Inspection of Pipelines through thick coating

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Existing Technology for inspection through coating

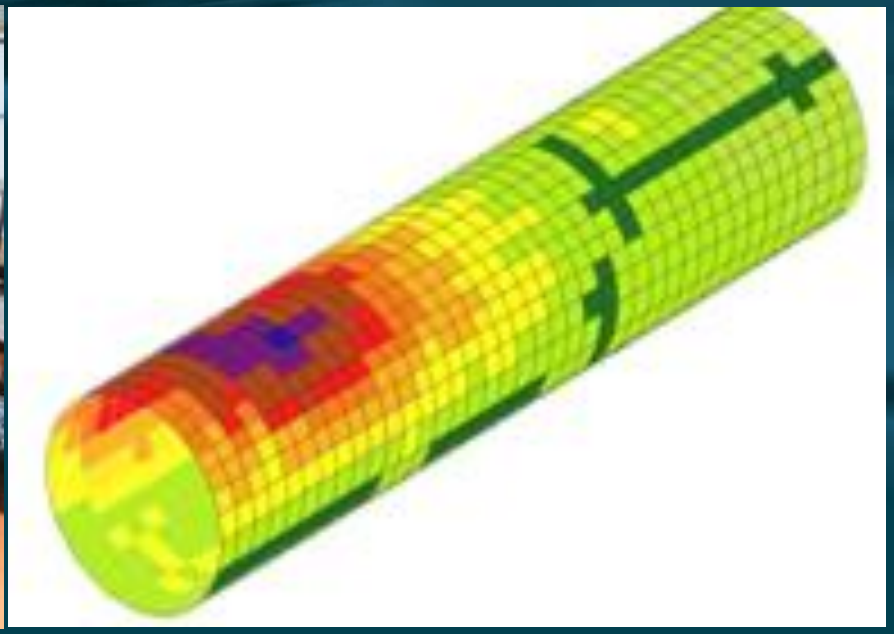
Context: Inspect steel pipe through a thick layer of non-conductive coating (possib. incl. thin conductive layer)

- ***Ultrasonic***
  - ***Long Range UT***
    Not through the coating; requires a point of access
  - ***ART (Acoustic Resonance Technique)***

- ***Radiography***

- ***Electromagnetic***
  - ***Pulsed Eddy Current (PEC)***
  - ***Magnetic biased Eddy Current (MEC/SLOFEC)***

Application of PEC for subsea pipeline inspection



Pictures: Courtesy of Impresub

Advantages of PEC:

Has been used for CUI (Corrosion under insulation) for up to 150mm

Drawback:

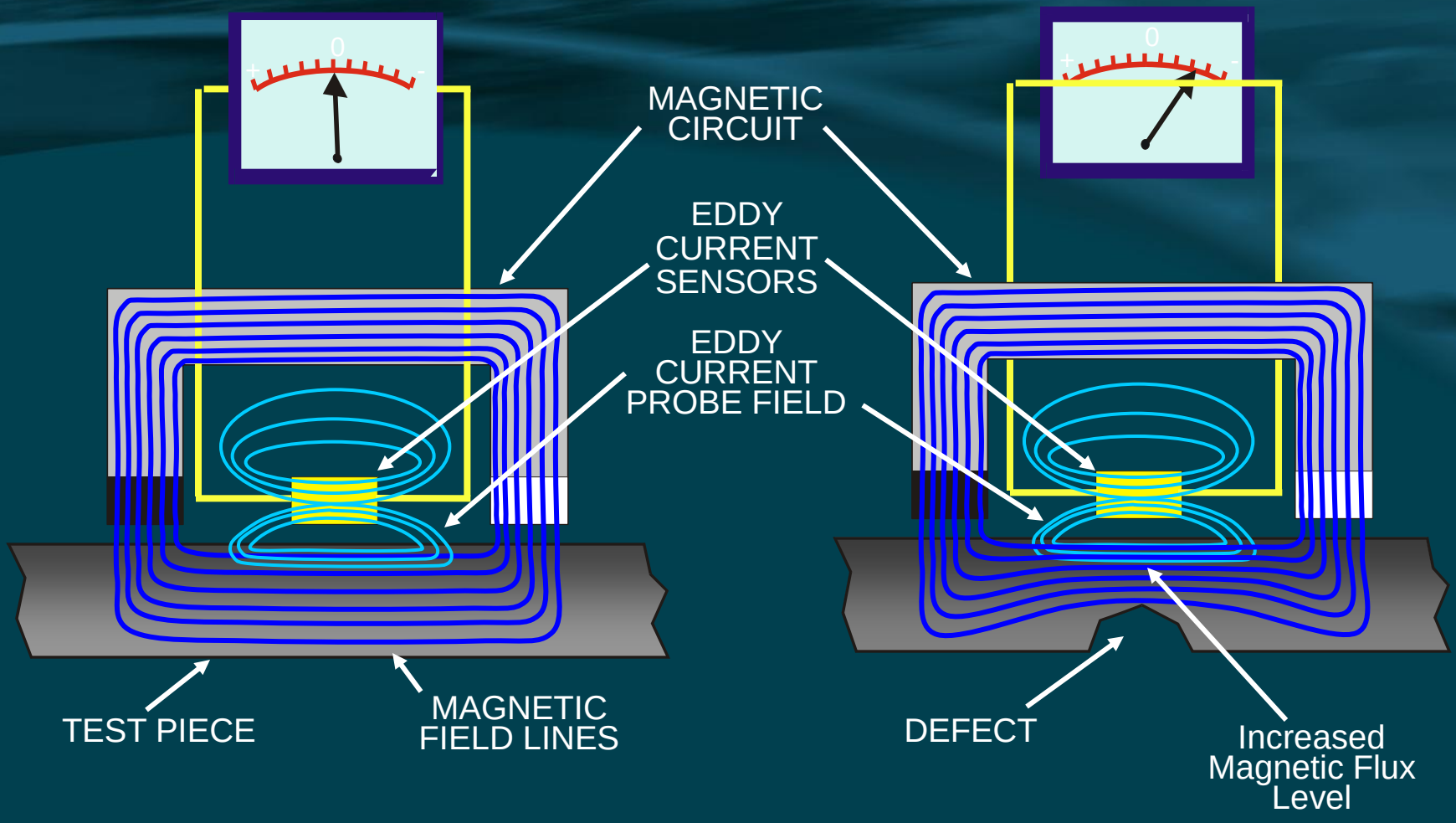
Resolution limited, not a fast scanning technique

The task: Neoprene - coating on a riser
Inspection using
Magnetic Eddy Current (MEC)

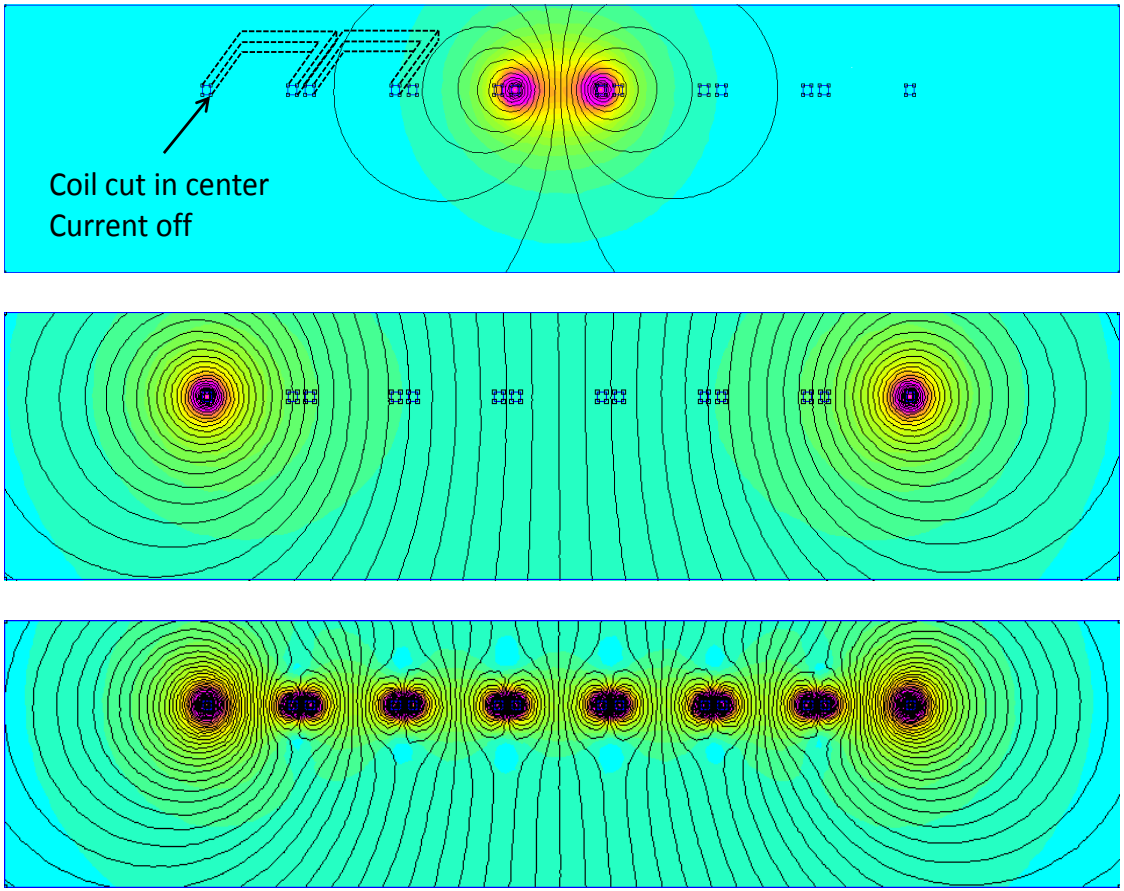
- ***Several riser had to be inspected with a neoprene coating of 12.7 mm and up to 25.4 mm wall thickness.***

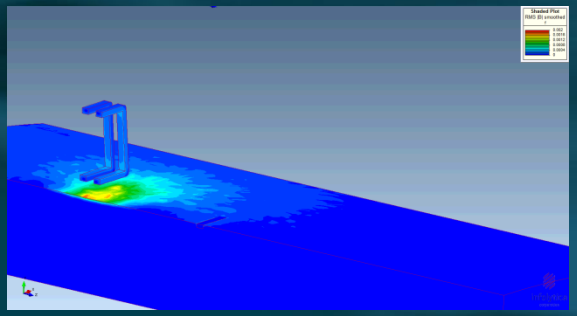
- ***Pipes for testing and calibration were produced to stipulate the performance under these conditions.***
- ***Defects in the range of 10 mm diameter and 10% wall loss had to be detected.***

The MEC/SLOFEC Inspection technology



2D and 3D FEM calculations carried out to understand performance of sensors

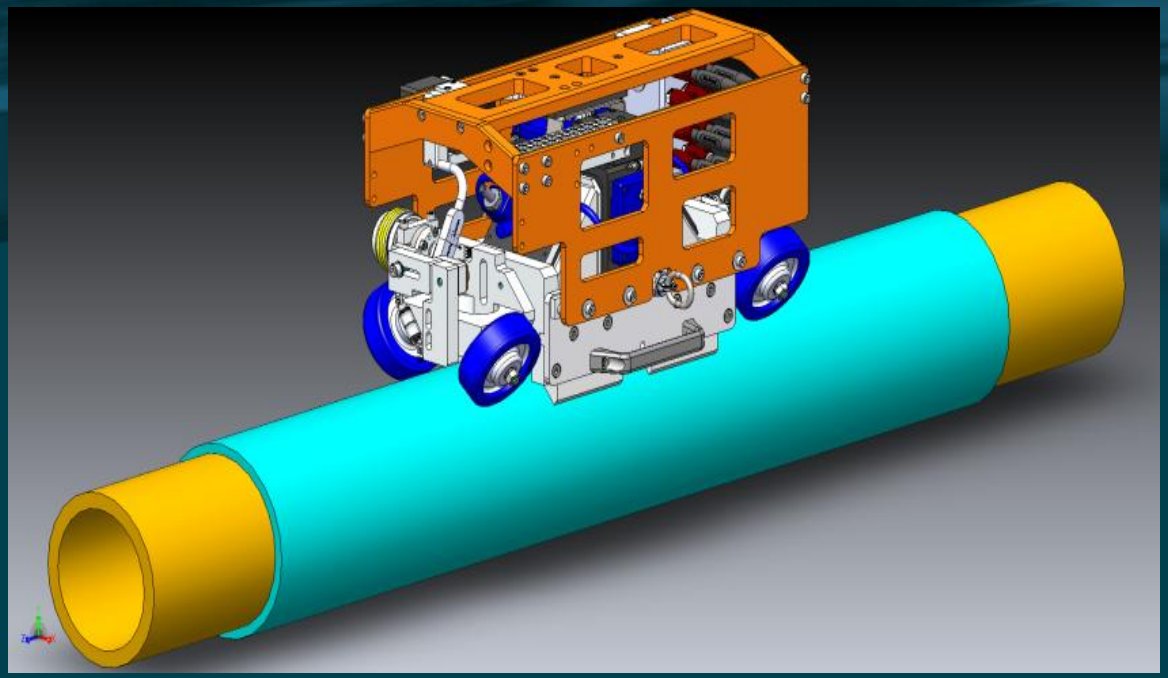




Eddy current sensors have an active field contrary to Hall Sensors for MFL.

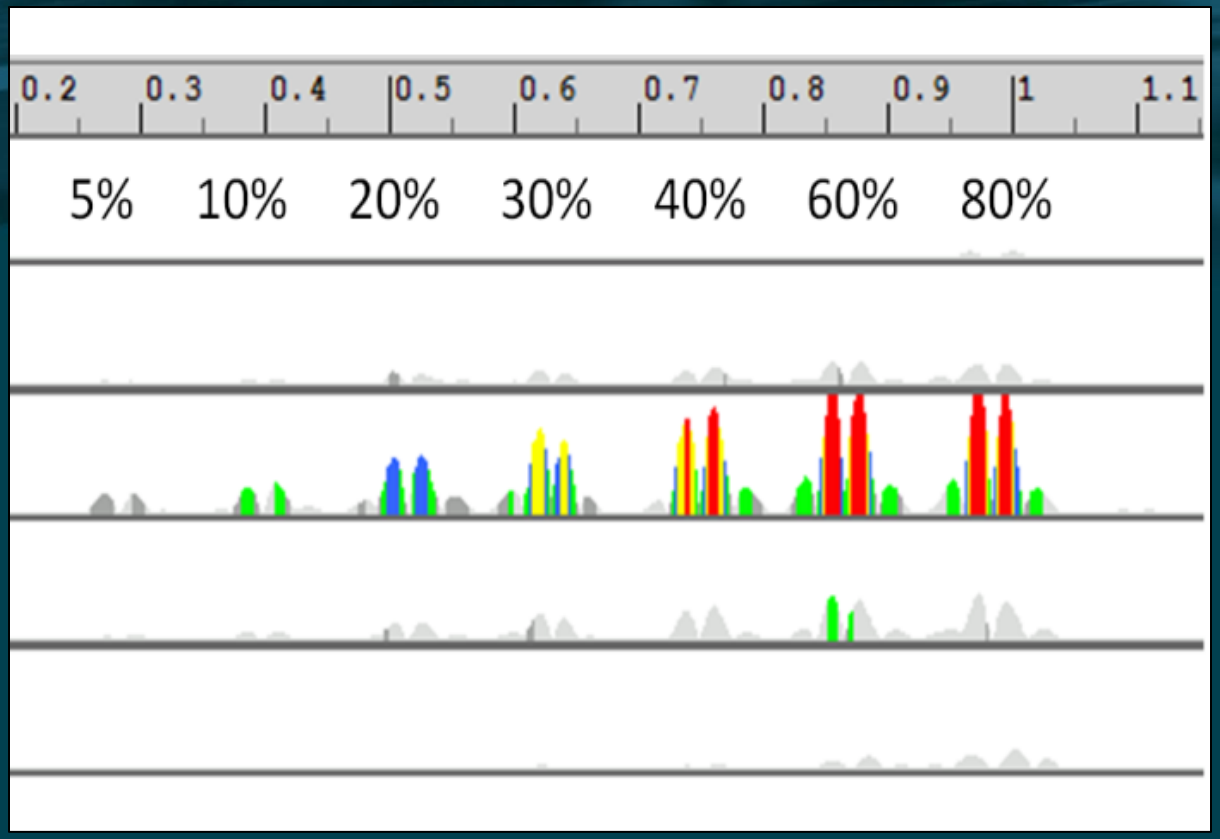
Placed in an array and excited continuously, the field will form like in a large coil, but with high resolution.

The MEC-MPS200+ inspection tool



- *Standard equipment: array of eight magnetic eddy current sensors*
- *Additional depending on project:*
  - *Cleaning nozzle*
  - *UT wall-thickness (probe array with stand-off)*
  - *Camera*

Data on a calibration file

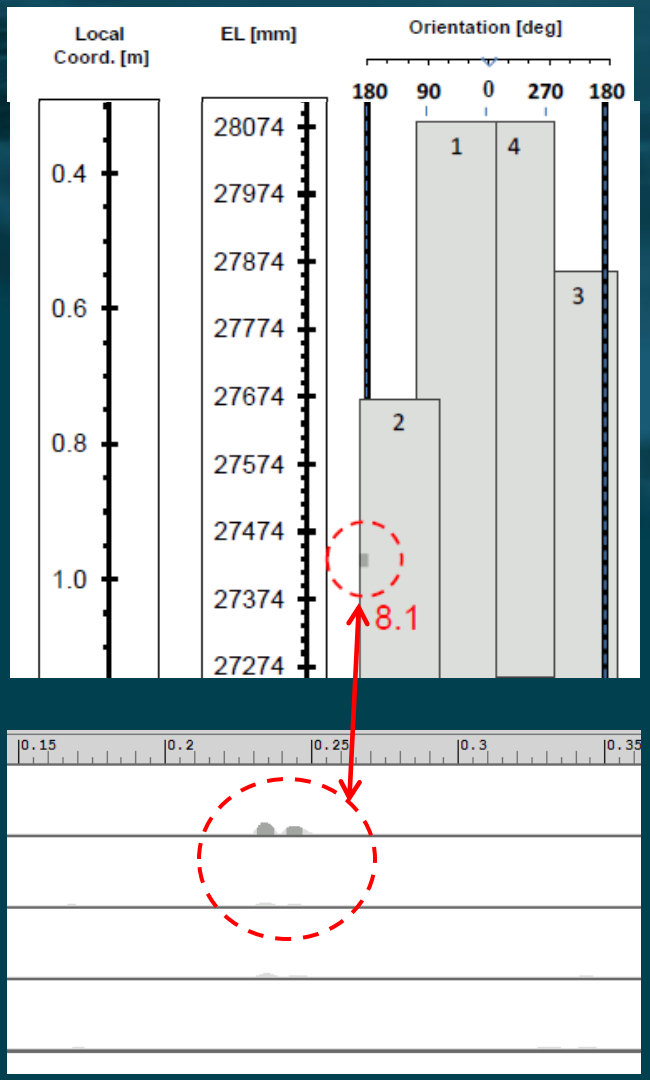


Sequence of 20 mm near-side defects in an 8” pipe of 23 mm wall thickness under 12.7 mm (½”) coating.

A clear almost linear dependency of amplitude versus defects depth is found.

The double peak structure of the differential sensors allows for a precise determination of the defect length.

MPS200+ Tool on the riser



No major defects found.
Focus put on even small indications in the range below 10% wall loss.

Project:
Detection of wire misalignment on flexible riser

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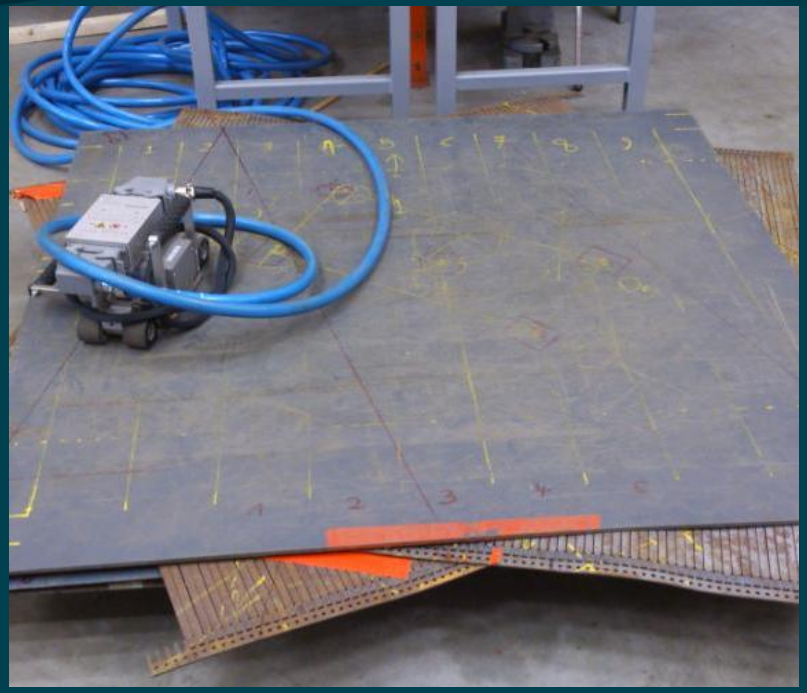
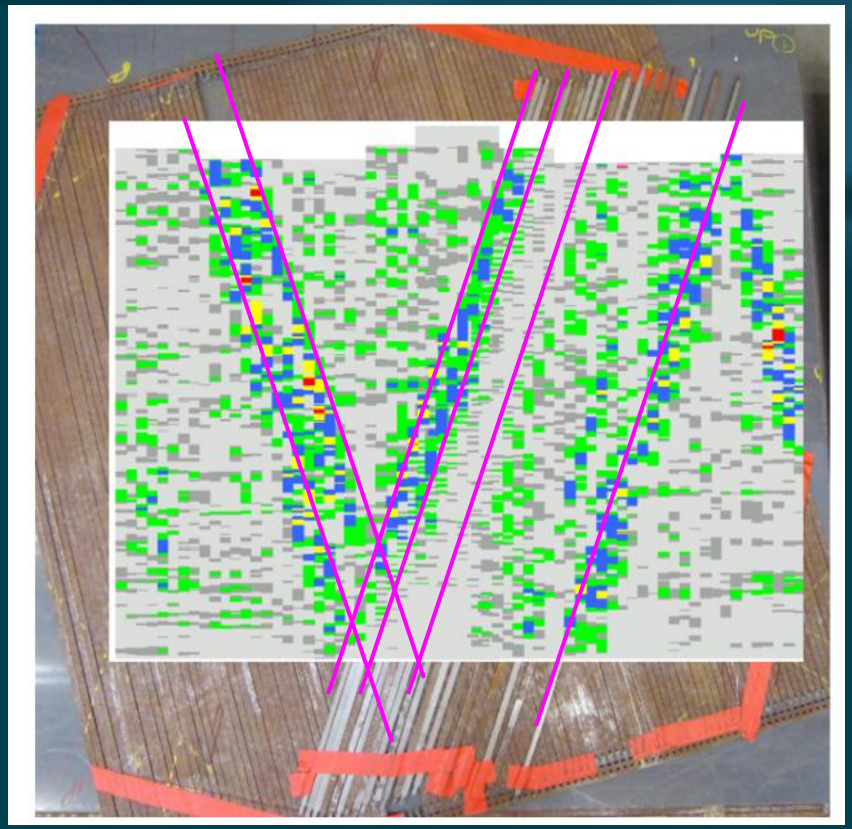
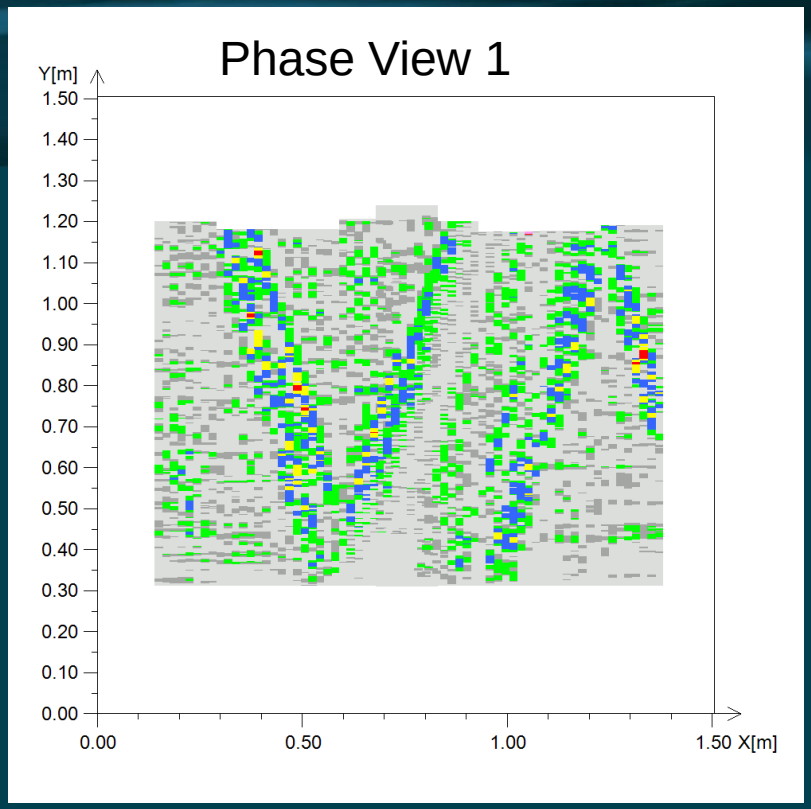
Wire misalignment or disorganisation

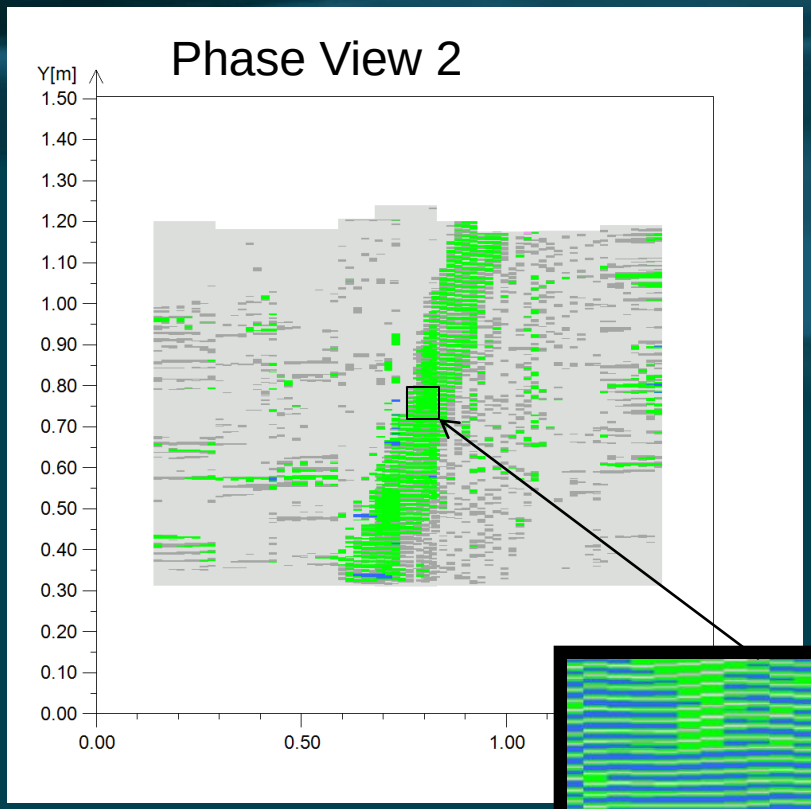


Workshop set-up

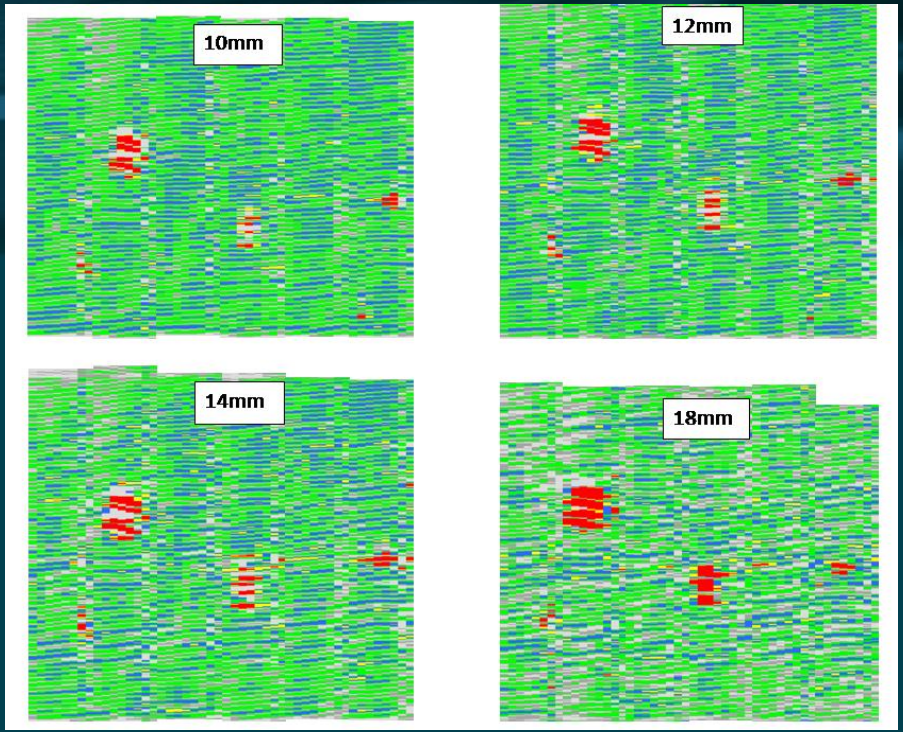


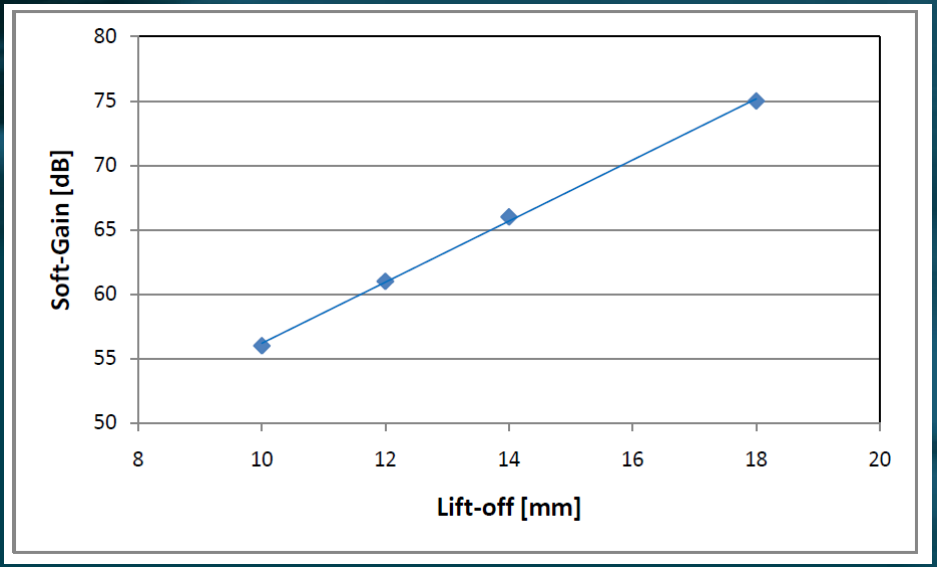
The standard pattern for the intact pipe observed through a coating





Dependency on lift-off





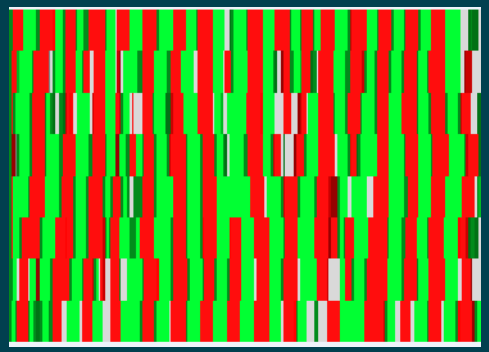
With higher lift-off signal strength decays. Increasing gain can restore signal until electronic noise level interferes.

In this configuration a lift-off (incl. a coating) can be up to 18-20 mm.

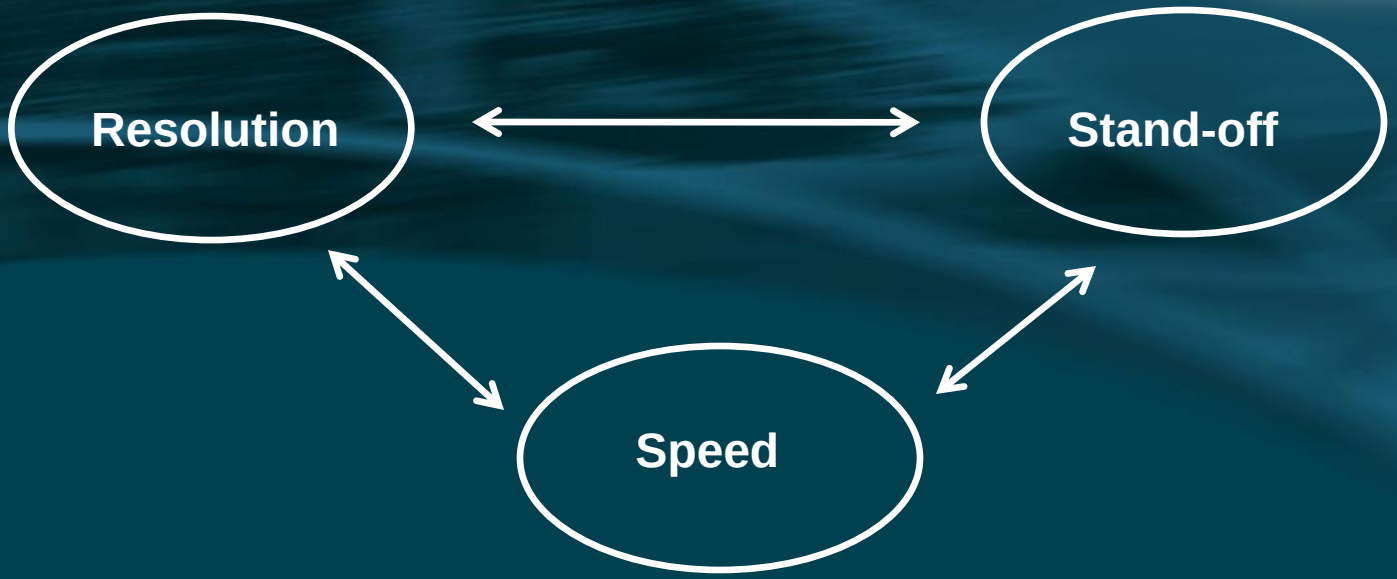
MEC-Combi crawler tool in the sea

- *The tool had to inspect on a flexible with bends of unknown curvature.*
- *It was important to be able to sense at different levels of lift-off and to easily adjust the signal with a variable gain.*

No wire disorganisation detected, but regular pattern retrieved with lift-off compensation



Conclusions



Magnetic Eddy current offers a good compromise between the three goals of high resolution data, high stand-off data acquisition and speed of data acquisition.

It is applicable is various fields of external pipeline inspection and possibly of internal inspection.