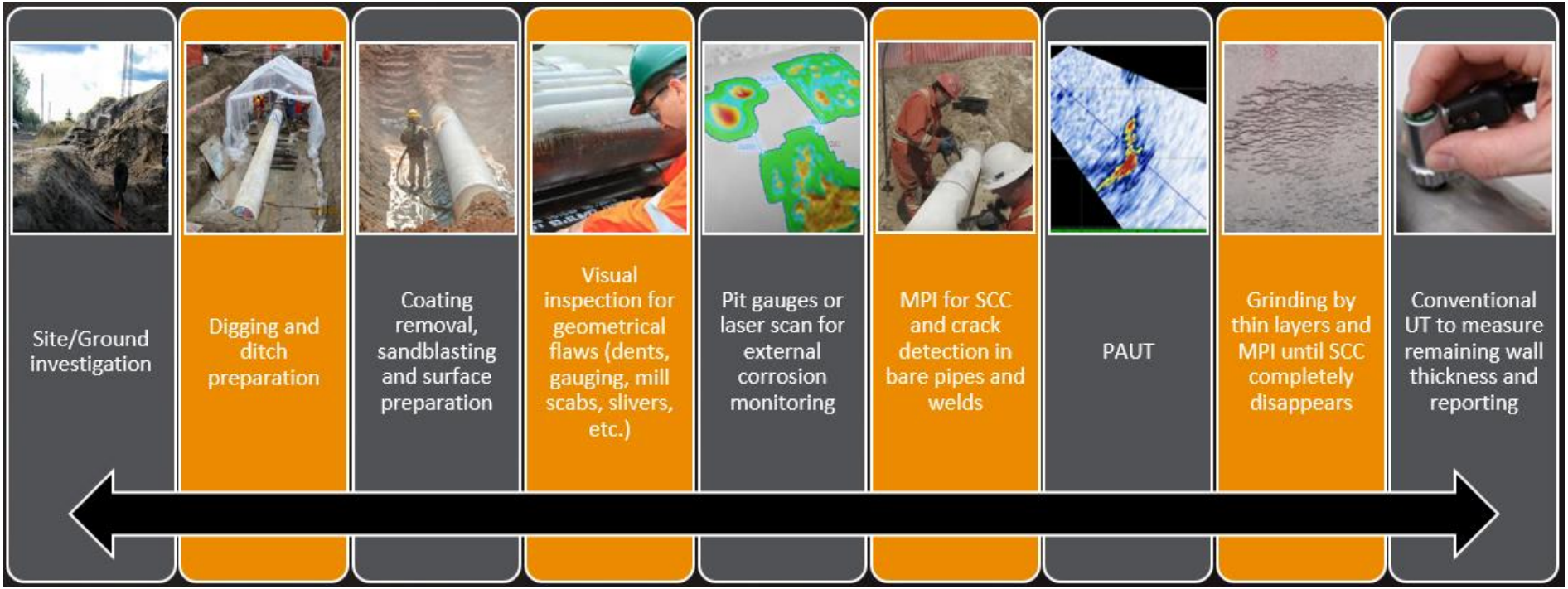
Content

Current in-ditch assessment



Current in-ditch assessment

FIRST SCREENING FOR SCC

MPI is the main technique currently used:

- Relatively cheap, easy to deploy, many technicians available
- High sensitivity over small cracks

However:

- Human factor has a huge impact on PoD
- Quite long process, requires intensive surface preparation

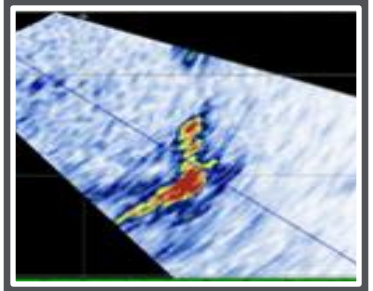
MPI for SCC and cracks detection in bare pipes and welds

Current in-ditch assessment

SCC CHARACTERIZATION

Depth sizing on SCC is generally done using PAUT:

- Effective for deep and isolated cracks but difficult with high density colonies
- Long process looking for the deepest point where colonies contain thousands of cracks
- Complex signals from SCC – Analysis operator dependent



PAUT/TOFD

ECA for SCC first screening

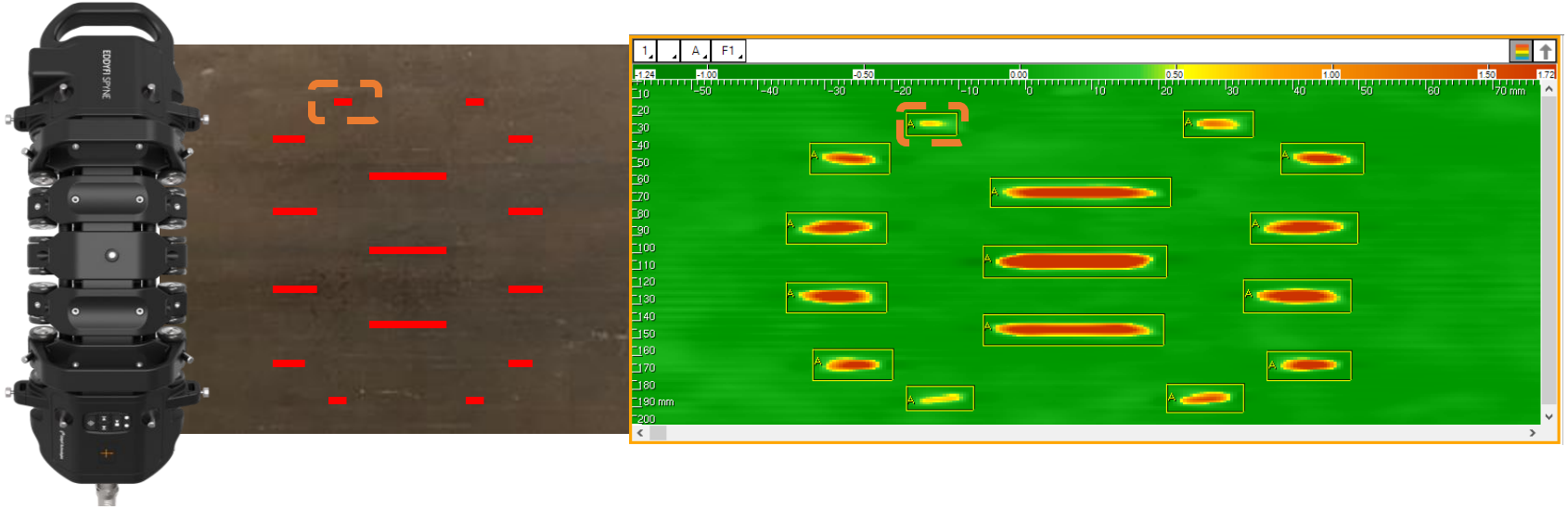
Spyne™ is an advanced ECA solution for the detection of SCC on pipelines

- High POD
- Reliable data
- Cracks detection in all orientations
- 8 in. coverage in a single pass
- Max speed of 2 ft./ sec.
- 6 in. pipes OD up to flat surfaces

ECA for SCC first screening

PoD – High sensitivity

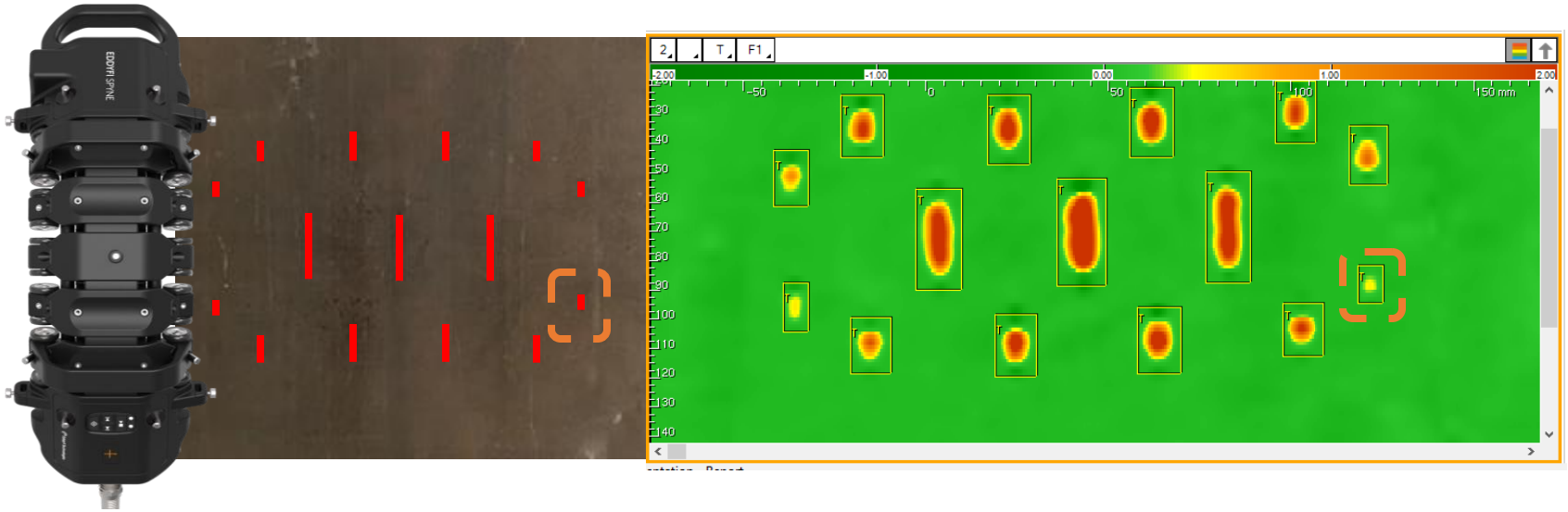
- Can detect isolated cracks as small 0.080” L X 0.020” D
- Semi-elliptical notch 0.120” L X 0.040” D detected with a SNR of 23dB



ECA for SCC first screening

PoD – High sensitivity

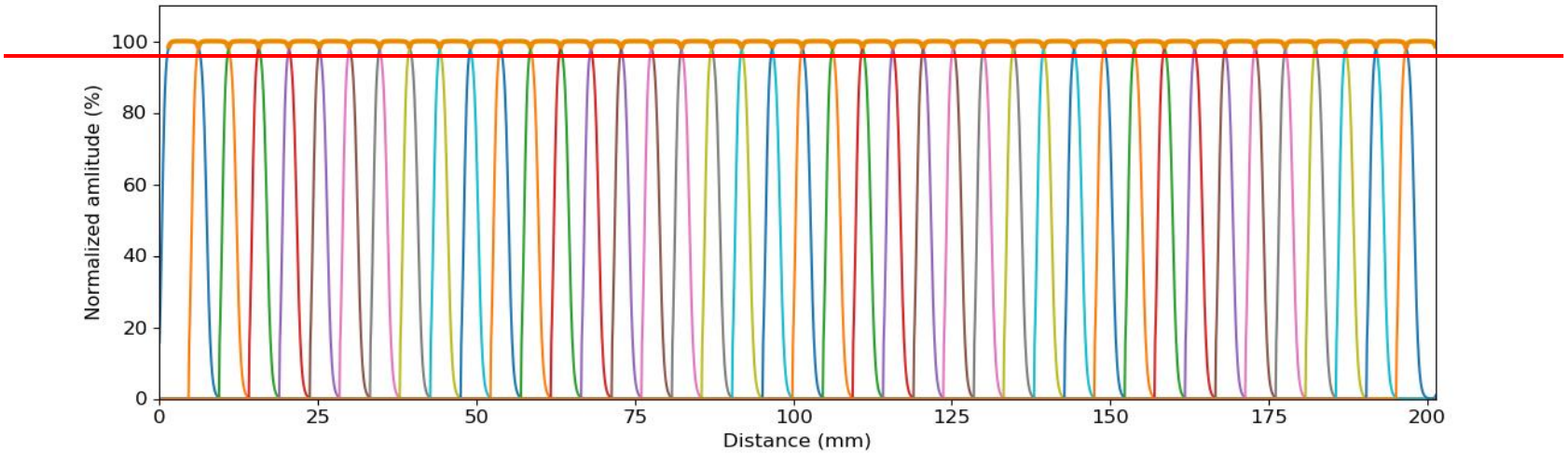
- Same sensitivity over circumferential cracks
- Cracks in all orientations being detected within a single scan



ECA for SCC first screening

PoD – High coverage

- A key parameter with ECA probe is the inter-channels coverage
- Coverage at 98% of max amplitude for a 0.120” L X 0.040” D EDM notch



ECA for SCC first screening

PoD – Human factor control

ECA not impacted by:

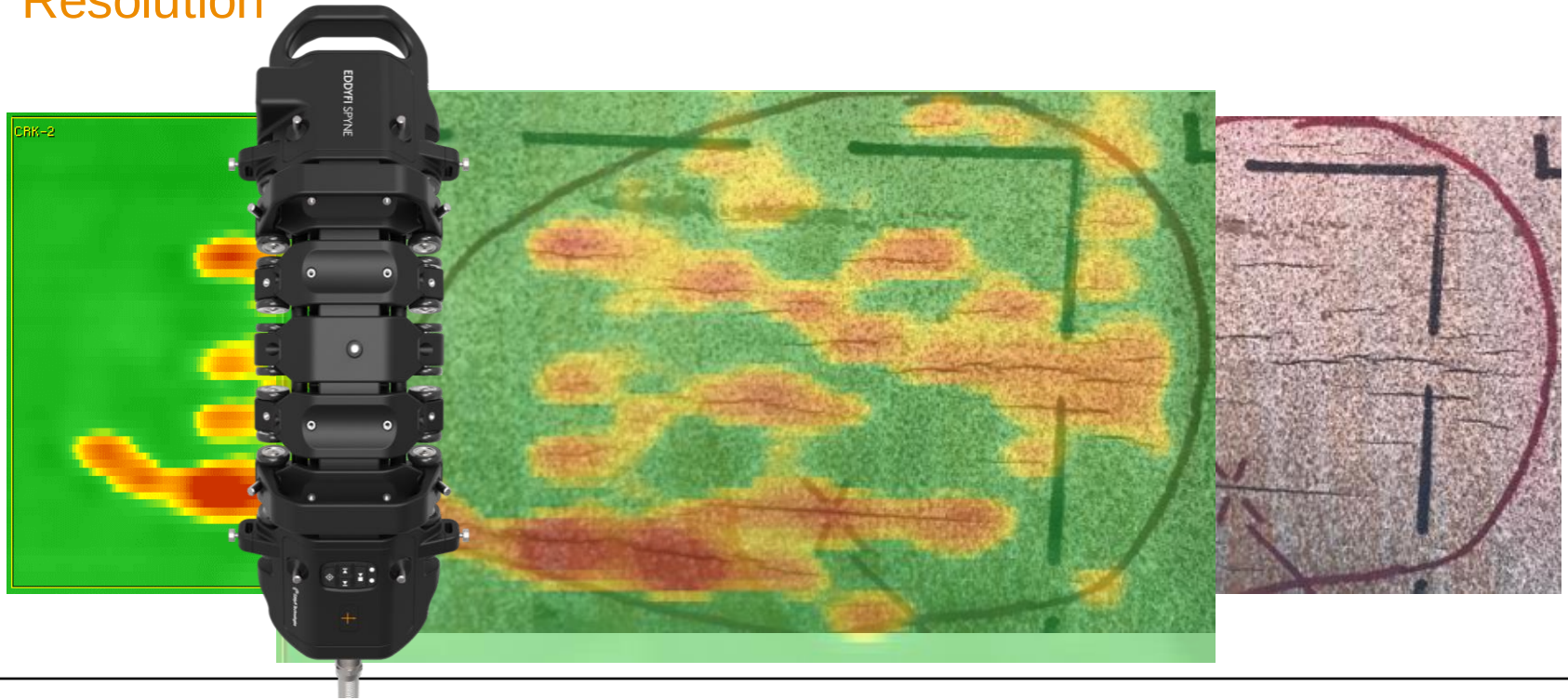
- Size of surfaces being inspected
- Harsh ditch conditions
- Condensation on pipes
- Bad surface preparation/contrast
- Poor lightning

Many cracks missed with MPI between 5 and 7 O'clock under pipes

ECA for SCC first screening

ECA for SCC first screening

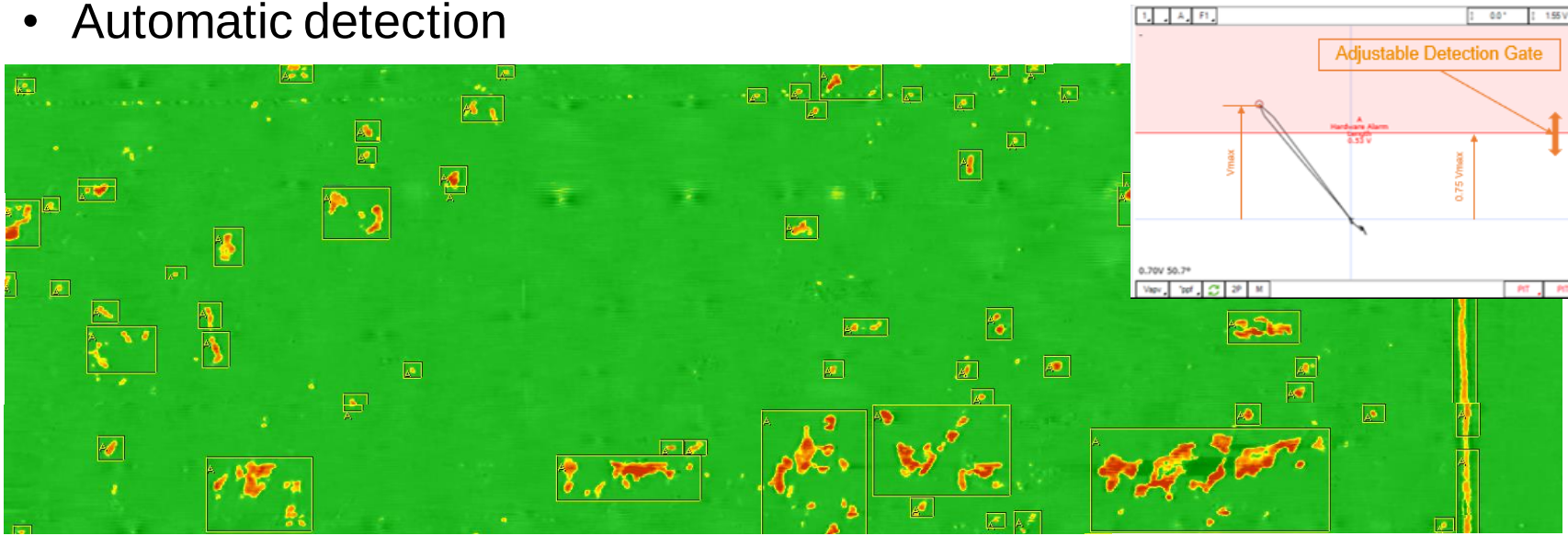
Resolution



ECA for SCC first screening

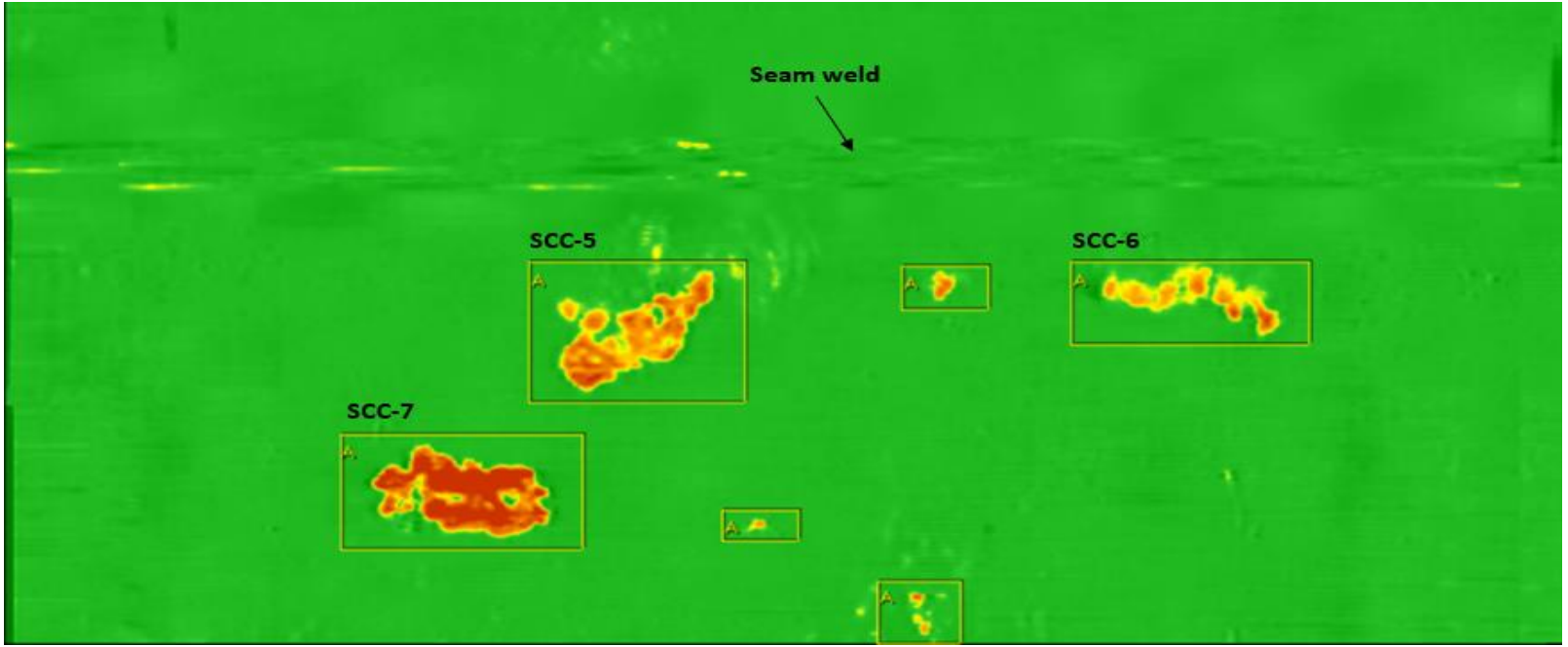
Mapping and automatic detection

- “Unrolled” data of a 12 in. OD X 20 ft. long pipe section
- Automatic detection



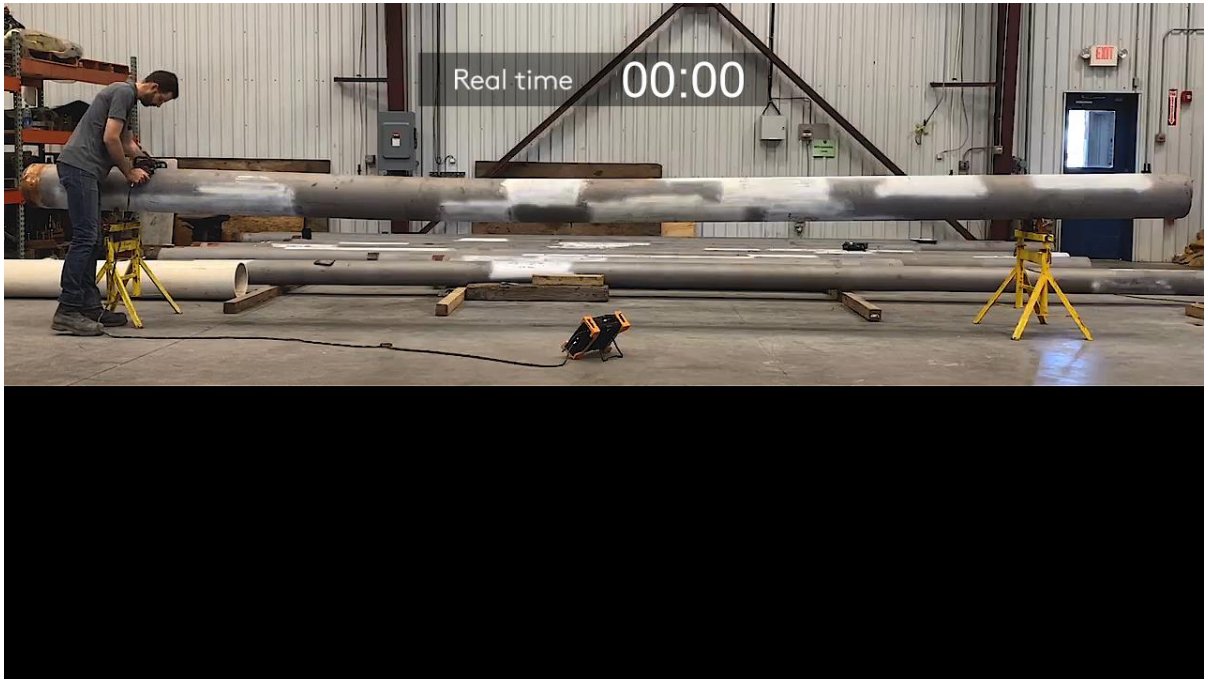
ECA for SCC first screening

Results from the field - SCC beside longitudinal welds



ECA for SCC first screening

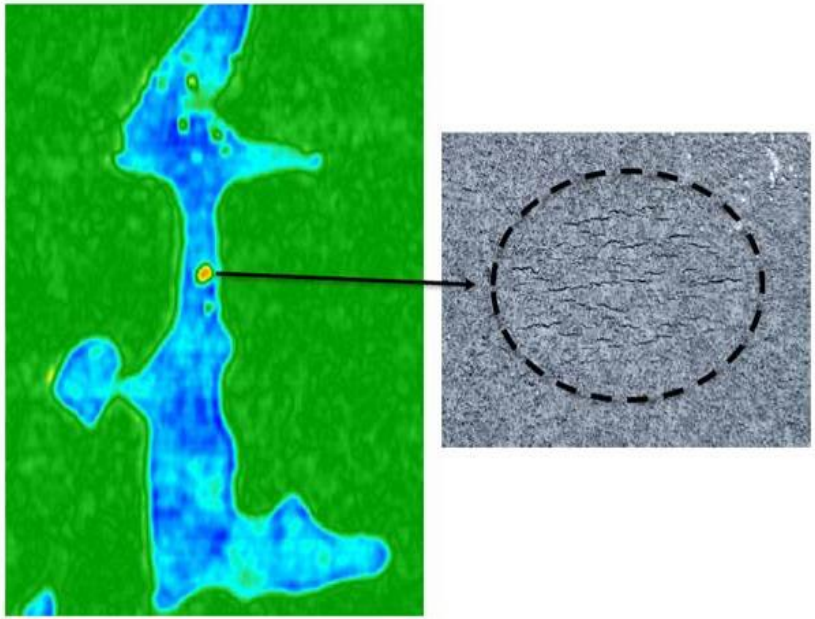
Speed



ECA for SCC first screening

Hard spots detection

- The change in steel microstructure produces a change of magnetic properties
- The eddy currents are affected by these changes and detects hard areas
- ECA allows a rapid screening of pipelines to localize hard spots
- Direct assessment with Spyne showed more sensitivity than in-line smart pigs



ECA for SCC characterization

TECA™ High Resolution (Sharck HR) for depth sizing on SCC

- Depth sizing range: 0.010” to 0.120”
- Coverage: up to 3 in.
- Speed: 8 in. / sec.
- 6 in. OD pipes up to flat surfaces
- Dynamic lift off and permeability compensations
- Embedded encoder

ECA for SCC characterization

Depth sizing

X52 pipe section with various EDM notches profiles and configurations:

1) Shallow crack (0.020” deep)

2-3-4) Steeped profiled crack

5-6) Cracks axially distanced by 0.120”

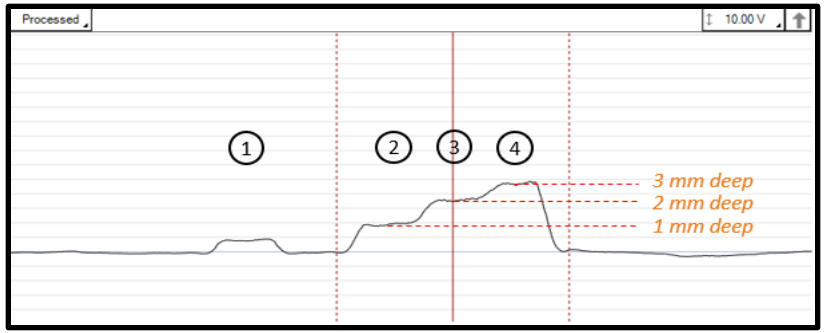
7-8-9) Shorts cracks (0.060” to 0.120”)

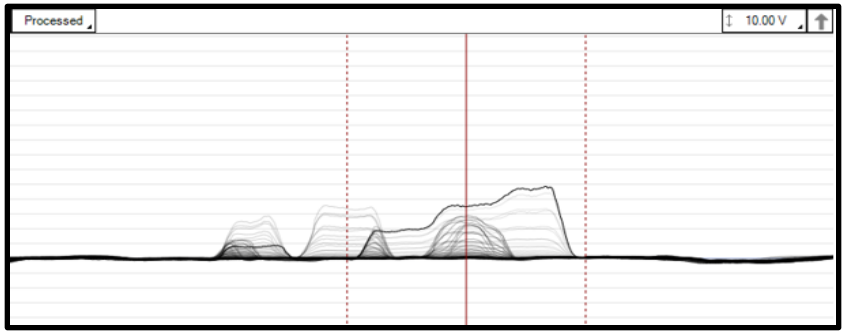
10-11) Cracks circumferentially distanced by 0.120”

ECA for SCC characterization

Resolution

- Axial resolution ≈ 0.040”
- Circumferential resolution ≈ 0.040” (with sharpening process)
- Cracks profile assessed using sideview (defect 2-3-4)
- Steps below sized at 0.040”, 0.080” and 0.120”

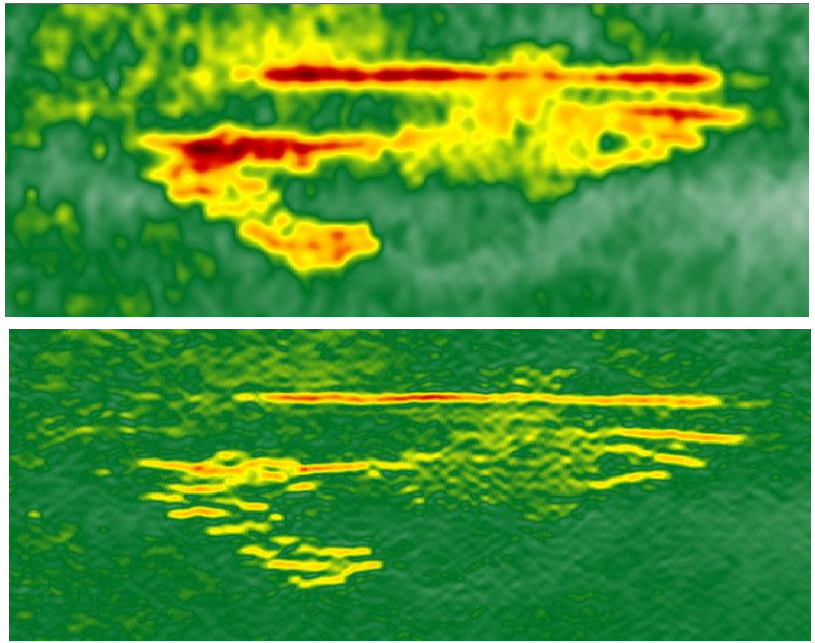




ECA for SCC characterization

Resolution - Sharpening

- High cracks density has a big impact on depth sizing (over estimation)
- Advanced process must be developed to sharpen data on C-Scan images
- Increases physical resolution from TECA elements alone and allows to provide good depth sizing
- Sharpening process optimized using SCC samples for which XCT data were available

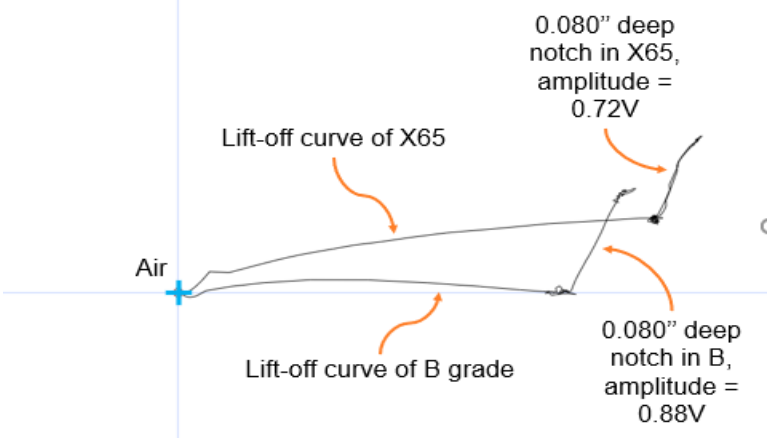


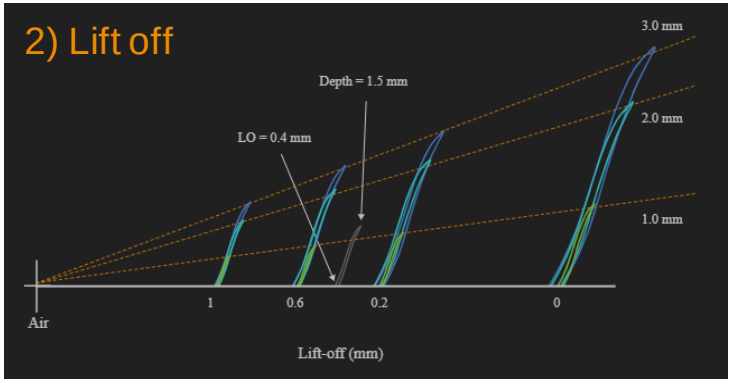
ECA for SCC characterization

Signals compensation

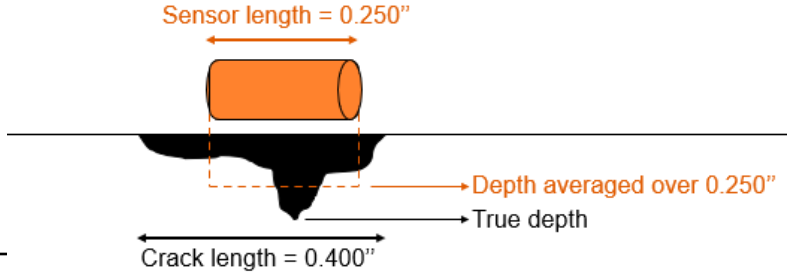
Few factors significantly impact EC signals, so there is a need to compensate for those to assure accurate depth sizing:

1) Material properties





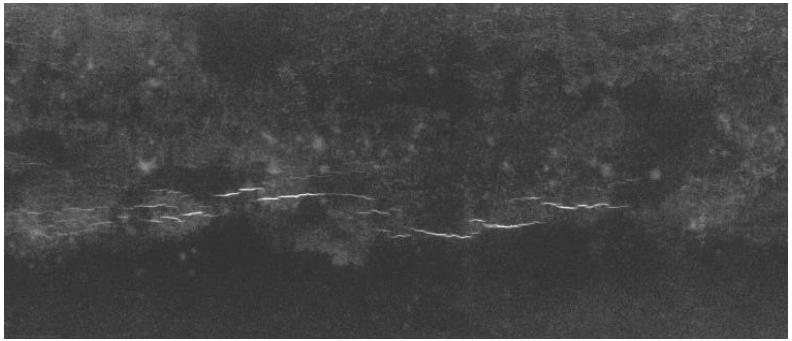
3) Cracks profile

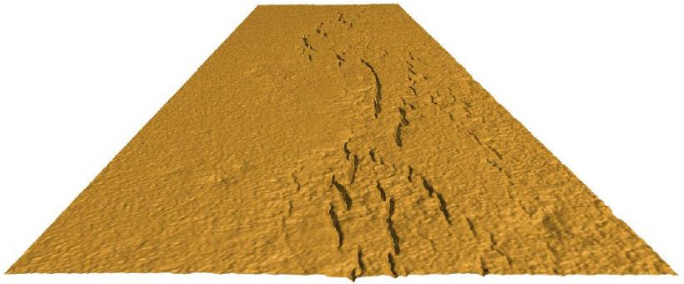


ECA for SCC characterization

Depth sizing accuracy validation

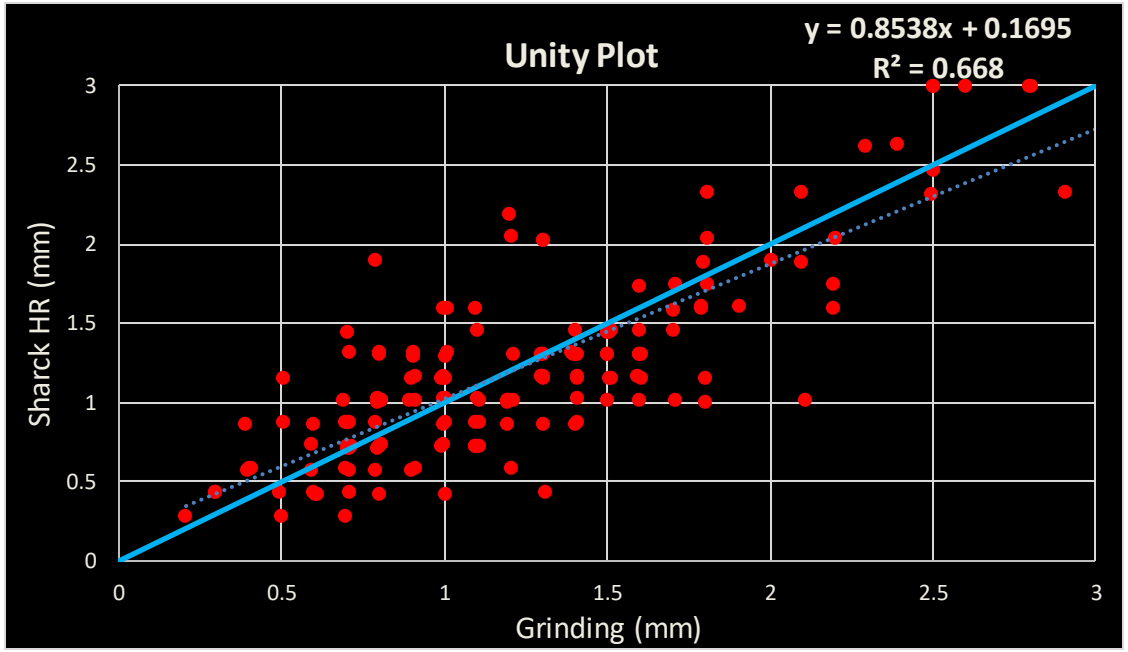
- In-ditch grinding measurements (remaining wall thickness with UT)
- XCT data on real SCC samples
- 3D radiography
- Metallographic cuts
- Freeze and break
- Trials NDE 4-6 at the PRCI in 2018 on real SCC samples.)





ECA for SCC characterization

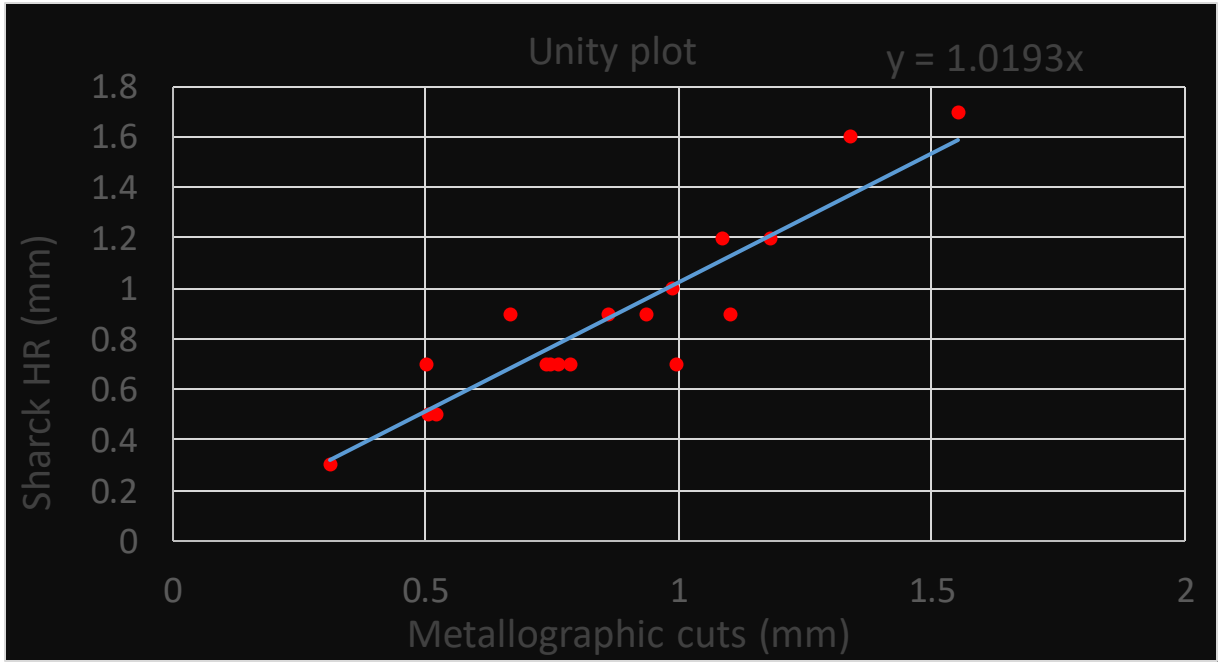
Results from field trials with TC-Energy: Sharck HR vs. Grinding

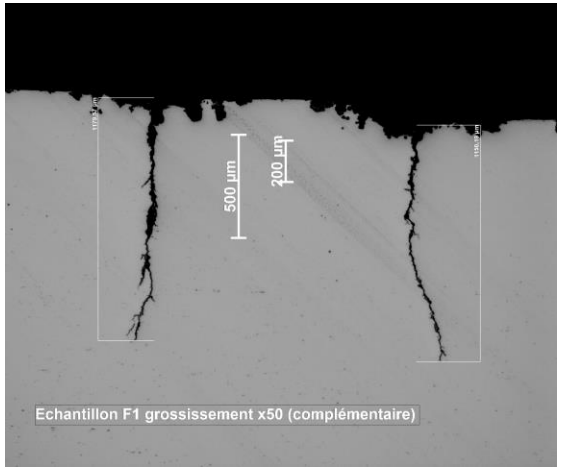


Out of 160 data points:
Accuracy ± 0.012” (± 0.3 mm) with 80% certainty and 95% confidence criteria

ECA for SCC characterization

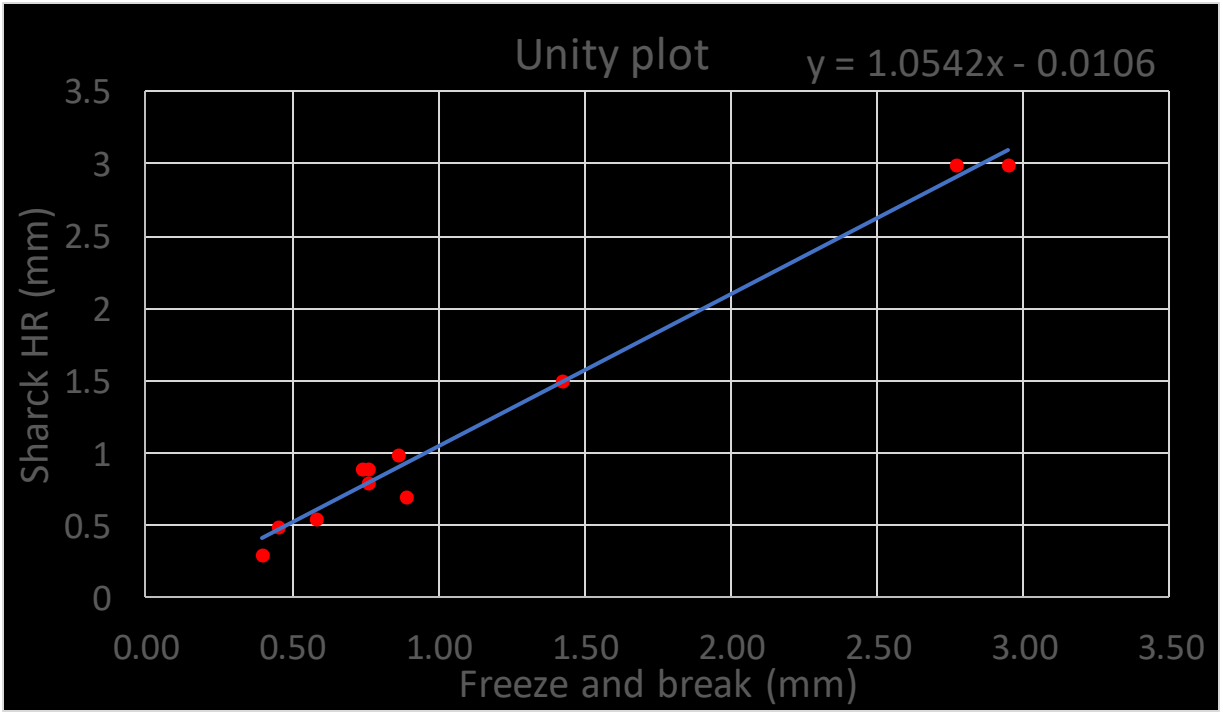
Results from qualification with a major European gas operator: Sharck HR vs. metallographic cuts

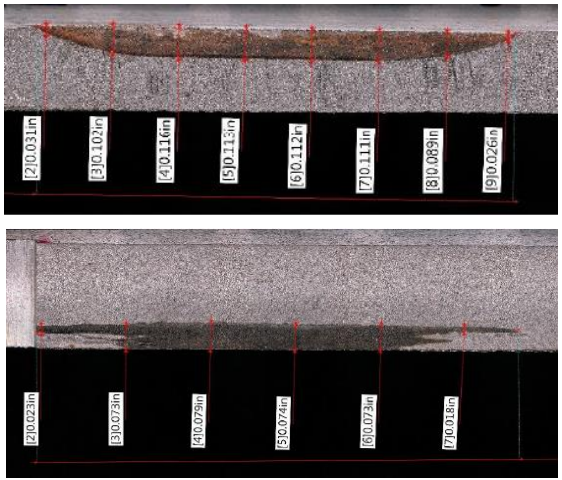




ECA for SCC characterization

Freeze and break on ERW welds





Conclusion

- Advanced ECA solutions represent potential game changers for the pipeline integrity industry
- The Spyne™ tool with its impressive speed and very high PoD has outclassed MPI in the field for the first SCC screening process
- The Sharck HR probe (TECA™ based technology) takes over for depth sizing and represents a good alternative to PAUT
- Qualifications already completed or still ongoing with several asset owners in North America and Europe
- These solutions have been used onsite and demonstrated their capacity to mitigate potential errors caused by human factors and those from the unrepeatable results of current methods used in ditch today

Thank you!