IEW
INDIA ENERGY WEEK 2023

UNDER THE PATRONAGE OF

सत्यमेव जयते

MINISTRY OF PETROLEUM AND NATURAL GAS

6-8 February 2023, Bengaluru, India

GROWTH. COLLABORATION. TRANSITION.

OPERATIONAL EXCELLENCE 631

Improving asset integrity with advanced ultrasonic 2D and 3D imaging technology for non-destructive testing

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Content

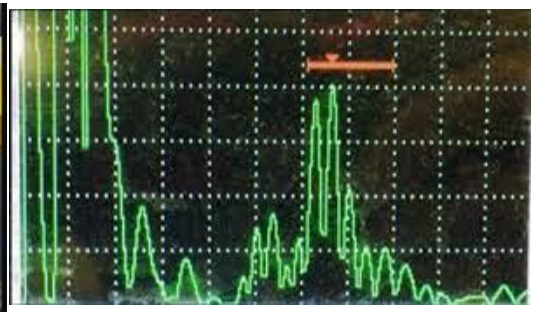
- Inspection challenges for facility operations and maintenance
  - Traditional inspection with radiography
  - Traditional inspection with ultrasonic testing
- Principles of inspection with ultrasonic imaging
  - Full Matrix Capture (FMC) data
  - Image reconstruction (Inverse Wavefield Extrapolation)
- Examples of use cases
  - Pipeline girth weld inspection (new construction)
  - Inspection of Inconel weld (in-service)
- Conclusions

Inspection challenges for industrial facilities

- Industrial assets require inspection and non-destructive testing
- Operational objectives → Safety, reliability, integrity
- Economic objectives → efficiency, productivity, durability
- Accurate and reliable information about the assets condition is crucial

Traditional non-destructive testing

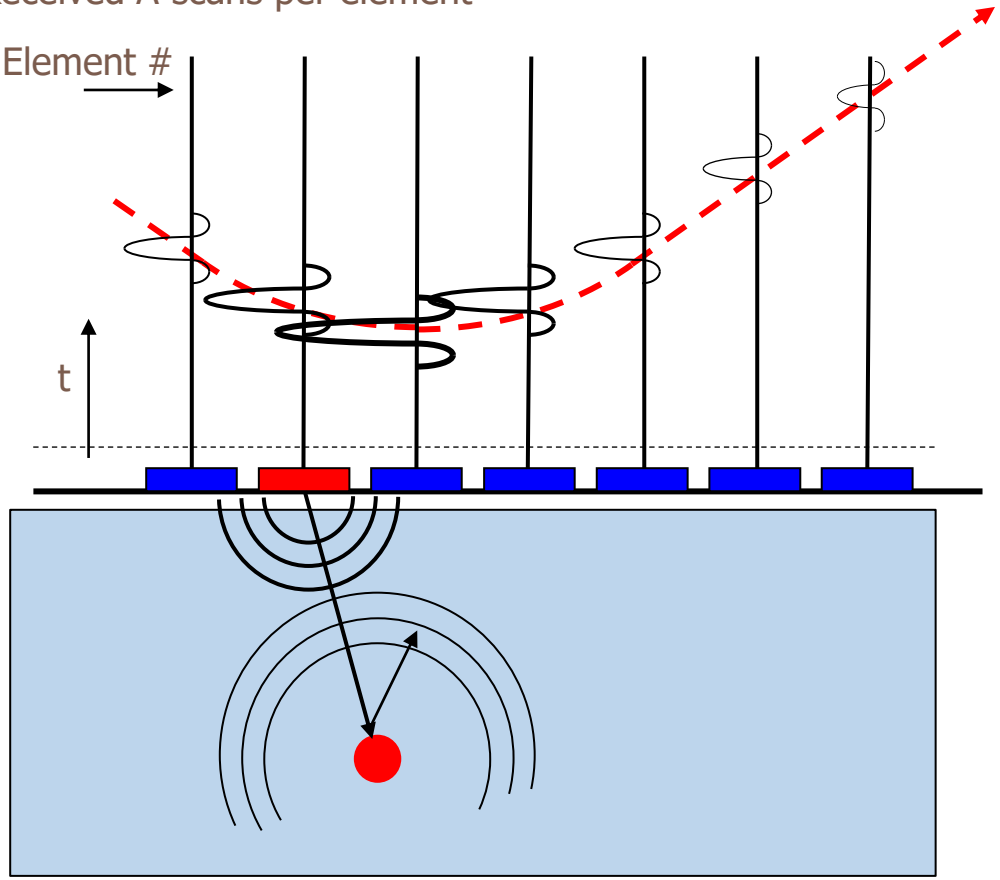
- Radiographic and ultrasonic testing are mostly used
- Traditional NDT requires expertise and experience
- Detection depends on conditions such as material properties
- Data display and interpretation can be ambiguous and not accurate
- For safety and efficiency, ultrasonic testing is often preffered

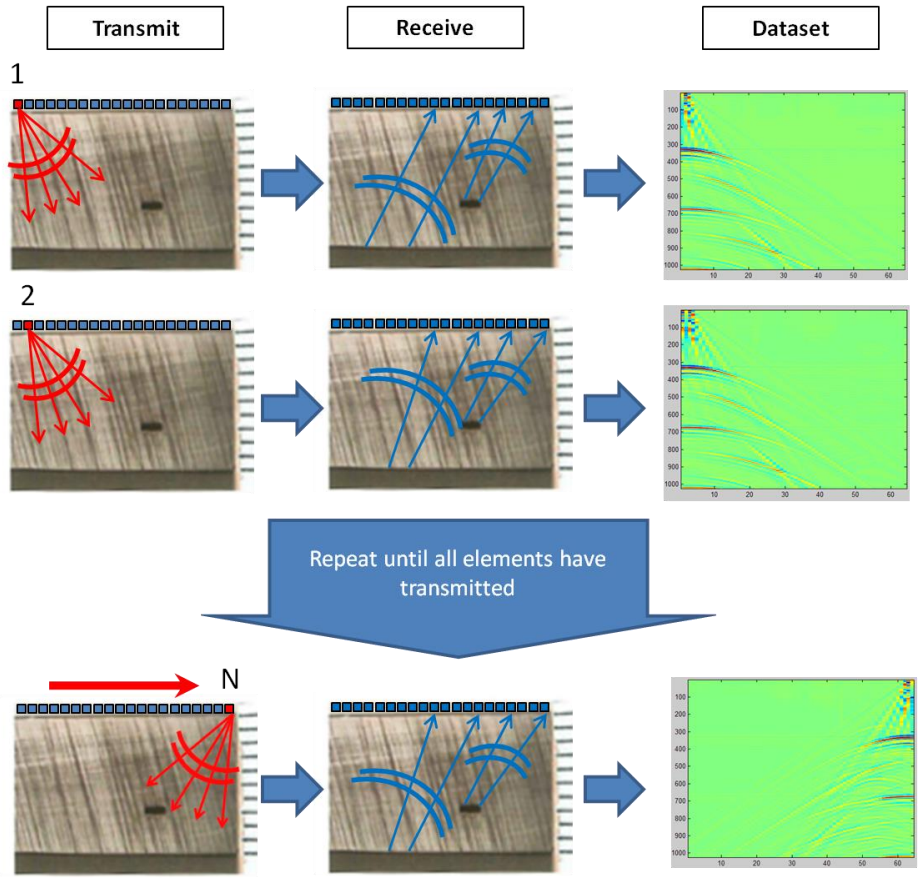


Principles of ultrasonic imaging

- Ultrasonic (phased) array technology is readily available
- Recording of an ultrasonic 'fingerprint'→ Full Matrix Capture (FMC) data
- 2D image can be calculated with a reconstruction algorithm → IWEX

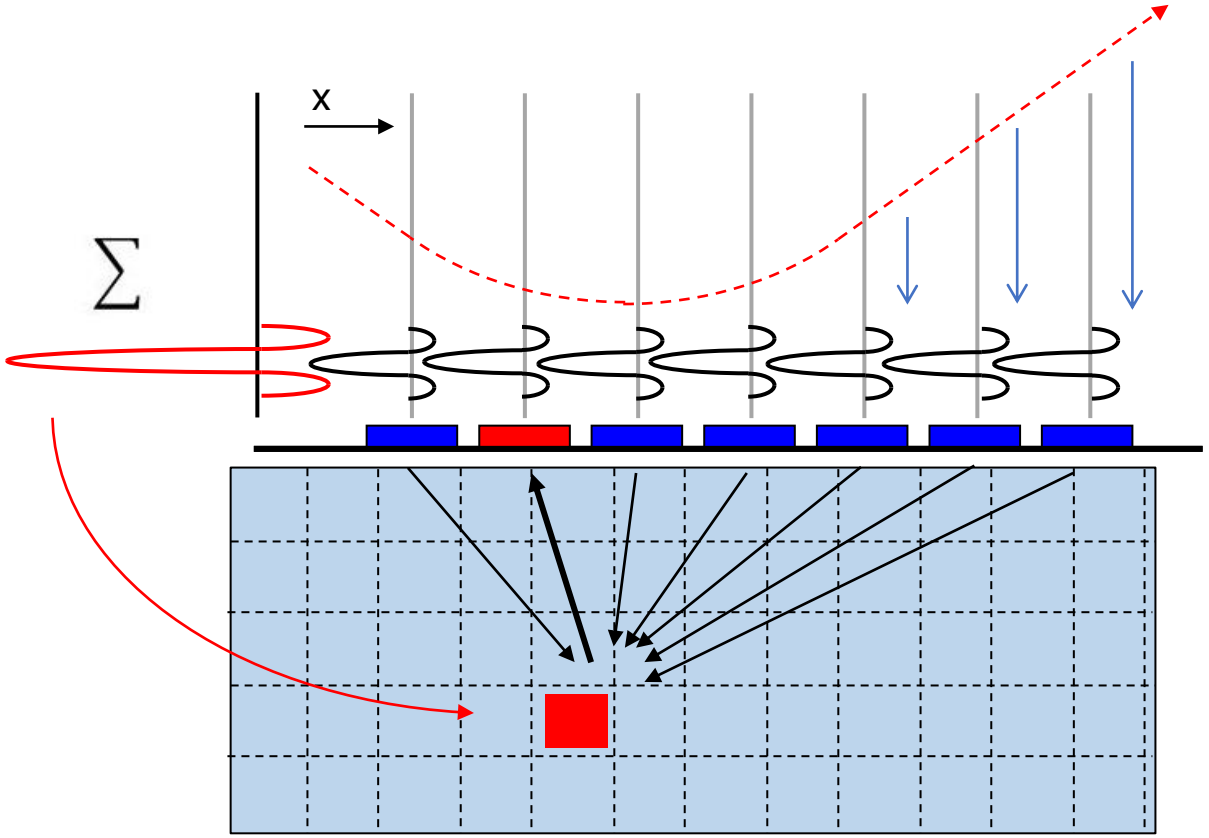
Received A-scans per element

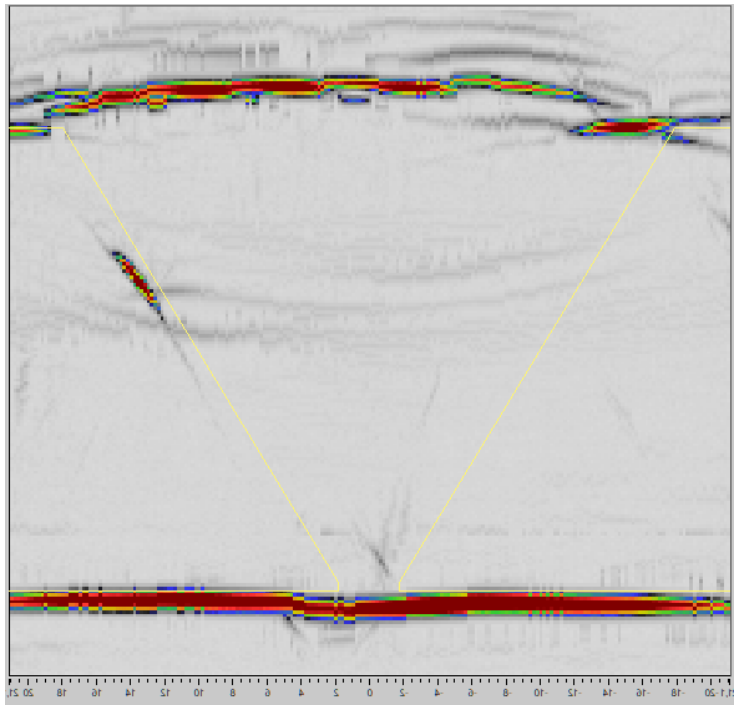




Principles of ultrasonic imaging

- Reconstruction is based on time shifting and summing of responses
- Different travel paths are taken into account → imaging modes
- A comprehensive 2D image is obtained

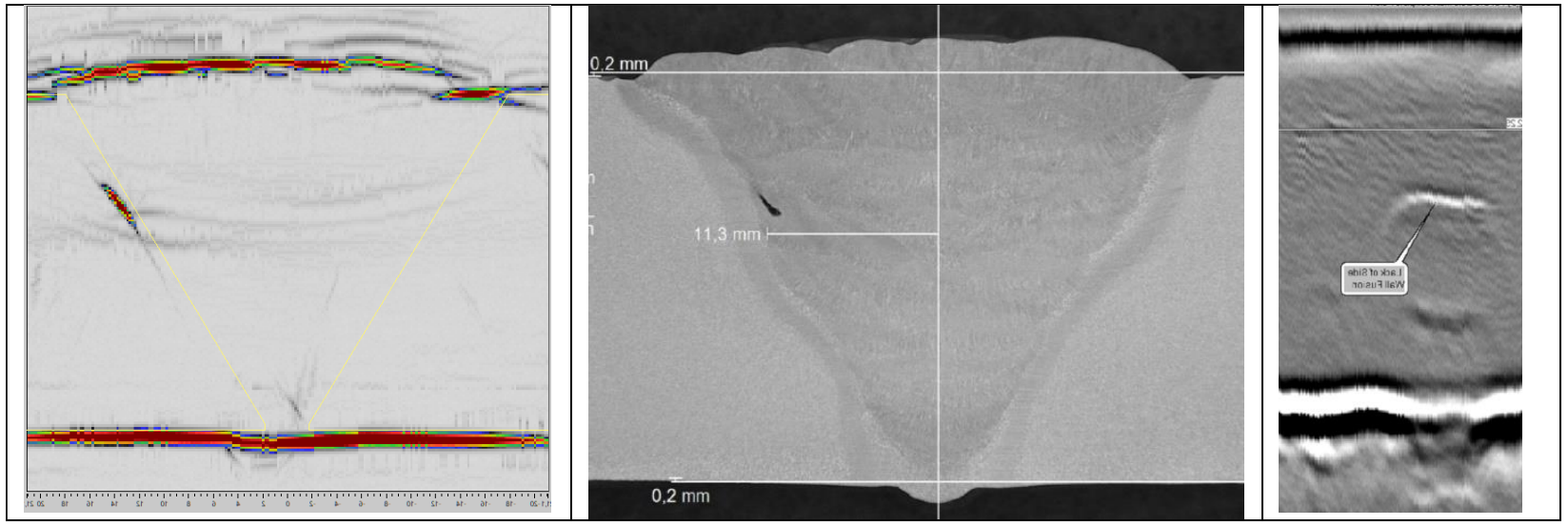




Use case → girth weld inspection

- Welding defects can compromise the pipelines integrity
- Common weld defects: lack of fusion, porosity, incomplete penetration etc.
- For weld assessment, characterization, reliability and accuracy are important

Lack of side wall fusion



2D image

Macro section

Use case → girth weld inspection

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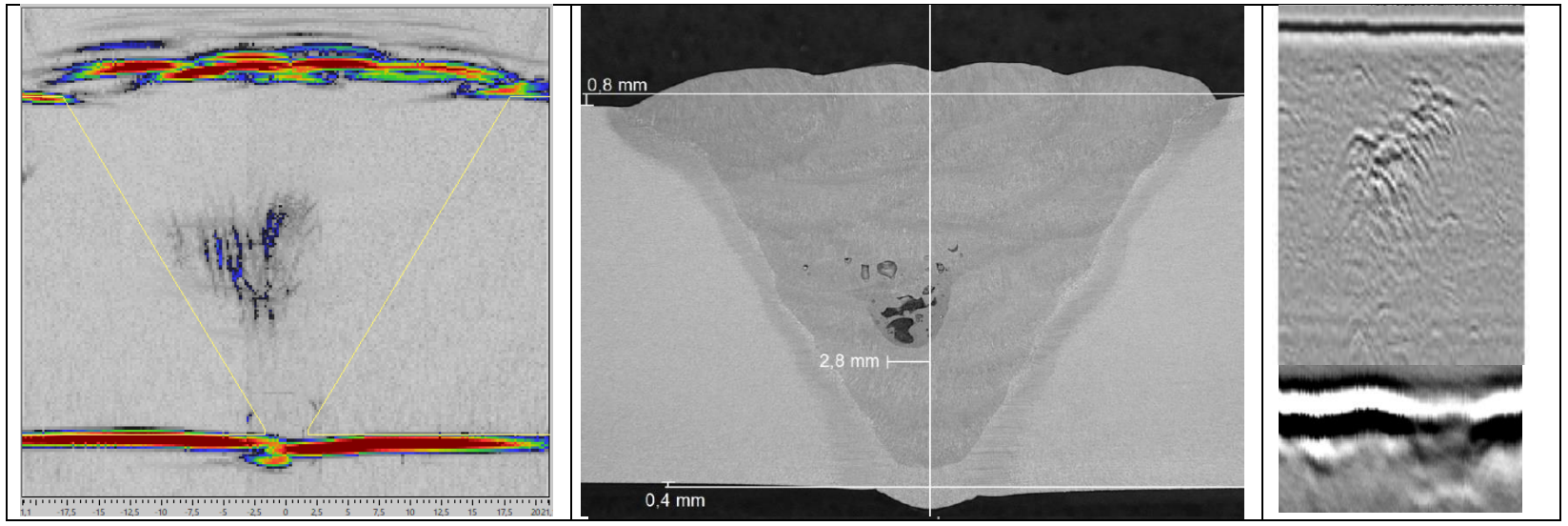


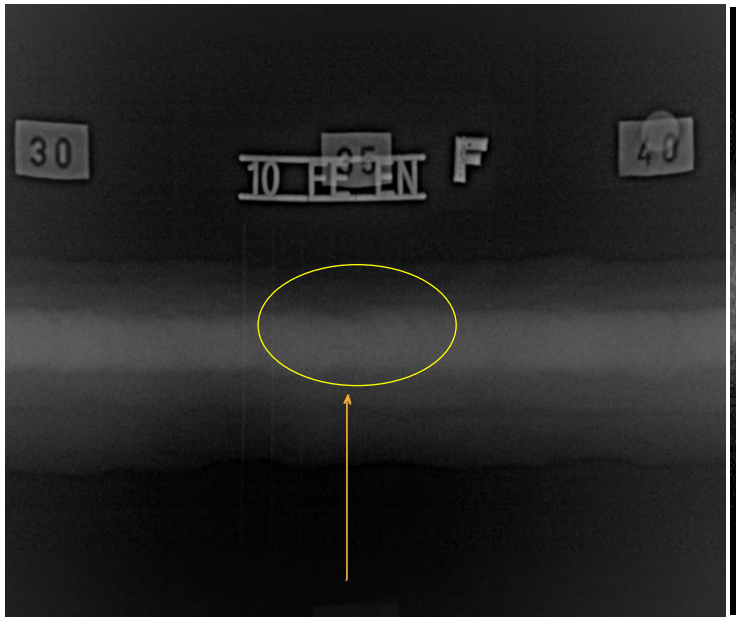
2D image

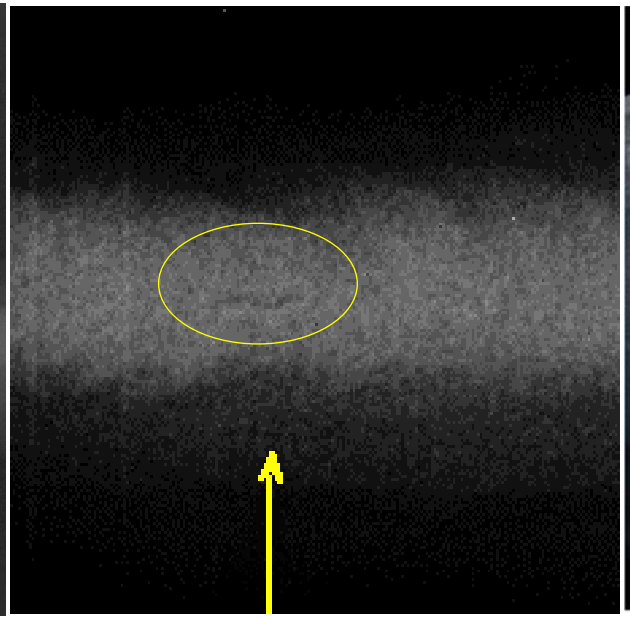
Macro section

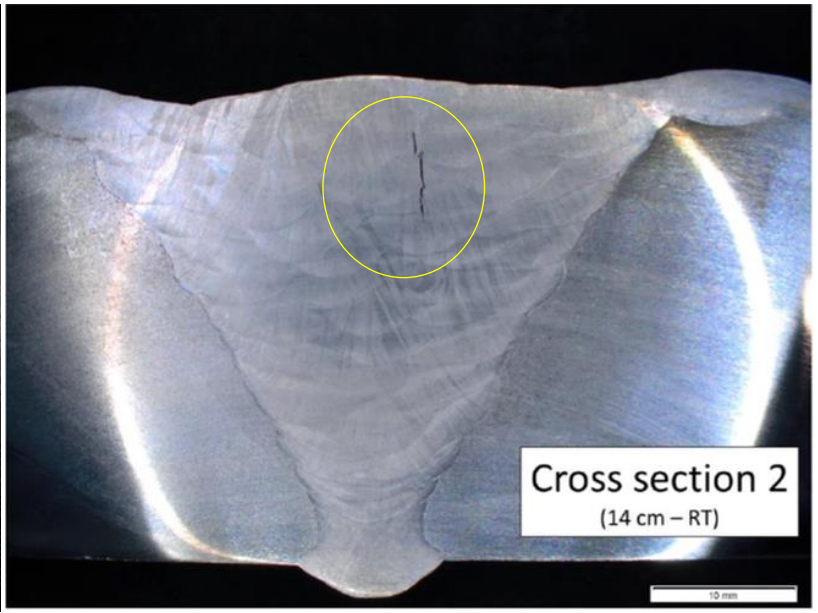
Example of a scan with 3D image

Use case → inspection of Inconel weld

- During periodic inspection cracks were identified with RT
- Height and depth location of the cracks could not be determined by RT
- There were concerns that cracks were missed
- Risk to keep facility in service → weld was cut for further investigation

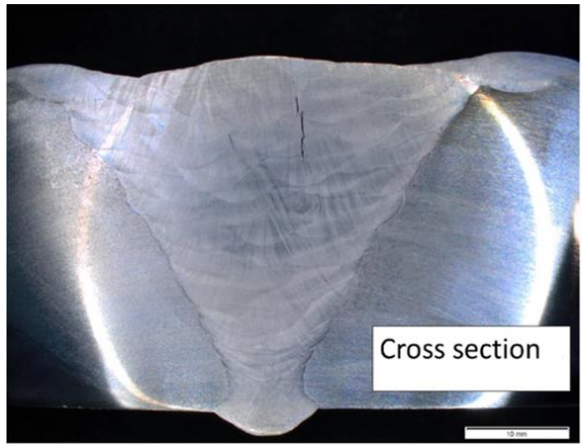


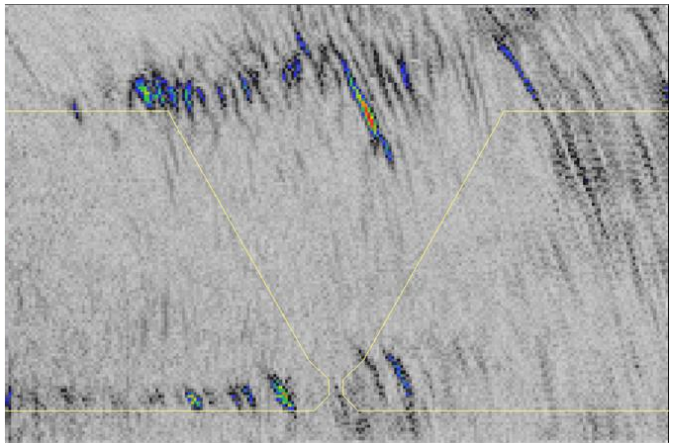


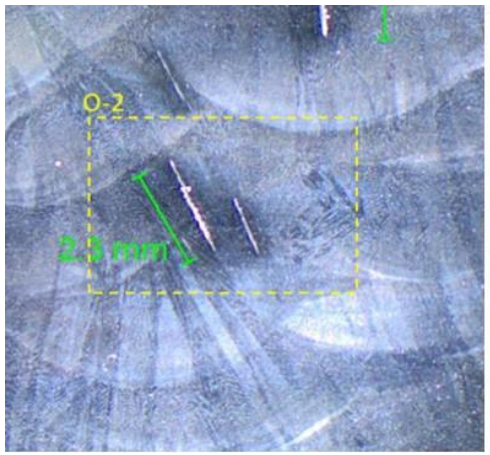


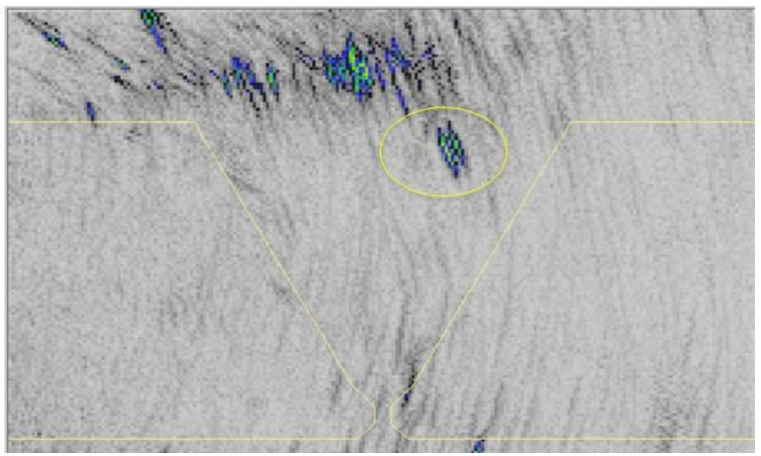
Use case → inspection of Inconel weld

- The remaining welds were inspected with IWEX
- Other cracks were unambiguously identified, which were missed by RT
- Based on the IWEX data, a reliable integrity assessment was possible









Conclusions

- To meet operational and economic objectives, adequate information about the condition of assets is required
- Traditional NDT technologies (RT and UT) have limitations
- Recently, advanced inspection based on ultrasonic imaging (IWEX) has been introduced
- The use cases illustrate that:
  - IWEX provides improved detection, characterization and sizing
  - Data display is comprehensive and intuitive
- Ultrasonic imaging strategies like IWEX become recognized in the industry (ISO 23864, ISO 23865, ASME BPVC.V-2019 Article 4, appendix XI and F)
- IWEX has been qualified in accordance with DNV ST-F101

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THANK YOU

ANY QUESTIONS?

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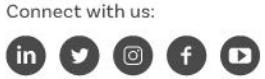

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