

26th World Gas Conference

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Thematic Session (WOC 3-2)

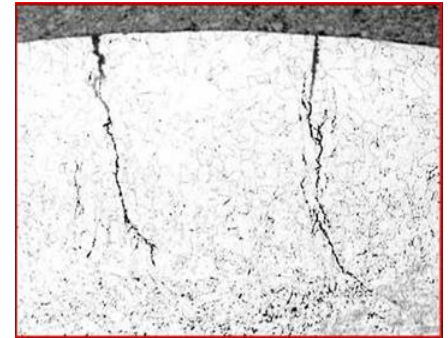
An Integrated Approach to the Integrity Management of
Stress-Corrosion Cracking in Pipelines

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ROSEN



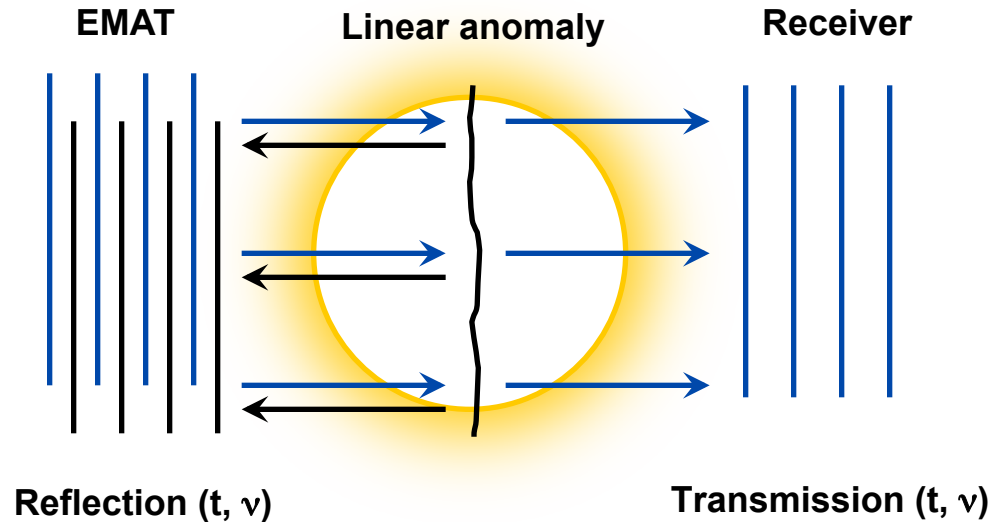
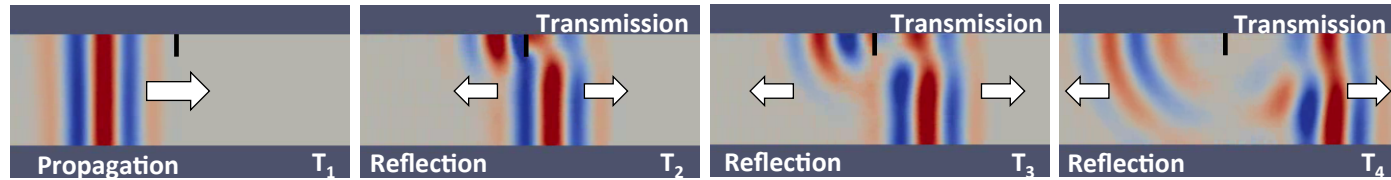
Introduction

- In 2010 a gas pipeline operator suffered an in-service failure due to High pH SCC
- Sub sequent hydro-tests results in further 5 failures
- The client looked into possibility of using ILI instead of further hydro-testing



- UT: costly in gas lines, coupling medium
- CMFL: limited in detection cracks, supports identification
- EMAT: effective for crack detection in gas pipelines

ILI Prequalification



ILI Prequalification

- Prequalification test following Section 9 of API 1163 (2005)
- Applied tools based on
 - Electro-Magnetic-Acoustic-Transducer (EMAT)
 - Circumferential Magnetic Flux Leakage (CMFL)



EMAT ILI Tool

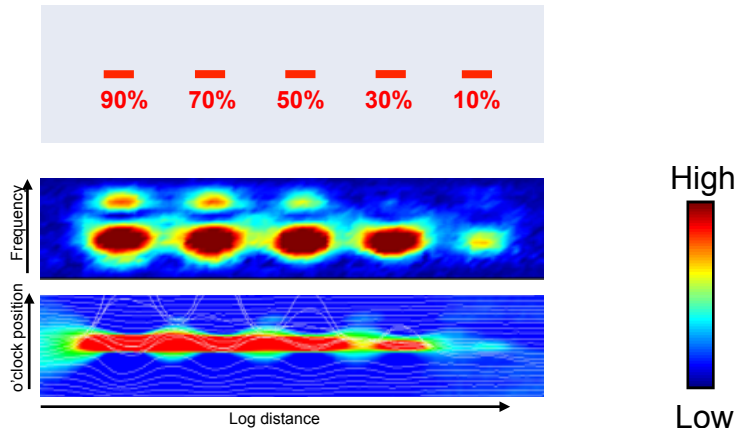


CMFL ILI Tool

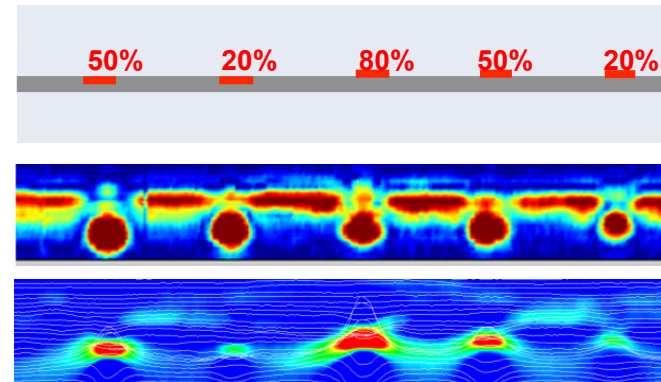
ILI Prequalification

- Test defects: Electro-Discharge-Machine (EDM) notches
0.5 mm opening in base material
and longitudinal weld

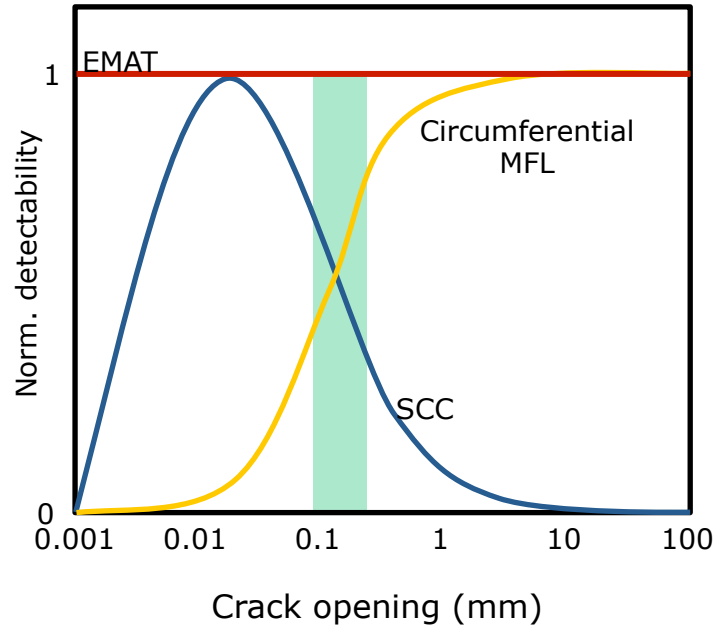
Base material area



Longitudinal seam weld (DSAW) area



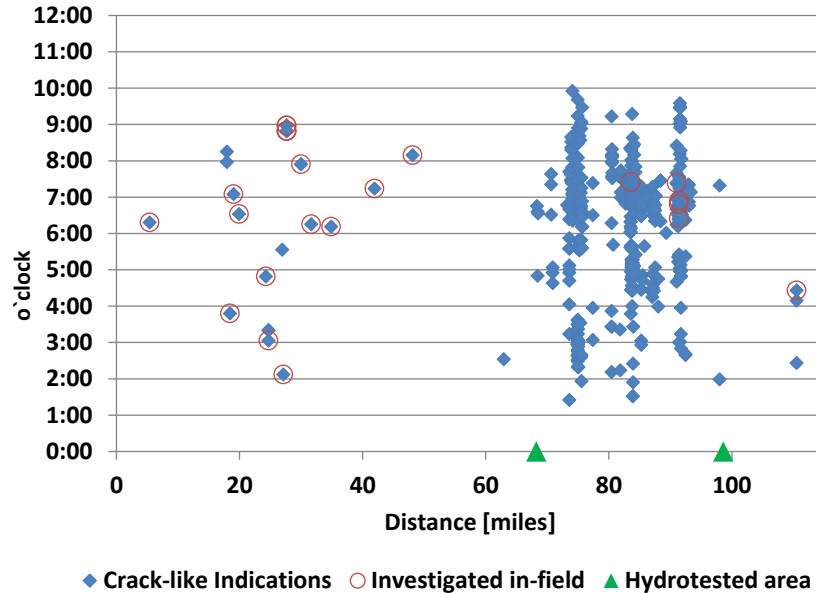
ILI Prequalification



- EMAT detects volumetric and non-volumetric defects
- CMFL detects volumetric defects
- Most cracks do not have a significant opening → CMFL is not a crack detection tool
- But CMFL may support crack classification

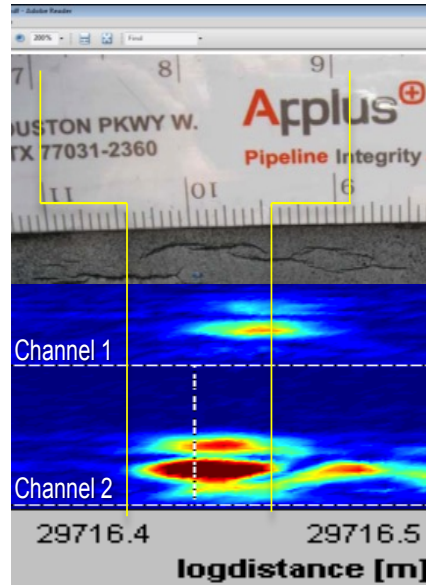
Source: Reber & Beller (NDT), 2003

ILI Results

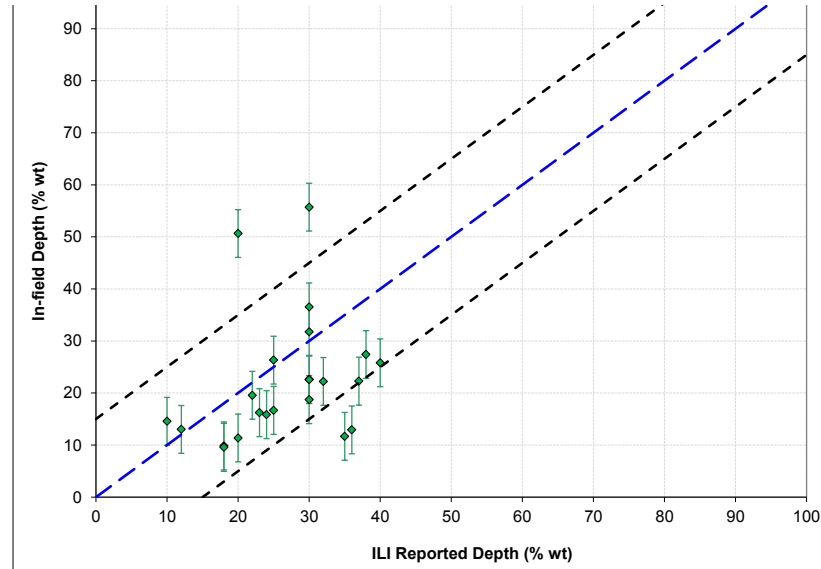


- Initial automated EMAT feature search → >50,000 indications
- 510 SCC and other linear and crack indications
- Majority of indications within hydrotest area / few indications outside that area
- 21 features excarvated

ILI Results



SCC – as found in field
(after MPI) and
corresponding EMAT signal



- EMAT/CMFL combined analysis → 43 SCC indications for FFS
- Detection of sub-critical (shallow) SCC
- +/-15% wt accuracy at 80% confidence

Conclusion

- The EMAT tool is an effective means for the in-line inspection of gas and liquid pipelines
- EMAT technology is a sensitive and accurate crack detection tool with high Probability of Identification (POI)
- EMAT/CMFL combined inspection increases inspection scope and further increases POI for cracks
- Accurate continuous depth sizing with EMAT is prerequisite for FFS, e.g. according to API 579
- Recommended continuation of the 'pig and dig' approach, with repeat hydrotest within 3 years and ILI within 3-5 years (Based on experience and industry guidance)
- Estimates of SCC growth rates can be obtained from industry wide practice



Thank you

Thank you for your attention