DETECTION OF CORROSION UNDER INSULATION (CuI) USING ADVANCED PIPE INSPECTION TECHNOLOGY

CUI

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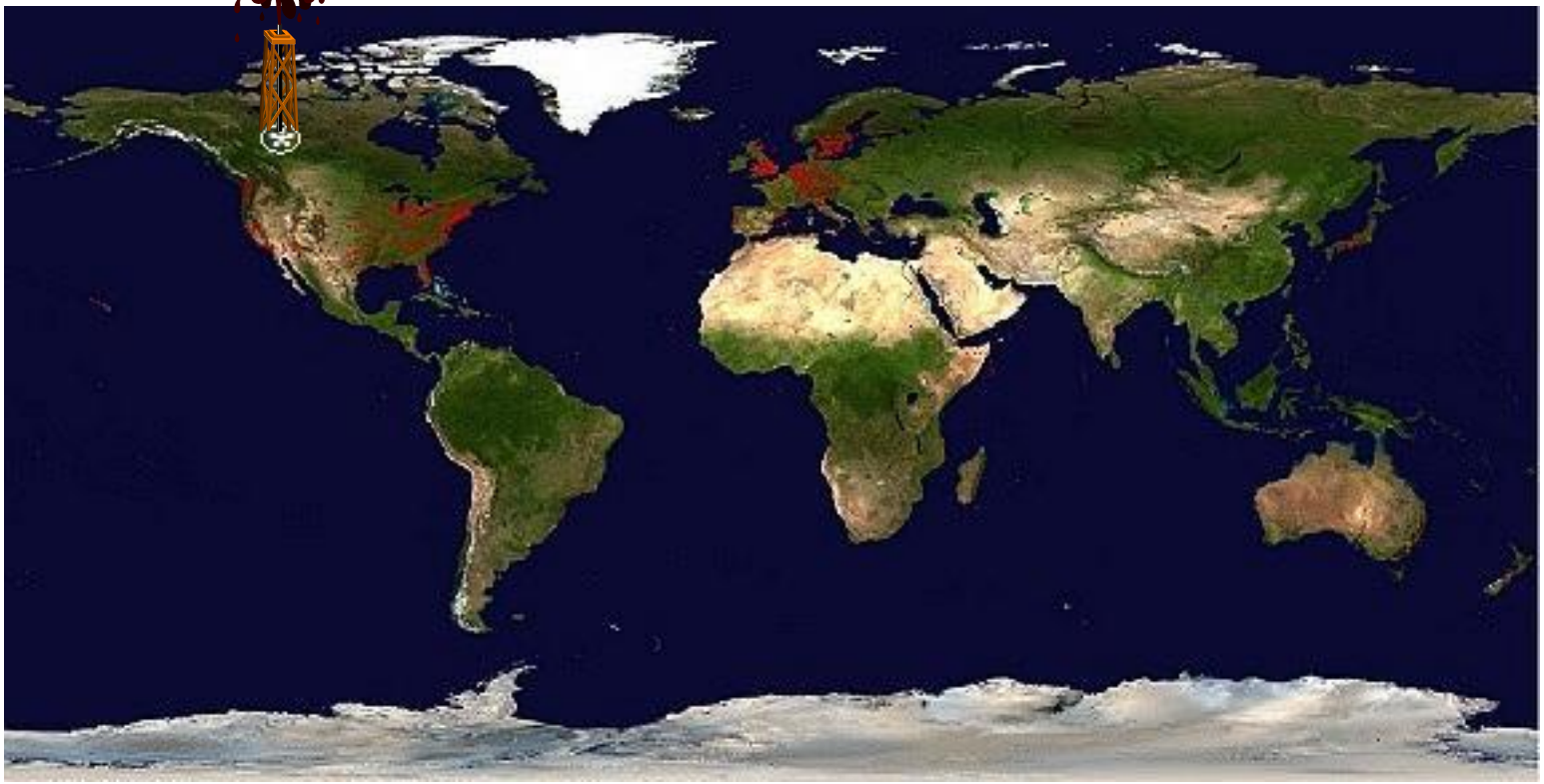
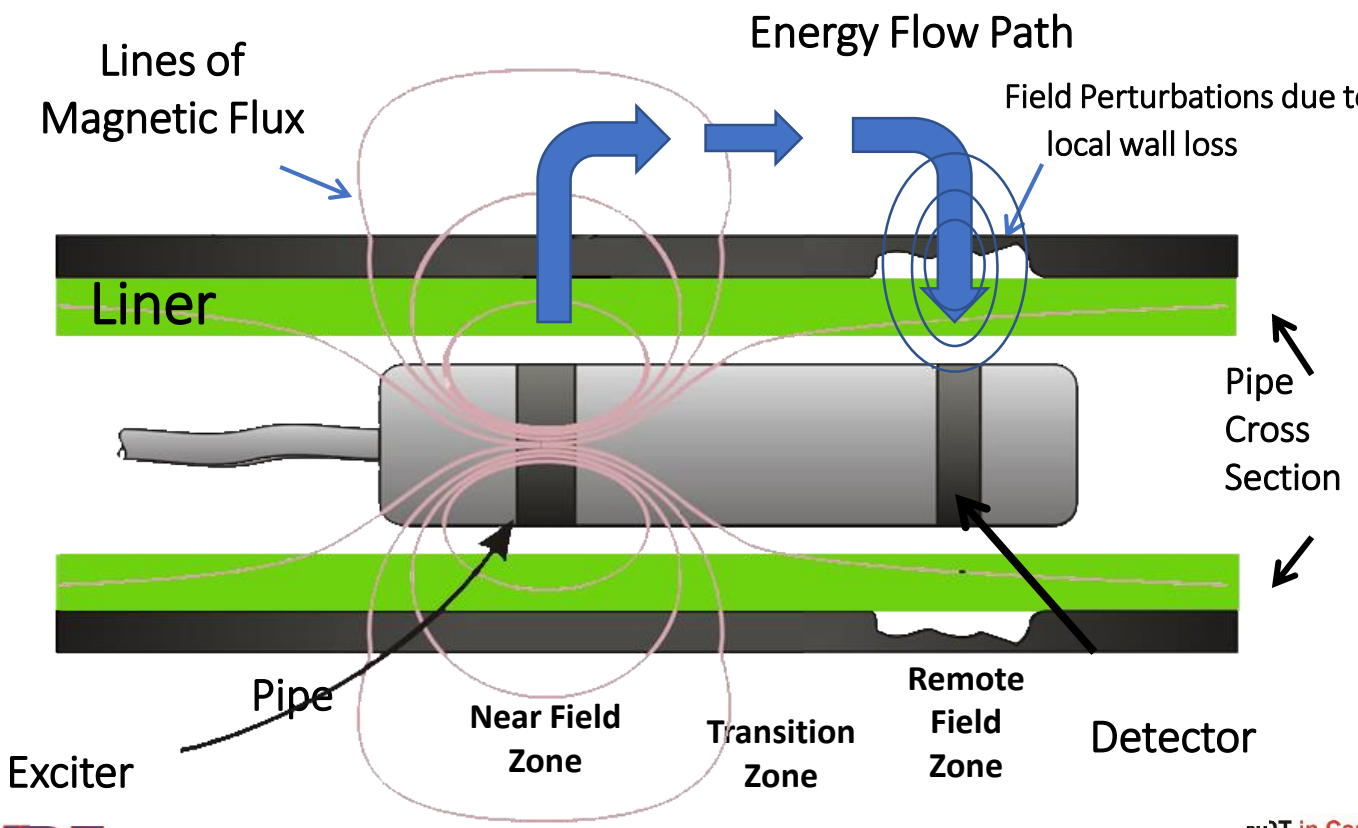
NDT in Canada
NDTiC 2019
Inform - Engage - Advance
June 18 - 20
River Cree Resort & Casino
Edmonton, Alberta

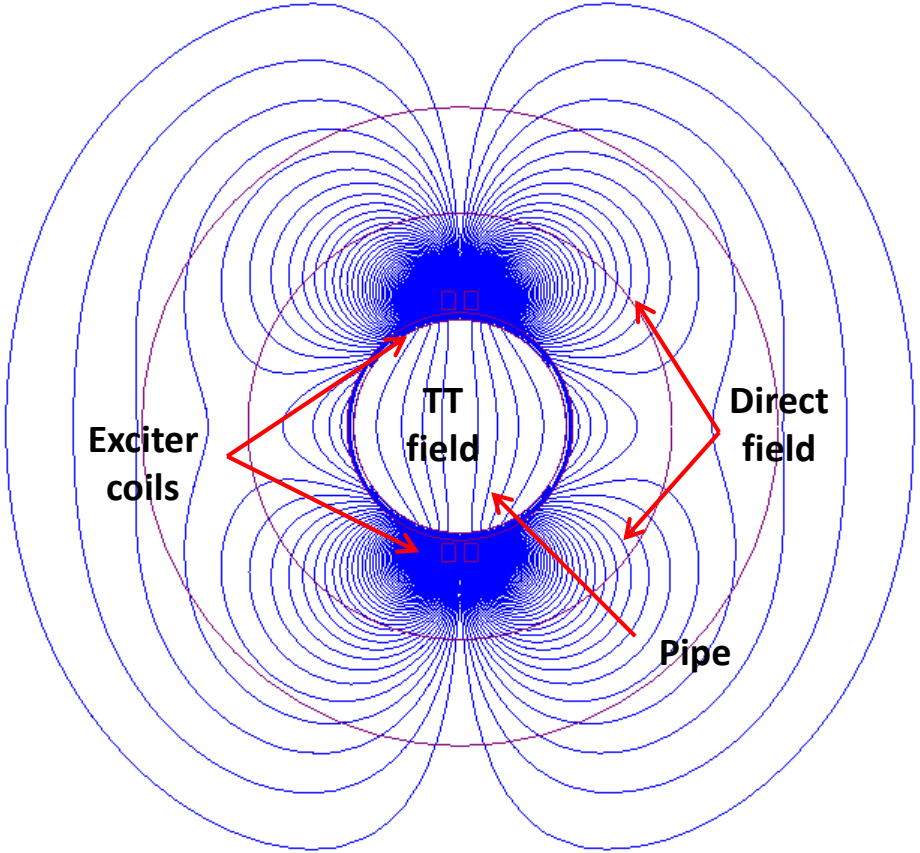
Russell NDE Systems Inc. are from **Alberta, Canada**



Graphically:



FEA Results



Magnetic field pattern for a Bracelet TT probe on an steel pipe

CUI & CUF detection

- Any inspection technique must cover a large area for fast scanning
- Must be sensitive to both large area general thinning and small local pitted areas
- Must be suitable for piping and tank walls
- Electro-magnetic probes offer a viable option

The Challenge

- **Relying solely on visual searches for sources of moisture ingress into the insulation system *is largely ineffective.***
- **Moreover, there are not always externally-visible signs of CUI presence.**
- **This makes the use of random, isolated searches for *CUI wholly inefficient.***

A Needle in a Haystack

- Although the mechanism (the chemical reaction) resulting in CUI is well understood and the root cause of the problems are known, ***finding CUI is not that easy.***
- Once moisture gets into the insulation, it is ***very hard to predict where it will start pooling and initiate CUI.***

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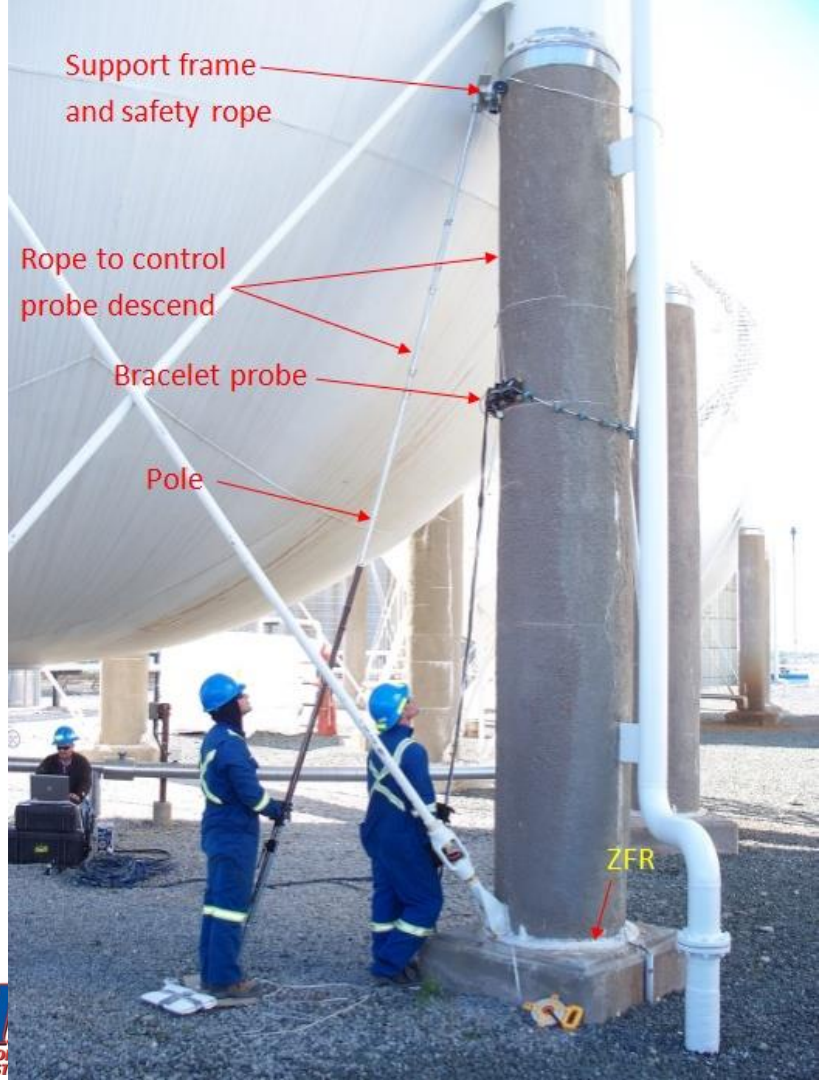
Electro-magnetic solutions for CUI detection

Modified RFT

(Remote Field Technology)

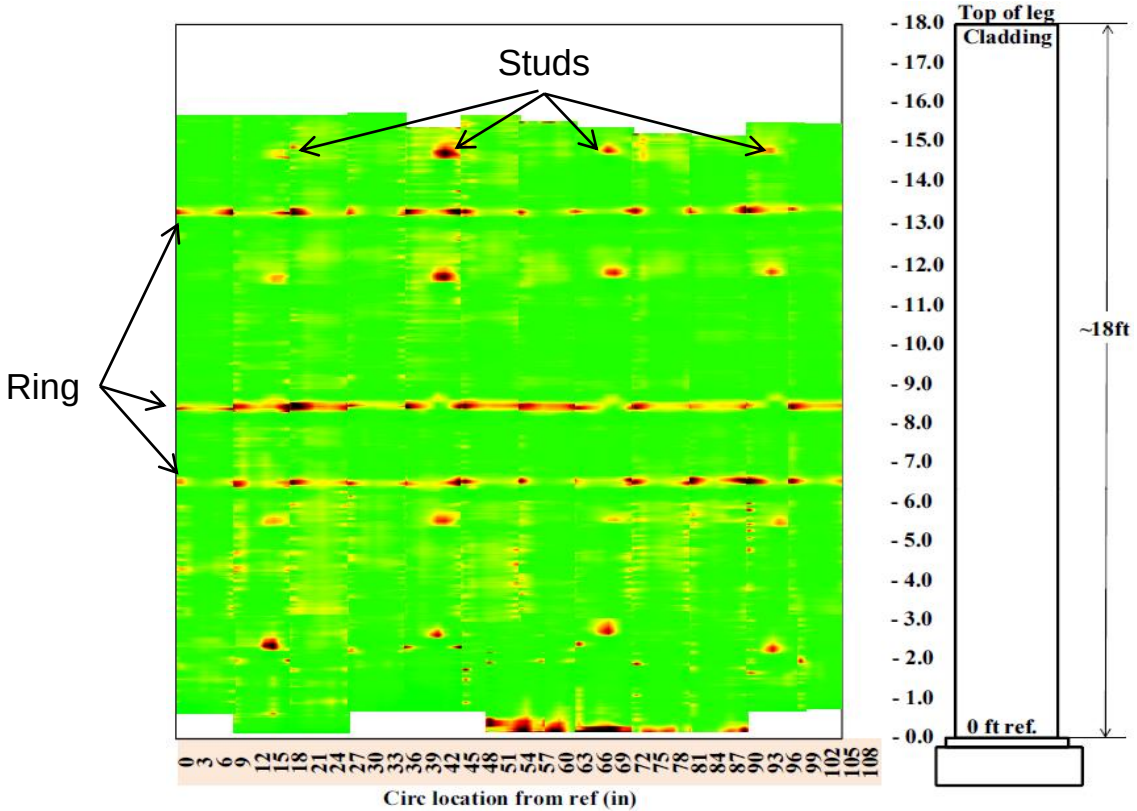
Butane Sphere Leg. Inspection through Fire Proofing



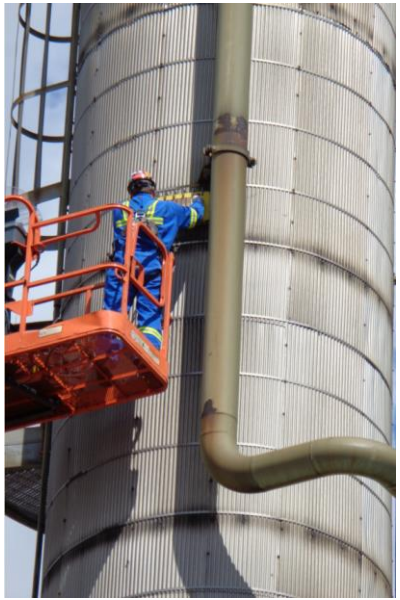
Standard 16-ch Bracelet™ Probe

Pole scan system

Standard 16-ch Bracelet™ probe



Typical CUF Bracelet probe colour map



RFT for CUI detection on insulated tanks & vessels

Bracelet Probe™

- **Bracelet Probe design means that it covers a wide circumferential extent of piping as it scans axially.**
  - **Effective area coverage**
  - **Can cover entire pipe circumference in series of scans;**
  - **each scan covers 10” of circumferential width.**

    Not limited to a single tangent view or the need to perform grid scans
- **Axial speeds of up to 12 feet per minute.**
- **Probe performance relies on a number of operational variables such as:**
  - **Test frequency (air gap, sample thickness)**
  - **Insulation thickness**
- **This not only dictates scan speed but also the threshold of detection.**

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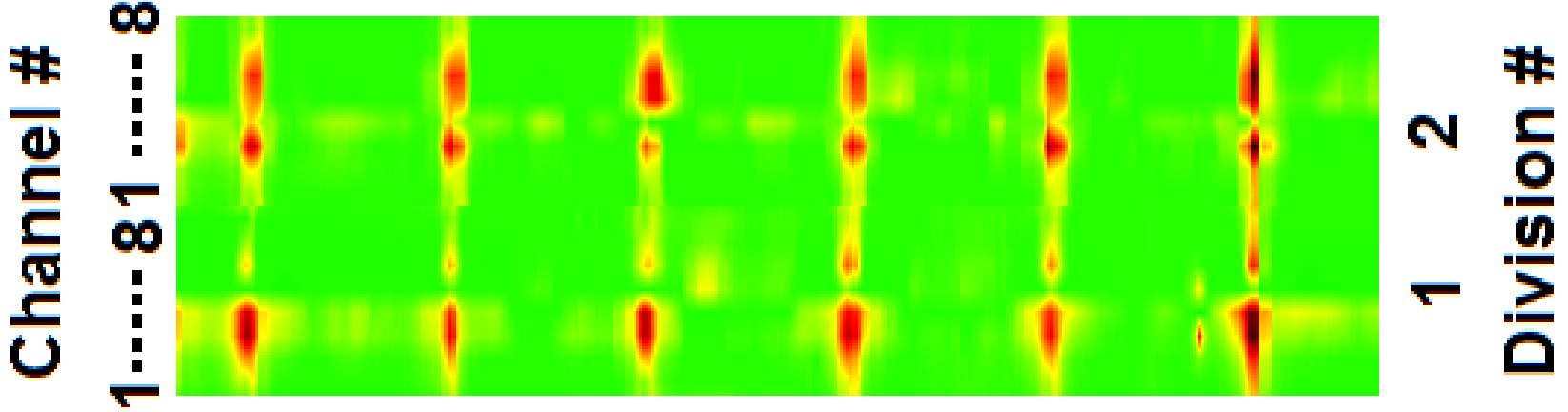
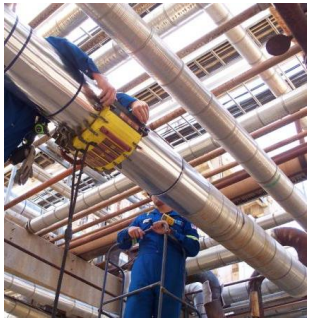
BITUMEN

Color map presentation - Bracelet for CUI detection



Applications

- Applications Include:
  - Insulated facility and cross-country piping.
  - Insulated vessels and storage tanks
  - Sphere legs – with fireproofing.



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Bracelet Probe on Tank Shell, Siberia

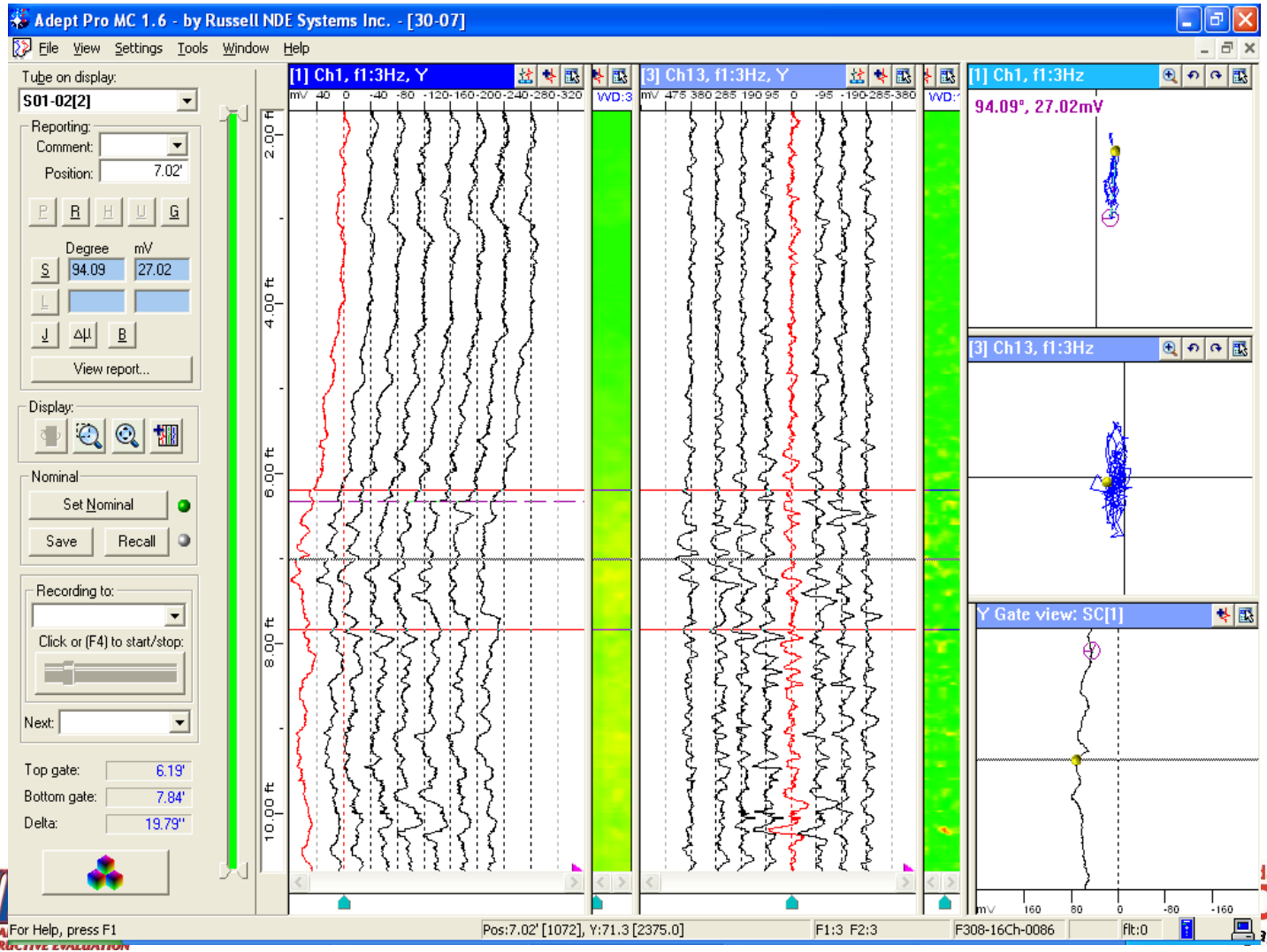
Bracelet Probe on Plant Piping, Colombia

Bracelet Probe on Plant Piping, Malaysia

Bracelet Probe on Tank Shell, Saudi Arabia

Bracelet Probe on Sphere Leg, Texas


RUSSELL
ET Probe


Adept Pro MC 1.6 - by Russell NDE Systems Inc. - [30-07]
File View Settings Tools Window Help
Tube on display:
S01-02[2]
Reporting:
Comment:
Position: 7.02'
Degree mV
S 94.09 27.02
View report...
Display:
Nominal
Set Nominal
Save Recall
Recording to:
Click or (F4) to start/stop:
Next:
Top gate: 6.19'
Bottom gate: 7.84'
Delta: 19.79''
[1] Ch1, f1:3Hz, Y
[3] Ch13, f1:3Hz, Y
2.00 ft
4.00 ft
6.00 ft
8.00 ft
10.00 ft
[1] Ch1, f1:3Hz
94.09°, 27.02mV
[3] Ch13, f1:3Hz
Y Gate view: SC[1]
For Help, press F1
Pos:7.02' [1072], Y:71.3 [2375.0]
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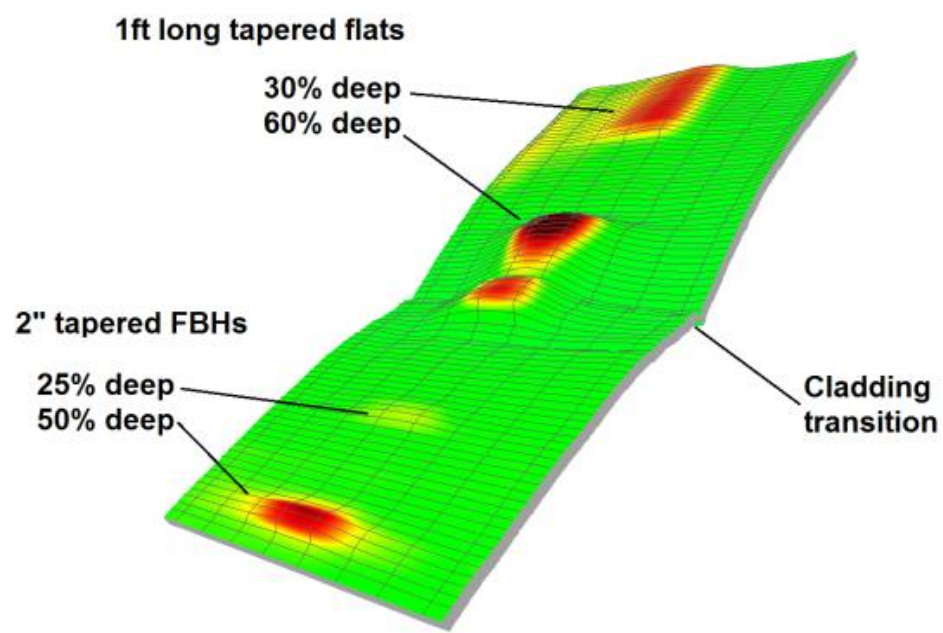
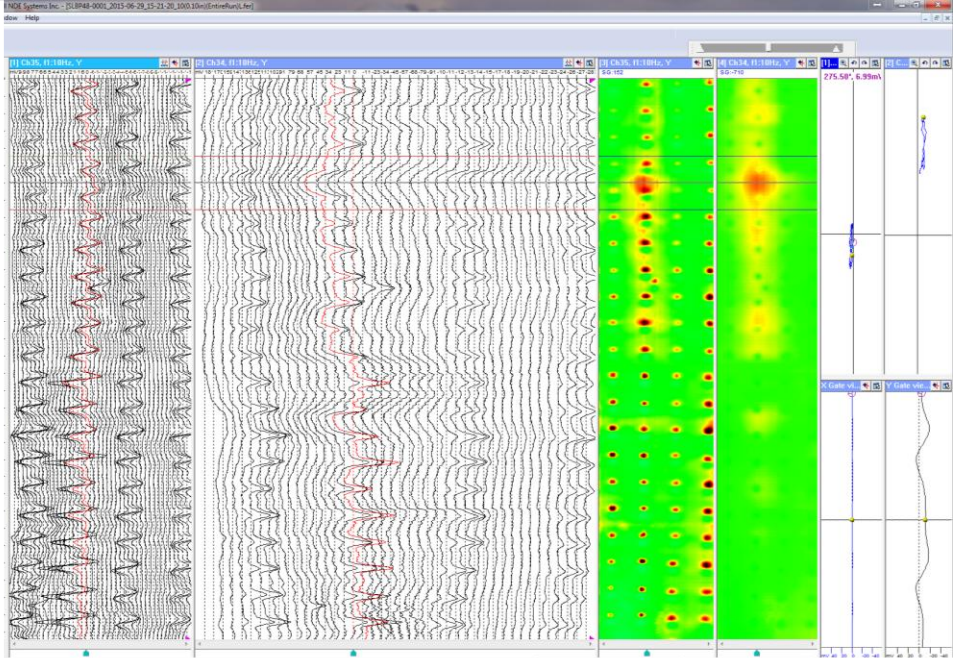
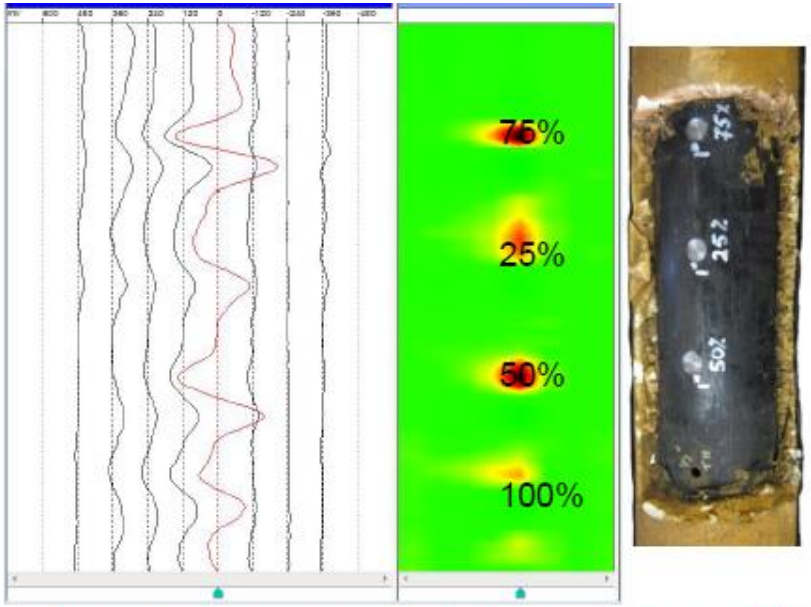




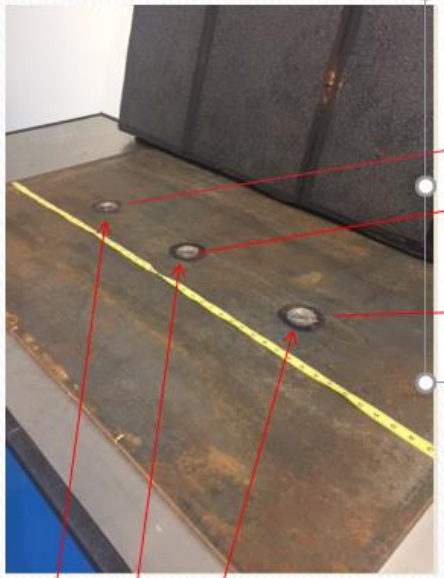
Easy to understand, graphical representation

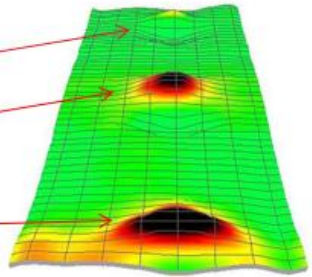
Calibration for localized pits, example

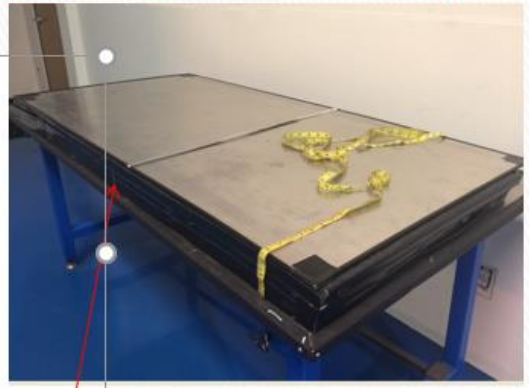


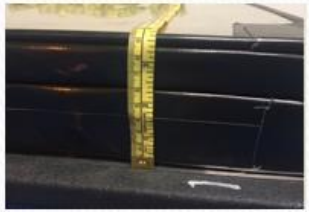
∅1” 25%, 50%, 75% and ∅1/2” 100% deep OD FBHs on 0.200” wall ∅6” CS pipe with 1” thick foam insulation and outside aluminum cladding (removed in photo)

Calibration ½" Plate (3.5" Insulation 1/8" Aluminum clad)





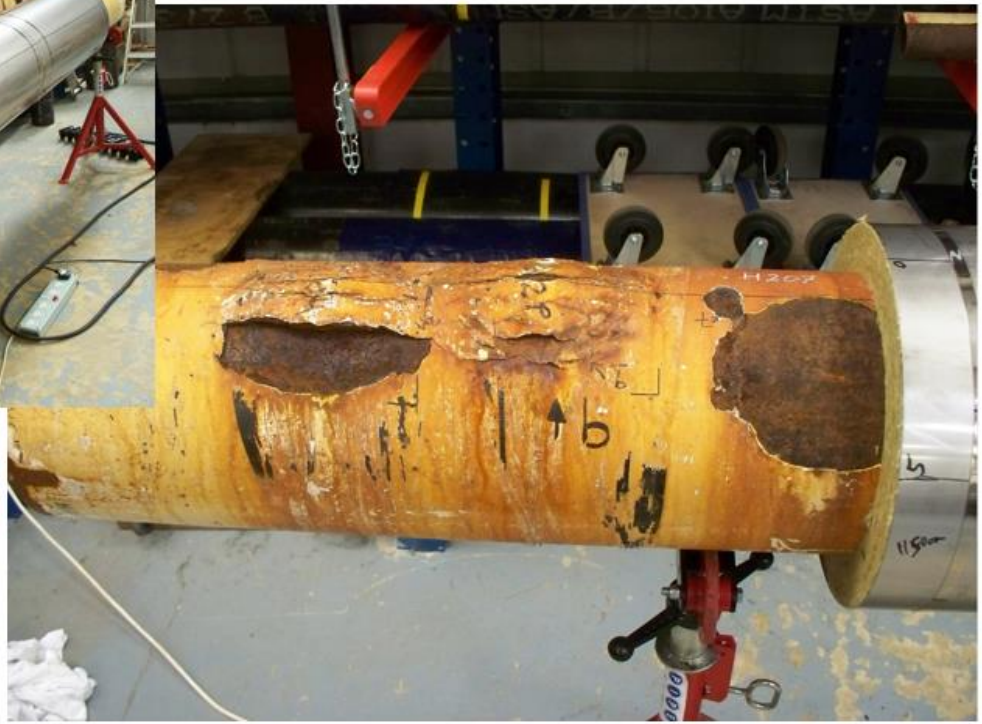




25%,50%,75% – 1"x 2" Tapered FBH

3.5" Insulation with 1/8" Aluminum clad

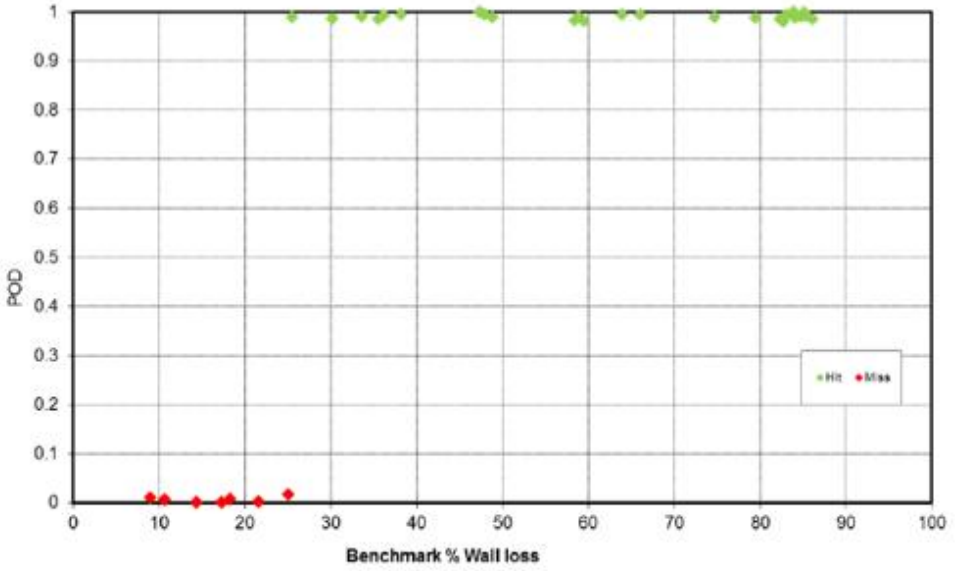
Industry Trials with Real World CUI

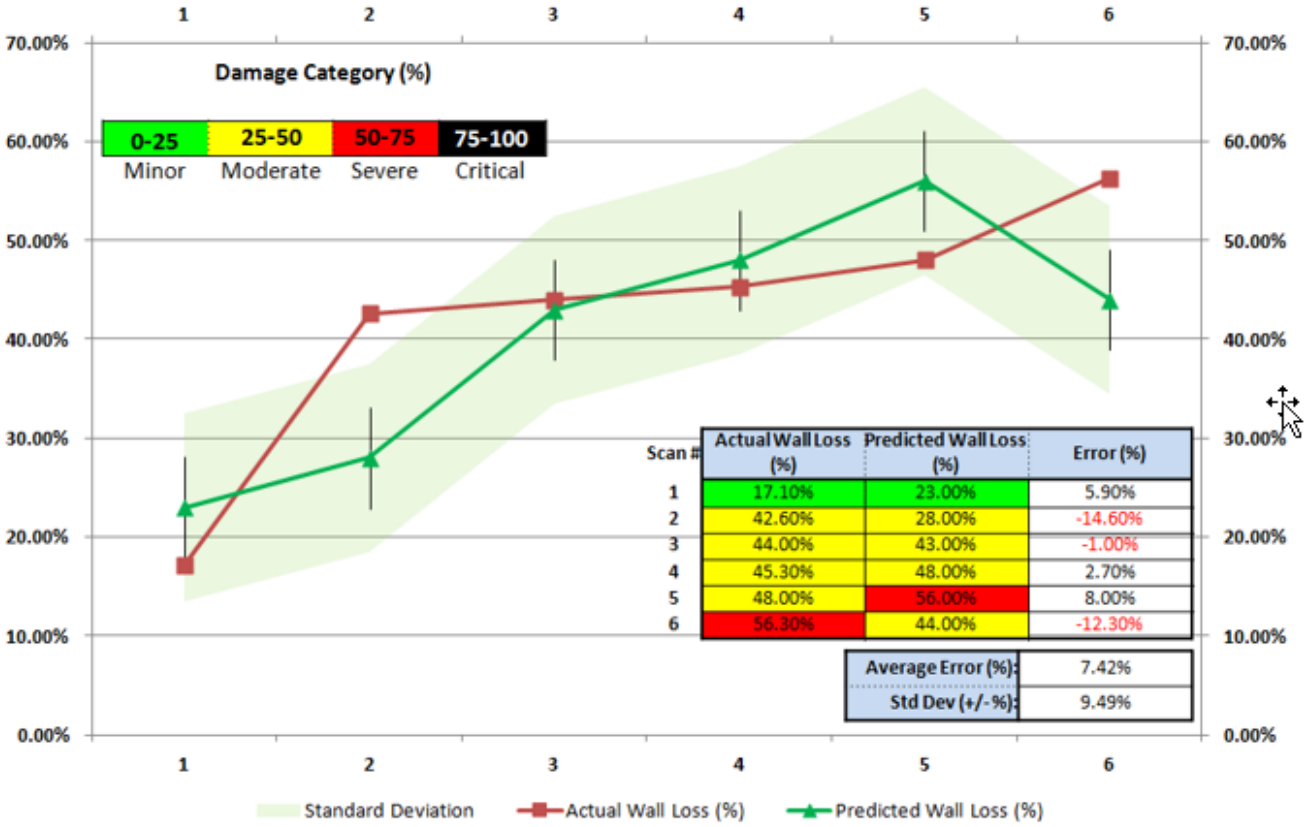


We have participated in several blind trials for Industry-supported groups who have gathered real life samples

- Application has undergone extensive client-specific blind and field trials, in addition to having participated in industry-sponsored trials

Results of blind trials showing 90% POD for damage exceeding 25% wall loss





Scan #	Actual Wall Loss (%)	Predicted Wall Loss (%)	Error (%)
1	17.10%	23.00%	5.90%
2	42.60%	28.00%	-14.60%
3	44.00%	43.00%	-1.00%
4	45.30%	48.00%	2.70%
5	48.00%	56.00%	8.00%
6	56.30%	44.00%	-12.30%

Average Error (%):	7.42%
Std Dev (+/-%):	9.49%

The RFT Technology

- Concept is simple: large area scanning at reasonable speed
- 16 sensors spread across 10” scan path, giving relatively high resolution to small areas of CUI on outside of pipe or vessels under 2”-4” of insulation
- Aluminum, stainless and cloth covers are acceptable
- Results are semi-quantitative within +/- 15% categories

Benefits:

- A major benefit of the system is in the data it provides to the end user.
- Due to the nature of the application, a CUI location is ***fully mapped with length and width, in addition to an estimate for wall loss.***
- These are metrics that can be fed into a fitness for service calculation and used to articulate a response to the find.
  - ***A response based on sound engineering judgment, with input providing a whole picture of the damage being assessed.***

Final thoughts

- Like any NDT application, ***its use cannot follow a "one size fits all" approach.***
- Requires clear understanding of the challenges, and suitability for use as part of a detailed tank inspection program.
- Together with fit-for-purpose procedures, proper training, and ongoing system enhancement ***this application becomes a valuable tool in any CUI Program.***

*****GOOD DECISIONS START WITH GOOD INFORMATION*****