STRESS-CORROSION CRACKING DIRECT ASSESSMENT

Current Research and Future Needs

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SCC DA

- Identifying locations of highest probability of SCC is critical to success

- NACE RP 0204 provides general guidance on factors to consider but little specific guidance

- Some companies have developed useful correlations from extensive dig programs or ILI runs

J. A. Beavers and W. V. Harper, "SCC Prediction Model" NACExpo 2004

- Gas transmission pipeline, primarily asphalt enamel coating, DSAW

- Near-neutral-pH SCC

- Conclusions
  - 18 times more likely to find SCC with one **manufacturer** than with other manufacturers A

  - 3 times more likely to find SCC with **asphalt** than with other **coating**s (coal tar, epoxy urethane, FBE and wax) (No tape coating on the line)

  - 4 times more likely to find SCC with **glaciofuvial soil** than with lacustrine soil

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IPC04-0586: SCC Integrity Management Case Study - KinderMorgan Natural Gas Pipeline of America, J. D. Davis, et. al.

- Near-neutral pH SCC on a gas pipeline

- Verified model with 6 digs
  - 5 true positives
  - 1 true negative
  - No false positives or negatives

- Three important parameters
  - **Mild corrosion** (<10% w.t.) determined with high-res. MFL tool
  - **Intact (but disbonded) asphalt coating** as determined from close-interval on/off P/S survey (No SCC under coal tar)
  - **Alluvial deltaic modified sands** where drainage was influenced by topography

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IPC04-0267: A Statistical Model for the Prediction of SCC Formation Along a Pipeline, O. Youzwishen, et. al.

- Tape coated, ERW, liquid pipeline

- Near-neutral-pH SCC

- Model based on ~120 digs, confirmation based on 11 digs
  - 7 true positive, 1 true negative, 3 false positives
  - 48% of "corrosion" digs found SCC

- Most important parameters: **Proximity to mild corrosion and CP level**

- Other relevant parameters: CP shift, ground depression, bend angle of the pipe, direction of the bend

- More confirming activities are planned

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IPC04-0375: SCC Detection and Mitigation Based on In-Line Inspection Tools, W. Kresic, et. al.

- Near-neutral-pH SCC on liquid line

- Developing correlation with **pressure cycles and soil/terrain**
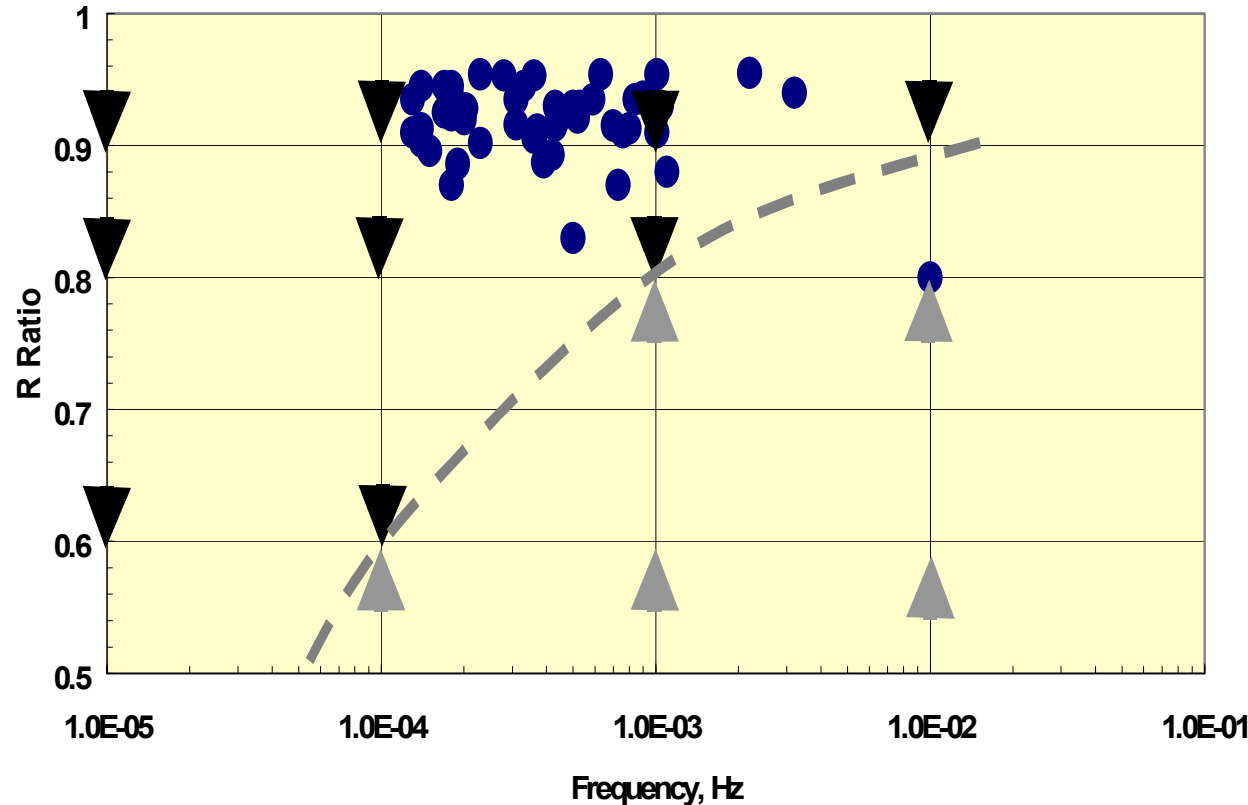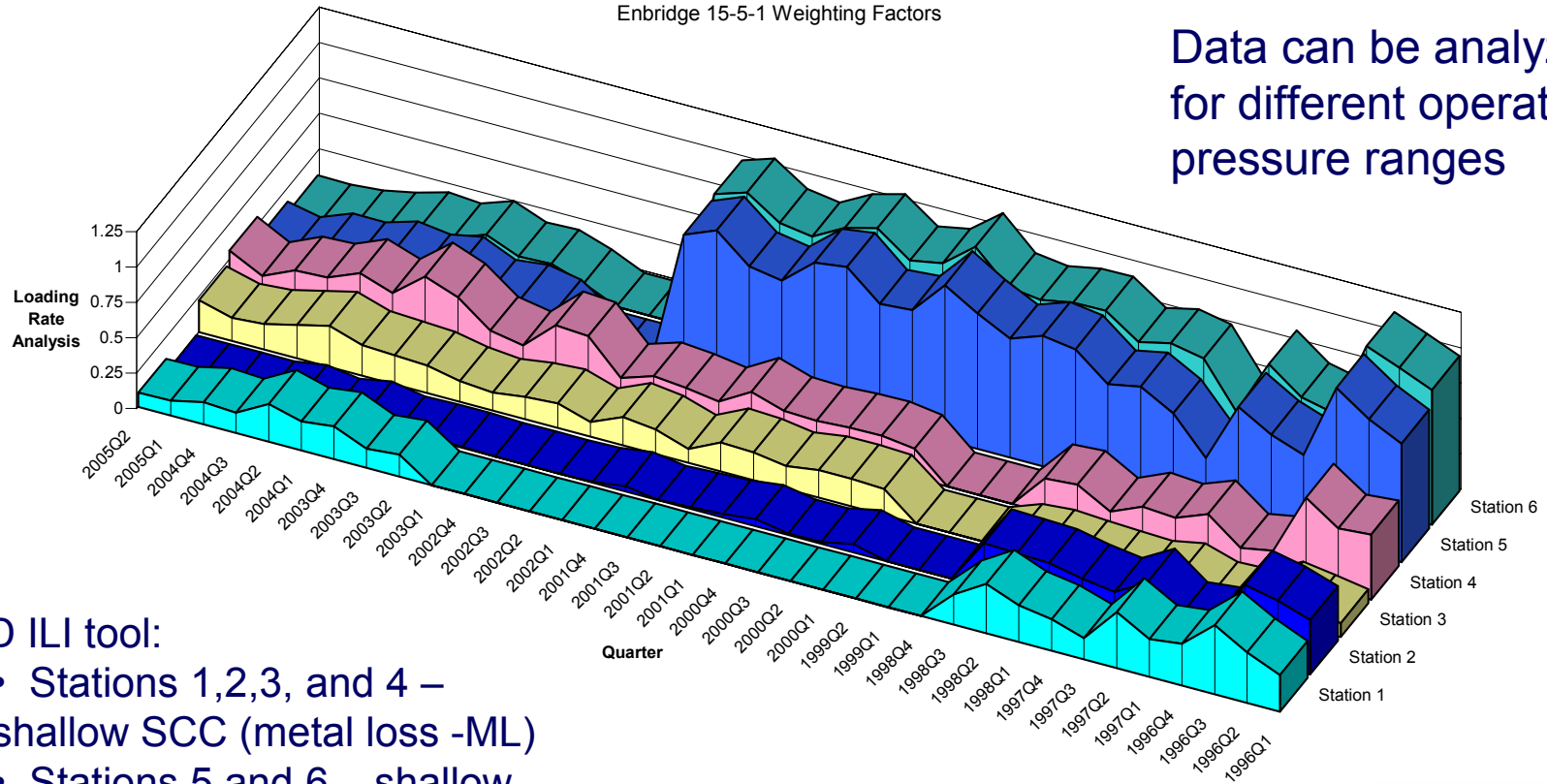
The Enbridge 15-5-1 Approach
- Loading Rate Analysis

Line A SCC Loading Rate Analysis
Normalized Against Line B-2001Q4-Pressure Analysis.xls
Enbridge 15-5-1 Weighting Factors

Data can be analyzed for different operating pressure ranges

USCD ILI tool:
- Stations 1,2,3, and 4 – shallow SCC (metal loss -ML)
- Stations 5 and 6 – shallow (ML) + significant SCC

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Factors Correlating with SCC Sites from Past Field Studies

	High pH Gas P/Ls	NN pH Gas P/Ls	NN pH Liquid P/Ls
Proximity to other SCC failures	Strong	Strong	Strong
Discharge of compressor station	Strong	Medium	Medium
Suction of compressor station	Negative	1 case	Medium
Temperature	Strong	None	None
Class I location	Strong	Strong	Strong
Age (> 15 years)	Strong	Strong	Strong
Coating type (tape, coal tar, asphalt)	Strong	Strong	Strong
Coating condition (disbonded)	Strong	Strong	Strong
Soil moisture level	Medium	Medium	Medium
Mild corrosion	None	Medium	Medium
Stress cycles (R & frequency)	??	??	Strong
Soil type	None	Area specific	Area specific
Terrain	Weak	Area specific	Area specific

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SCC DA -- Current Research

- Guidelines for the Identification of SCC Sites and the Estimation of Intervals for SCC DA
  - NRTC plus various subcontractors
  - Funding from PHMSA and PRCI
  - Initial approach: Mechanistic model based upon information from literature
  - Added approach: Validate model with field experience from industry survey

SCC DA -- Current Research

- SCC Data Mining
  - BIZTEK Consulting plus subcontractors
  - Funding from PRCI
  - Approach: Correlate severity of SCC as determined from ILI, hydrotesting, or extensive dig programs with operational and environmental factors
    - Gas and liquid pipelines
    - High-pH and NN-pH SCC

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SCC DA -- Current Research

- JIP on Management of SCC in HCAs on Gas Pipelines
  - BIZTEK Consulting and Macaw Engineering
  - Funding from El Paso, Great Lakes, Panhandle, Spectra, and TransCanada
  - Approach: Develop more specific guidelines based upon industry experience

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SCC DA -- Current Research

- Field Studies to Inspect for SCC
  - Various pipeline companies
  - Self funded
  - Approach: Develop algorithms for locating SCC based upon ILI, hydrotest, or dig programs

SCC DA -- Remaining Gaps

- Crack growth rate models based on measurable parameters, with emphasis on the effects of pressure fluctuations
  - Useful for selecting sites, determining intervals, and possibly prevention or mitigation
  - Parameters
    - High pH and NN pH
    - High and low amplitudes, high and low frequencies
    - Differentiate between corrosion fatigue and SCC
- More field correlations

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