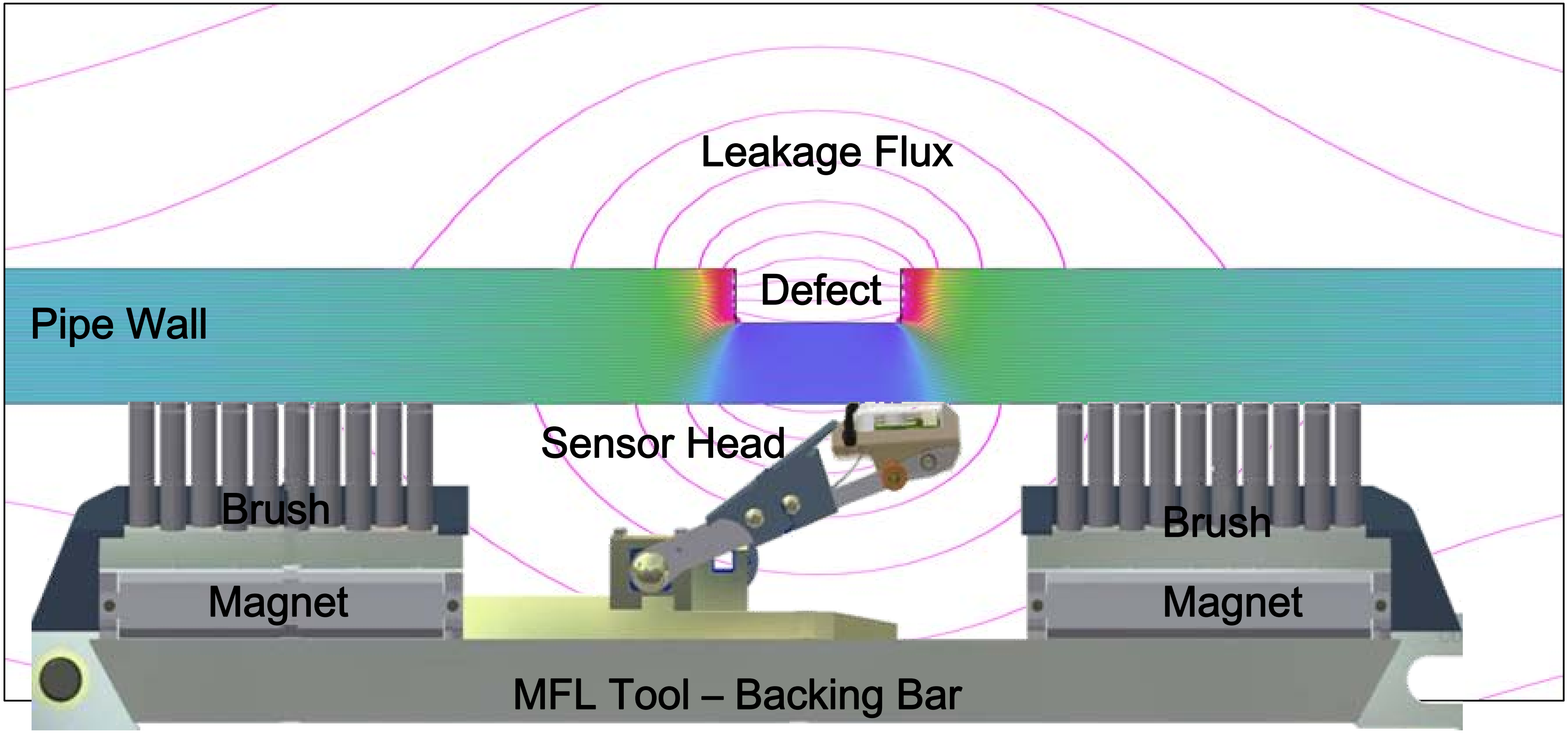
Anomaly Assessment and Repair Panel

Tool Tolerances

October 22nd, 2008

Stephen Westwood
Manager New Product Development
BJ Pipeline Inspection Services

Axial Magnetic Flux Leakage

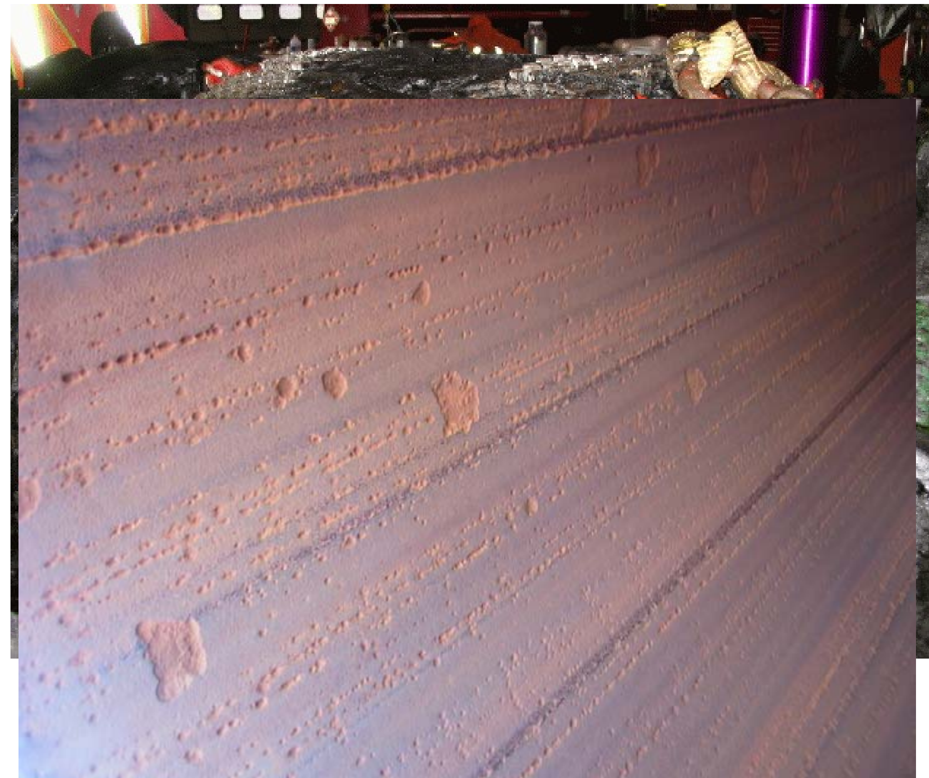


MFL Technology

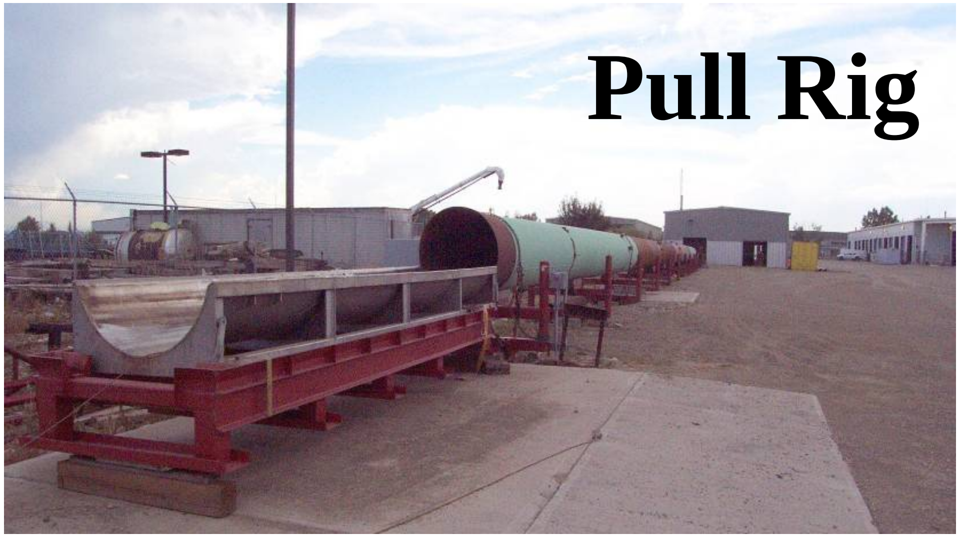
- Inferred Measurement
  - Not Measuring the Desired Quantity
- Has Limitations
  - Vendors Aware of
  - Operators Should be

Tool Tolerances Why ?

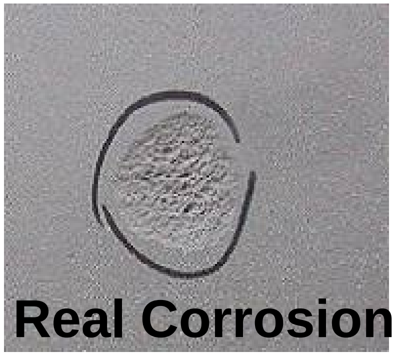
- Wide Range of Shapes, Sizes, WT and Defect Location
- Wide Range of Steel's
- Line Conditions
- Tool Performance
- Process Performance

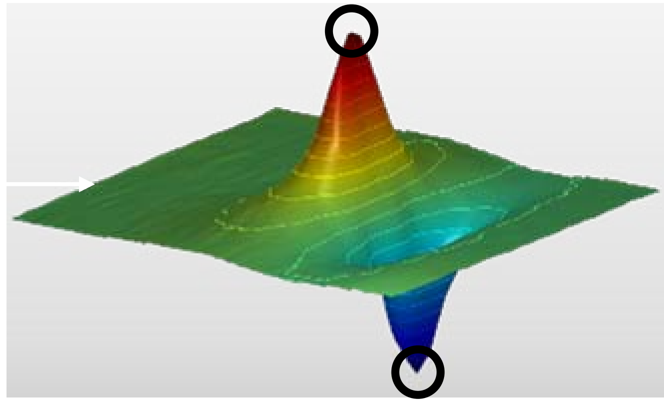


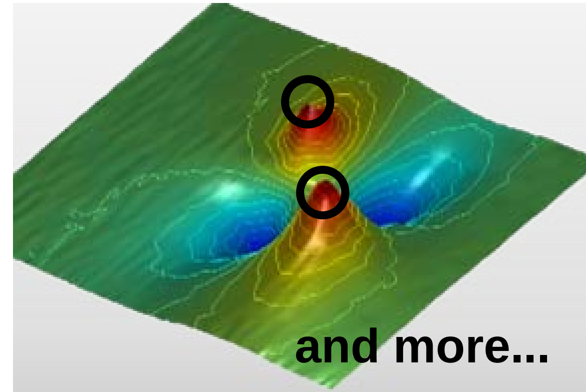
Tool & Data Verification

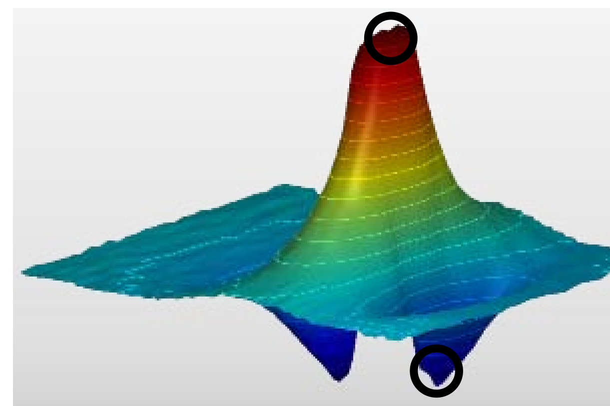


Calculating Defect Size





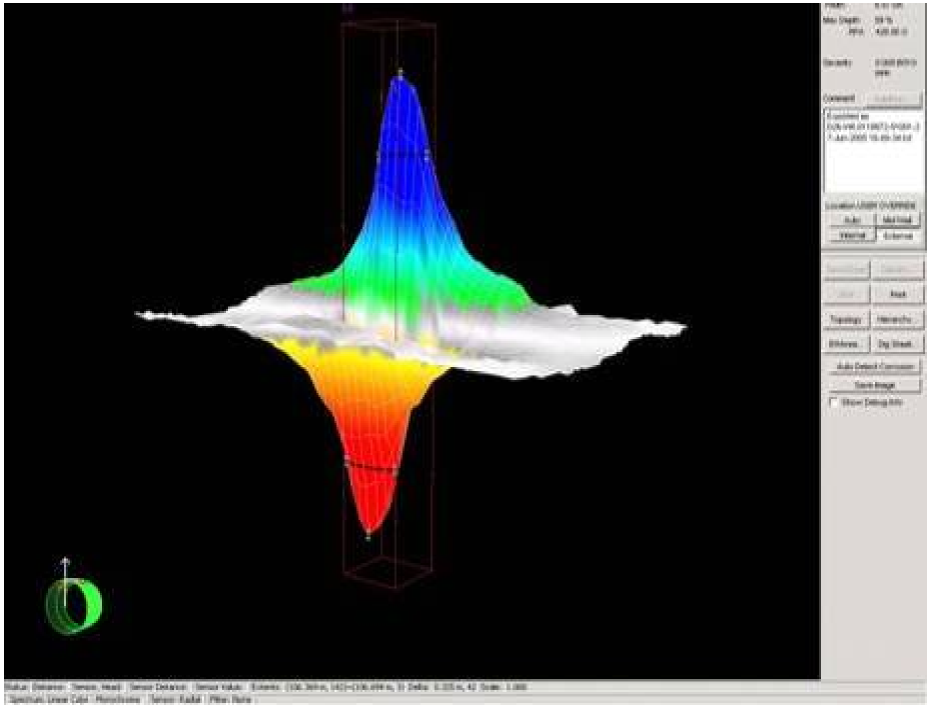


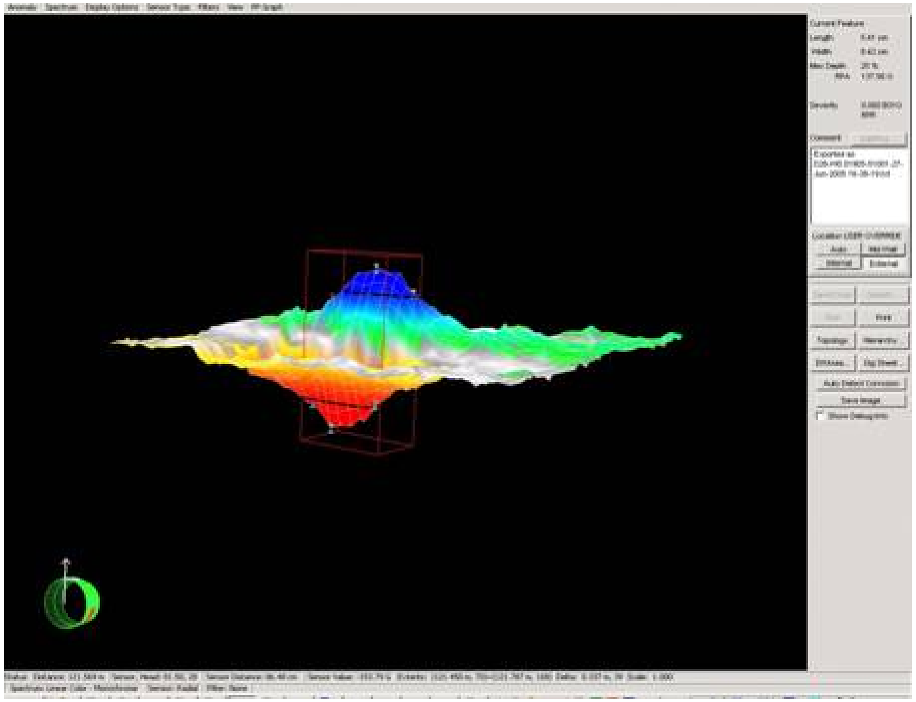


Apply Regression Techniques

Defect Size (Length, Width, Depth)

Defect Signal & Wall Thickness



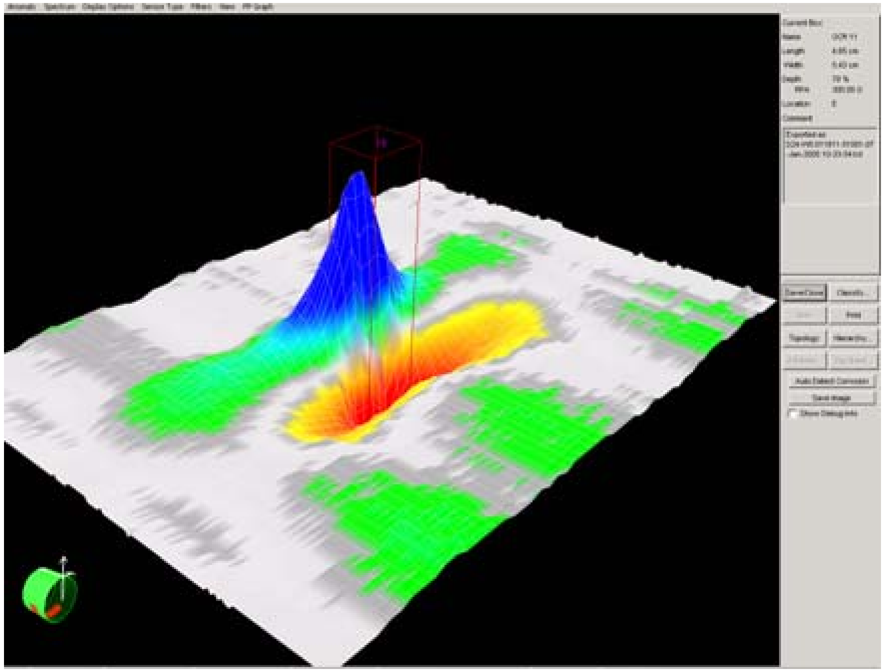


Wall Thickness – 11.8mm   Wall Thickness – 18.6mm

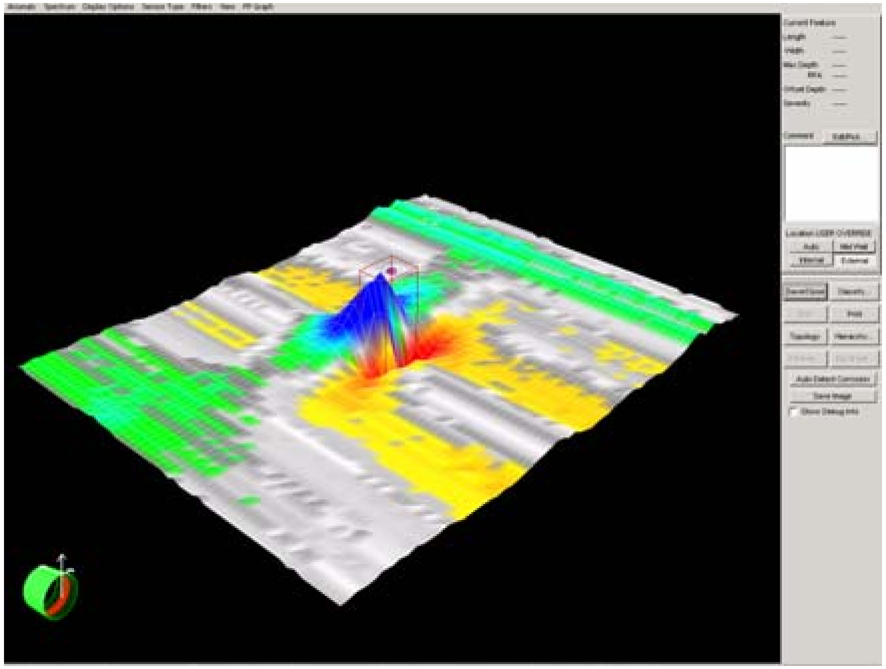
Defect Dimensions – 70mm x 70mm x 60%

Velocity Affected Defect

2.3m/s – 5.1mph
Reported Size
45m x 55mm x 78%

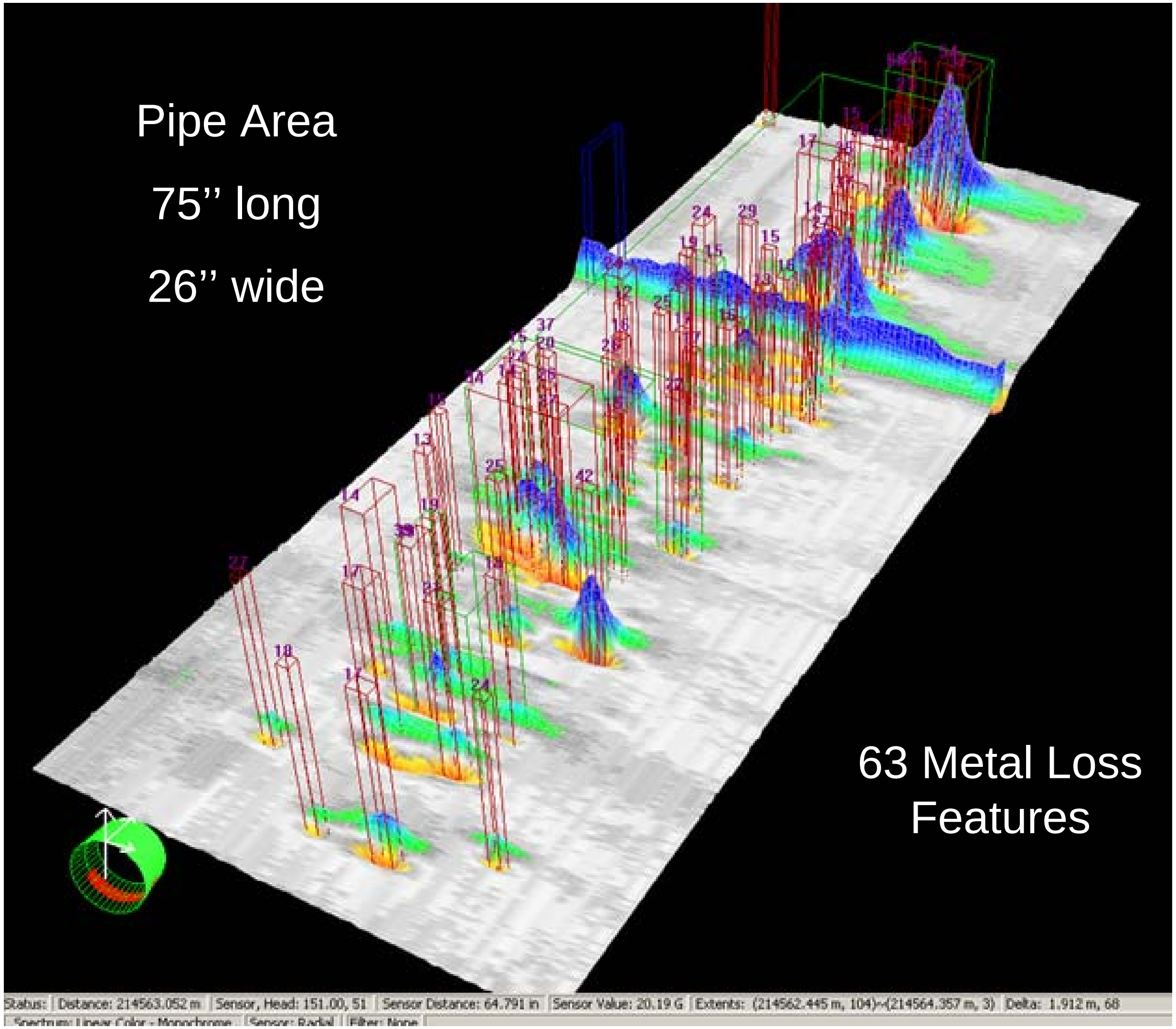


6.8m/s – 15.2mph
Reported Size
42mm x 54mm x 40%



Actual Defect Size
45mm x 45mm x 79%

Real Corrosion Cluster



Communication

- Before Inspection
  - Threats
  - Limitations
- During the Inspection
  - Line Conditions
- After the Inspection
  - Digs
  - Feedback

Anomaly Assessment and Repair Panel

Significance of ILI Uncertainties

October 22nd, 2008
Mark Stephens
Senior Consultant
C-FER Technologies

C-FER Technologies Inc.

LEADING PIPELINE RESEARCH

Context for Evaluation

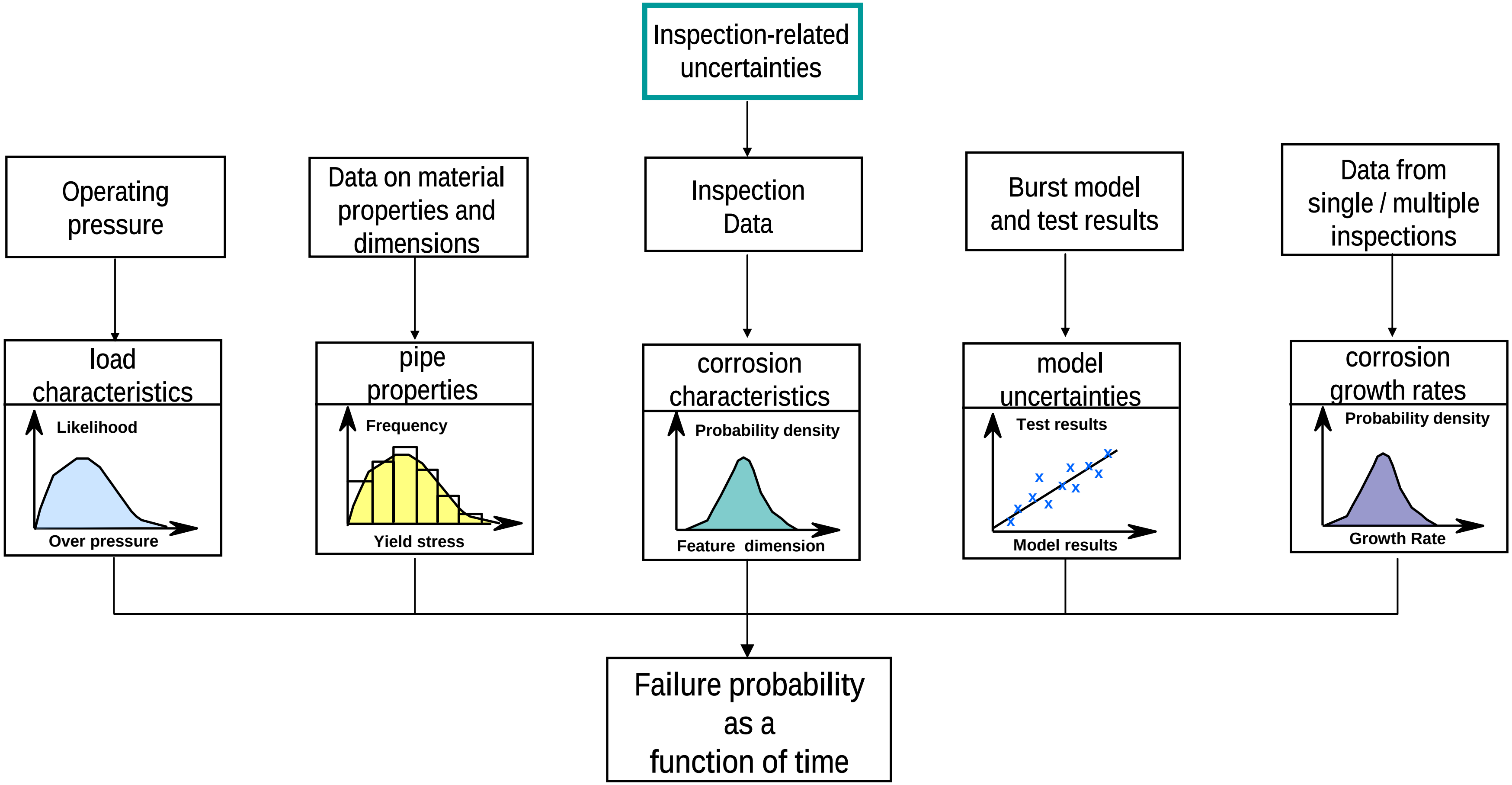
- **Reliability**
  - **Probability that a prescribed length of the pipeline will not fail within a certain period of time**

Reliability = 1 – Failure Probability

  - **General approach & guidelines developed thru PRCI* provide objective basis for assessing integrity/safety**
    - Adopted by CSA (Z662 – Annex O)
    - Under consideration by ASME for inclusion in B31.8

**Pipeline Research Council International*

Defect Specific Probability Estimation



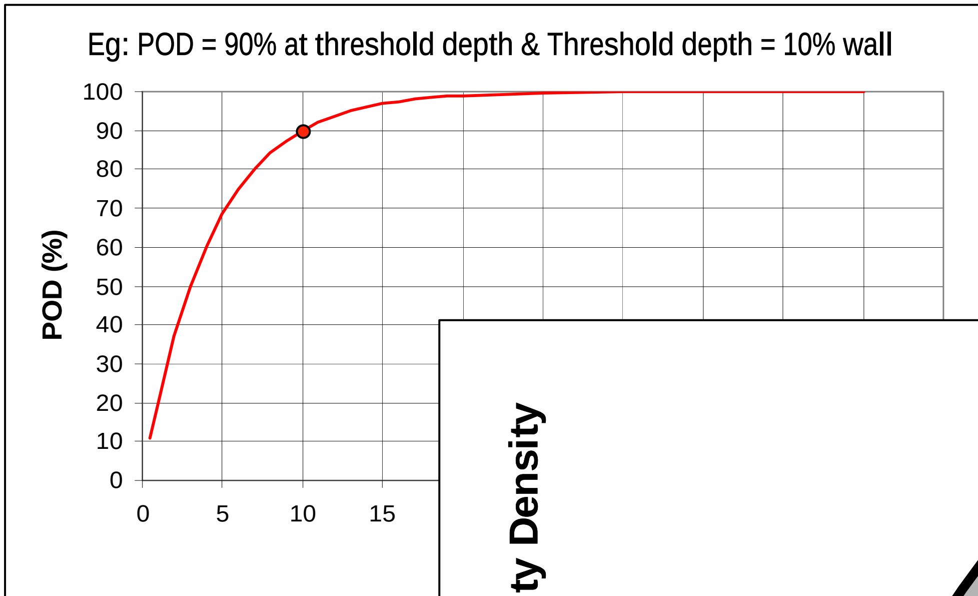
ILI Uncertainties

Sources of uncertainty → consistent with API 1163

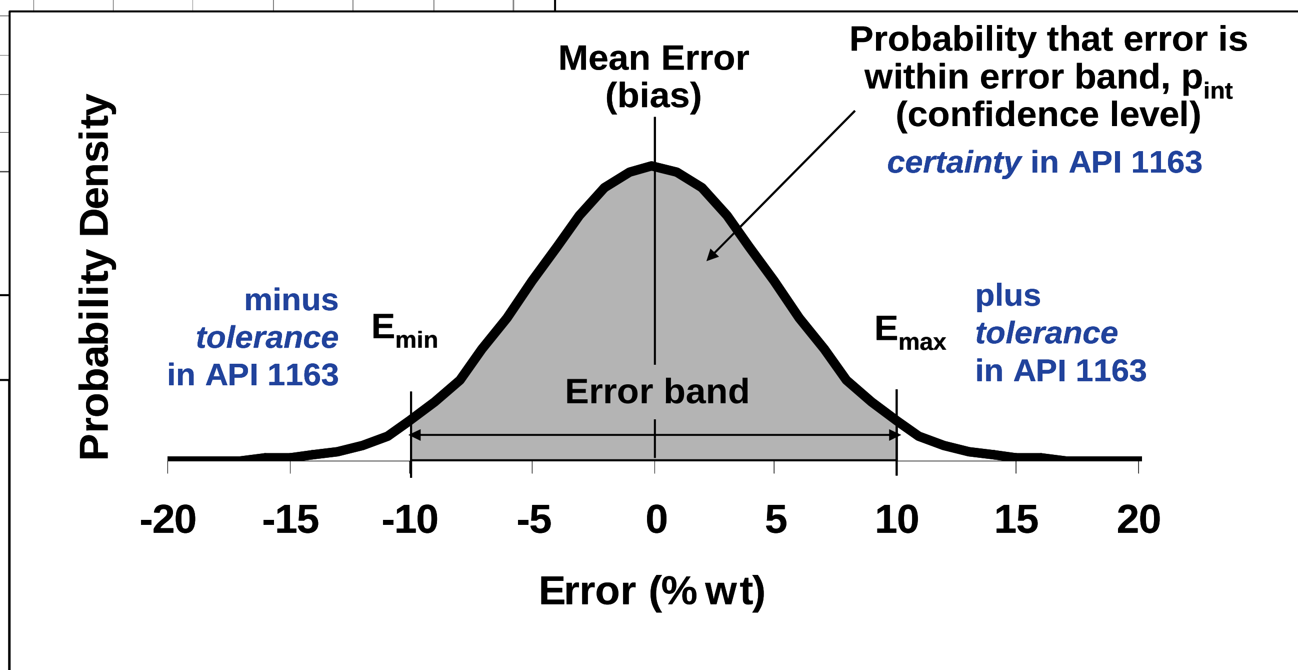
- **Probability of detection (POD)**
  - **probability of feature being detected**
- **Probability of false call (POFC)**
  - **probability of non-existing feature being reported as feature**
- **Probability of identification (POI)**
  - **probability that detected feature will be corrected identified**

- **Sizing accuracy (measurement error)**
  - **accuracy with which feature dimension is reported**

Key ILI Uncertainties



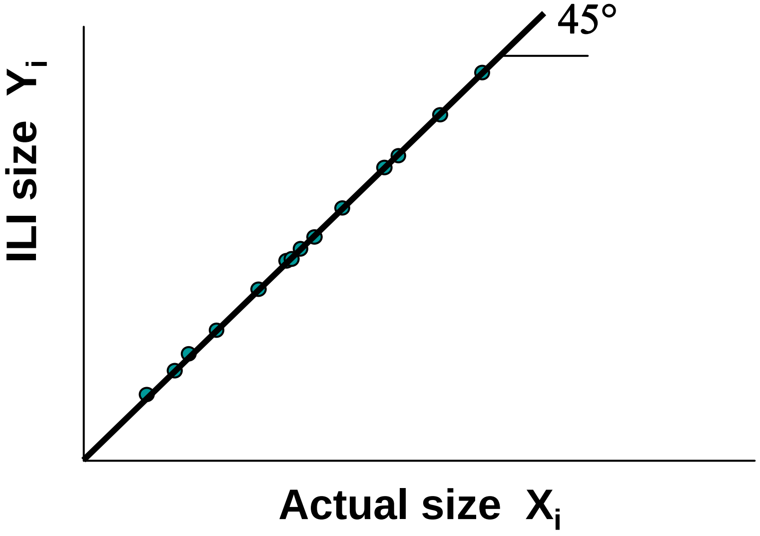
POD - Basis for inferring density & size distribution of non-detected features



Tool tolerance & Confidence Interval – basis for measurement error distribution

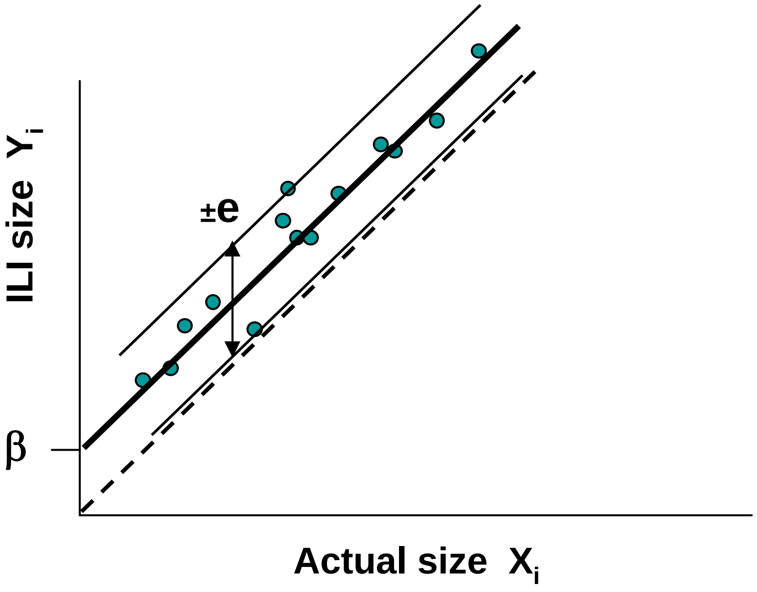
Comments on Sizing Accuracy

Perfect tool

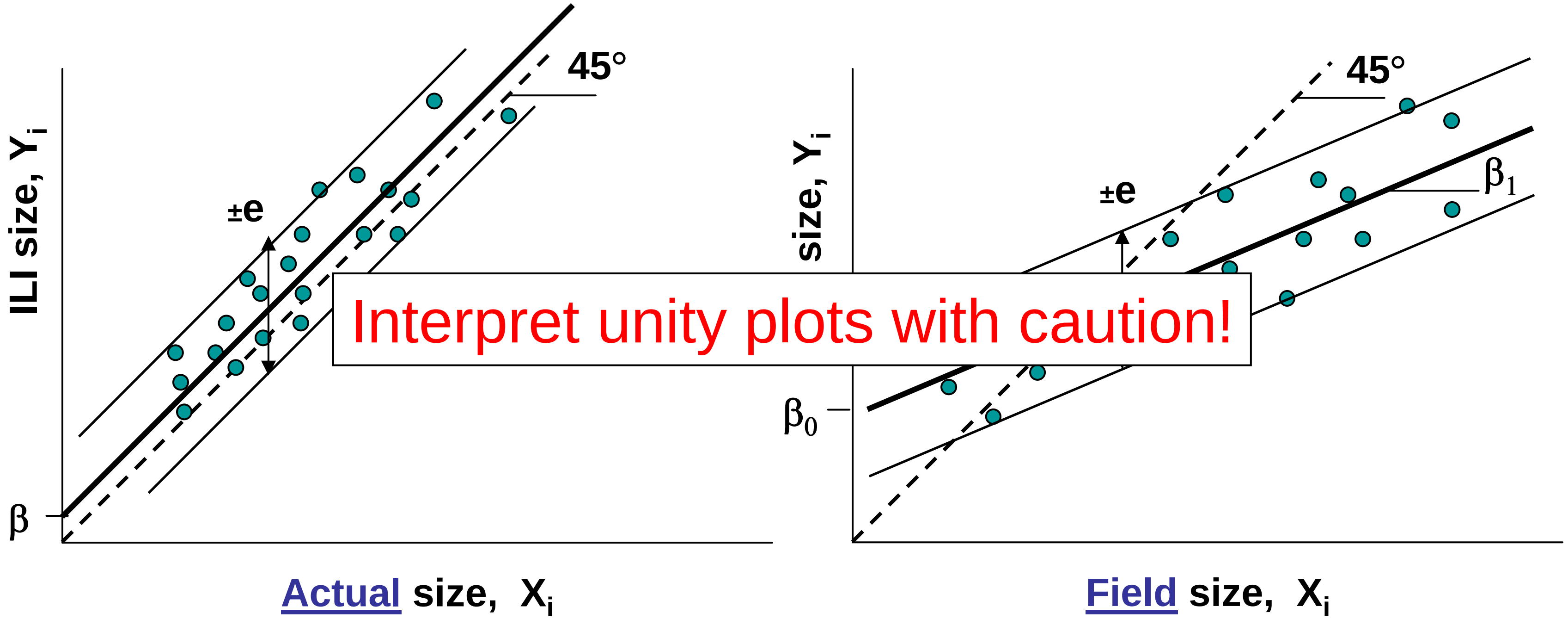


Real tool

- with bias (β) and random error (e)



Comments on Field Verification



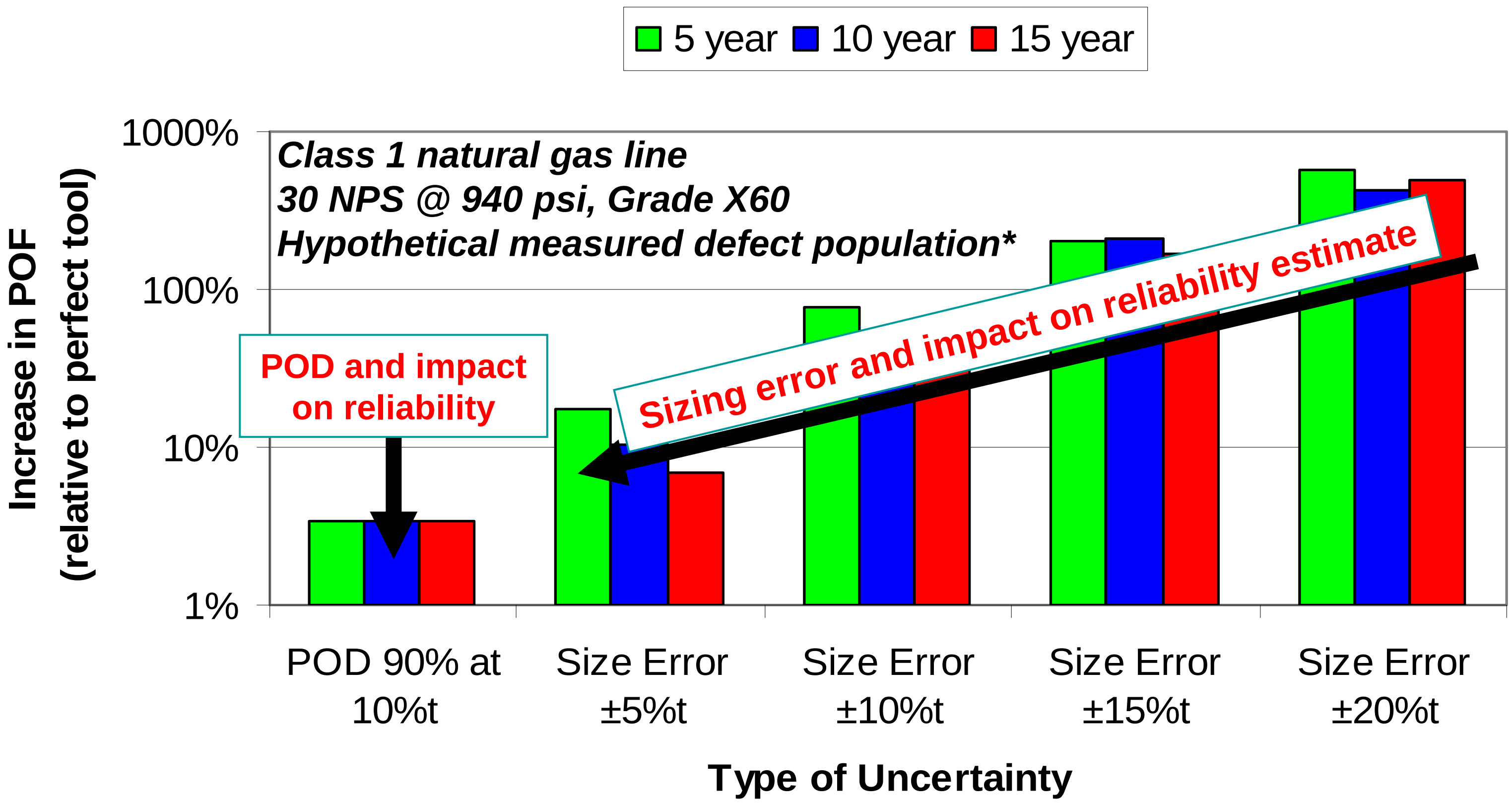
Real tool

- with bias (β) and random error (e)

Real tool

- with bias and random error characterized by ***field tool with random error and possibly bias***

Implications for Reliability



****Growth rate - independent of measured defect size***

Comments on ILI Uncertainties

Impact on reliability

- **Sources of ILI uncertainty well understood**
  - **Some can conservatively be ignored (e.g. POFC)**
  - **Some can have negligible impact (e.g. POD for HR tool*)**
  - **Some have more significant impact (e.g. sizing uncertainty)**
    - **Tool performance often better than specified**
      - **Field verification results must be interpreted with caution**

performing to capability for intended features

Comments on ILI Uncertainties

Process

- **ILI results (interpreted with acknowledgment of inherent uncertainties) inform decisions on what to excavate**
- **Operators must understand significance of ILI uncertainties**
  - **Verify they are consistent with claims/assumptions**
  - **If not → make appropriate adjustments**

Trends

- **Technology constantly improving**
  - **Tending towards situation where impact of uncertainties is potentially minimal**

Anomaly Assessment and Repair Panel

Addressing Corrosion Anomalies as Reported by ILI Tools

October 22nd, 2008
Sergio Limon-Tapia
Pipeline Integrity Group
Williams Gas Pipeline

Outline

- Our Common Goal
- The Role of MFL Tools for Addressing Corrosion
- Addressing MFL Tool Performance
- Elements of an ILI Performance Validation Program
- Summary

Our Common Goal

- We all share a common goal: *<u>preventing any failures in the pipelines we manage</u>*
  - Leaks or ruptures
  - Operators, regulators and ILI providers together
- External Corrosion is one of the primary threats to most pipeline systems
  - We spend more time, effort and money addressing this threat
- External Corrosion Program
  - Prevention, control, assessment and mitigation
  - Stay focused on our normal good practice: CP surveys and appropriate mitigation responses (ground beds/recoats)
  - ILI program: an integral part of the corrosion program

MFL Tools for Addressing Corrosion

- The basic fundamentals of this technology have not changed
  - Induce a magnetic field that saturates the pipe wall
  - Coil and Hall sensors capture magnetic flux leakage produced by the metal loss present
  - Perform all of these tasks in a single opportunity while traveling in one direction at about 4-7 MPH
- Let’s not forget to recognize and understand the limitations in the technology
  - Characterization of various corrosion shapes
  - Pipeline Operators Forum classification chart
  - POI, POD specs
- MFL tools, analysts and operators have done a good job in reporting and ranking corrosion features
  - We need refinement and fine tuning in certain areas

Addressing MFL Tool Performance

Elements of an ILI Performance Validation Program:

- Manage the uncertainties using reliability engineering based methods
  - Based on well established statistical & probabilistic principles
  - Quantify and document the probability of failure of a corroded area as reported by MFL
- Consider using a form of the Probability of Exceedance concept
  - The probability that a corrosion feature as reported by MFL exceeds a threshold level
  - Determine an acceptable POE threshold level
- Manage integrity using POE/Reliability Engineering
  - Allows for the prioritization of response and remediation

Addressing MFL Tool Performance

Elements of an ILI Performance Validation Program: *continuation*…

- Validate MFL performance
  - Accurate in-ditch sizing of corrosion is essential
  - Create depth unity plots and Probability of Failure curves
  - Provide detailed feedback to the ILI analyst
- Understanding when adjustments to ILI data are needed
  - Identify correcting factors
  - Implement adjustments
  - Document that changes/adjustments made are effective
- Issue a final dig list

Summary

- We all share the common goal to continue to maintain safety
- We have experienced good success with the MFL/Analyst work in addressing corrosion
- MFL tool is an integral part of our corrosion program
- The basics of the MFL technology have not changed
- We are learning to better handle the uncertainties inherent in the process (MFL-Analyst-Prioritization-Response-Remediation)
- An ILI performance validation program can be structured using reliability engineering based principles
- The POE approach can assist in quantifying the uncertainness and managing integrity

Anomaly Assessment and Repair Panel

Tool Tolerances

October 22nd, 2008

Chris Whitney
Manager, Pipeline Services East
El Paso Pipeline Group

El Paso Pipeline System

- 37,000~ mile system (CIG,EPNG,SNG,TGP)
- 32,000~ miles in ILI program
- 3%~ HCA
- 60%~ ILI miles to inspect HCAs
- 40%~ ILI miles w/o HCA

EP ILI History

- Pre-2001
  - various company approaches
  - ~10,000 miles, low-resolution
- 2001-2007 (4 Pipes)
  - 438 segments
  - 17,800 miles, 14,100 1st time
  - ~6,500 actionable anomalies remediated
- 2008 – 85 segments, ~4000 miles

ILI Process

- Deformation and Axial MFL tools
- “Clean” Pipeline segment
- Tool speed within parameters
- Sensors functional – 97% coverage
- Tool rotation
- Length, data quantity/quality, AGMs, etc.

ILI Process

- Final Report – 60 days
- FPR with Modified ASME B31G vs MAOP
- Metal loss box interaction
- Align data with HCAs
- Initial Response report
  - Immediate action, pressure restriction
  - 1 yr dents
- Final Response report
  - Scheduled investigations

Tool Tolerance and Uncertainty

- HCA
  - 70% depth, 1.16 FPR – Immediate Action

- Scheduled Anomalies
  - Within 2 years of ILI
  - FPR $\leq$ 1.39 (10 yr criteria, B31.8S, fig. 4)

- Monitor dig program to confirm expectations
  - Some unity plots using field reported data
  - Provide feedback to facilitate improvement and relationships with vendors.

Panel 1 Summary

- MFL technology is a mature process for metal loss inspection
- Sources of uncertainty are well understood
- Various methods are employed to account for these uncertainties
- Operator feedback to ILI providers is critical for continuous improvement
- It is incumbent on Operators to apply appropriate conservatism to the process
- Incident statistics indicate industry is doing a good job of managing corrosion using all of the tools at our disposal