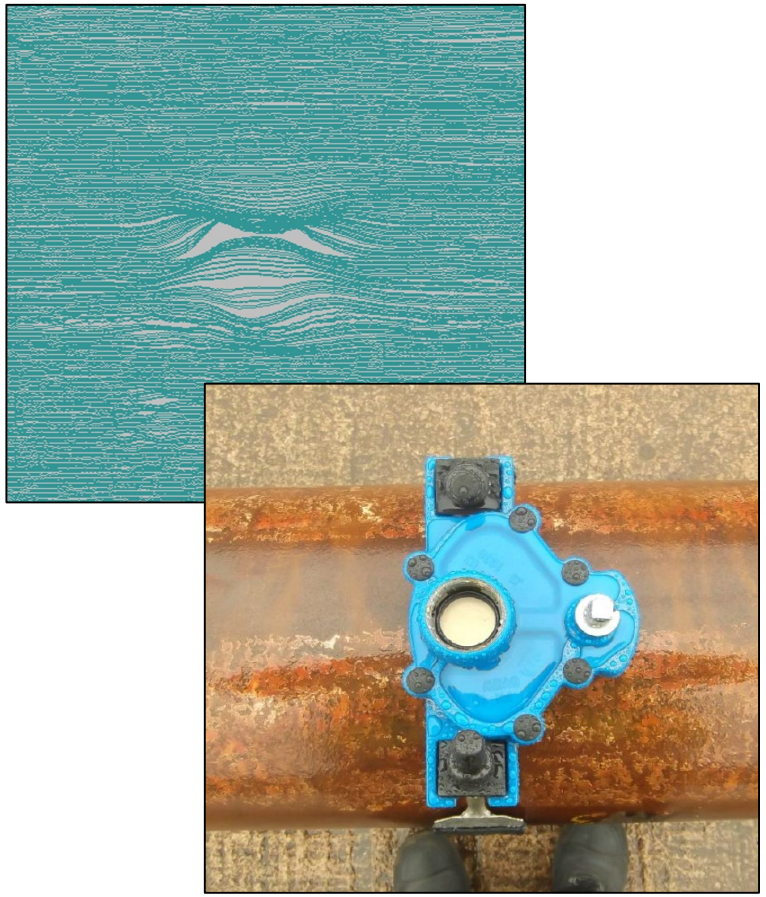
The aim to reduce the overall number of runs required by the operator.

Case study 4 - Identifying Illegal Taps Using TranScan

- All the tapping attachments were detected.
- The TFI inspection vehicle detected two small diameter through wall holes.

Illegal Tap detection could be incorporated into a TFI inspection, and the number of runs required by the operator was halved.

BHGE carried out five combined TFI and illegal tap inspections using the TranScan technology.



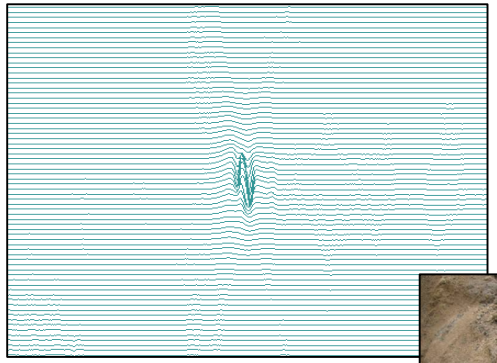
Conclusions

This presentation has illustrated MFL Technology's ability to:

- Accurately identify illegal taps
- Quickly produce useful information for locating and reporting them

It has also highlighted the need for:

- Developments in security and monitoring
- Continued visual and technical pipeline inspections
- Stress the importance of vigilance as thieves develop sophisticated and cunning techniques to avoid detection

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