Seam Failure Data Mining Efforts

Hazardous Liquids Pipeline Industry Data Mining on Seam Issues

A Presentation to
PHMSA Pipe Seam Issues Workshop
July 20, 2011

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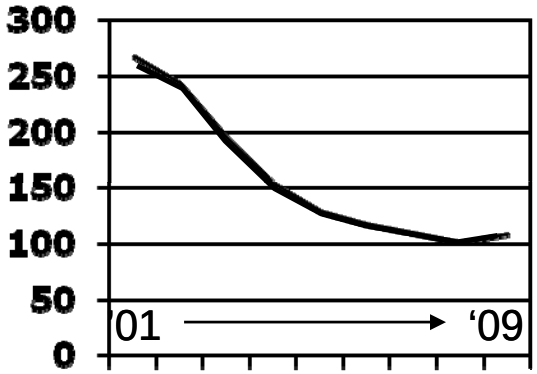
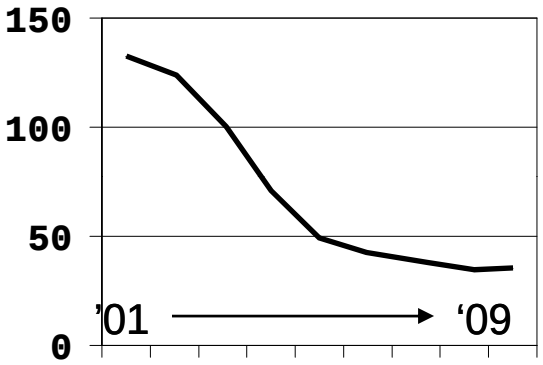
PPTS Onshore Pipe Incidents, '99-'09

3-Yr Average Ending Year Shown

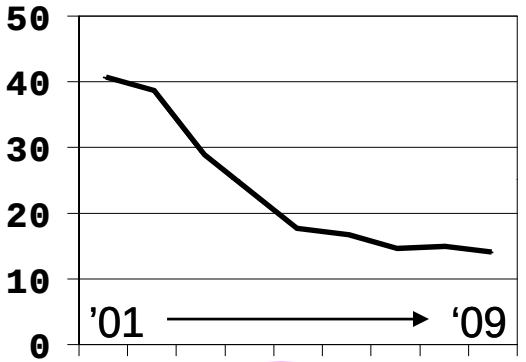
TOTAL, ALL CAUSES



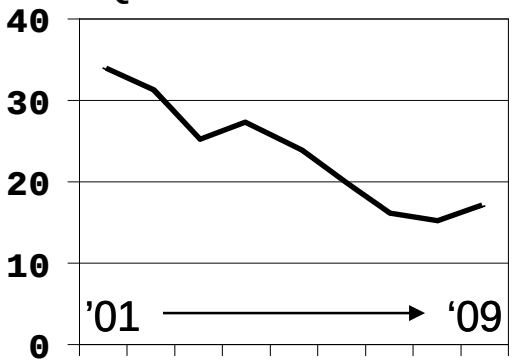
CORROSION



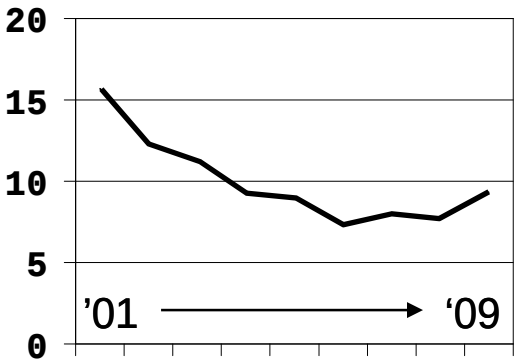
THIRD PARTY



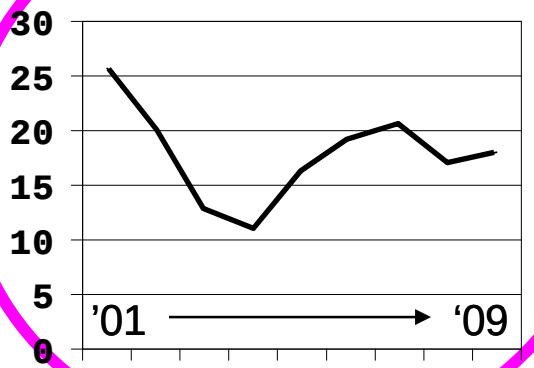
EQUIP./NON-PIPE



OPERATOR/OPER'N



MAT'L/SEAM/WELD



Focus on Seam Failures

- Uptick in Material, Weld and Seam Failures
- Data Mining Team worked with Pipeline Integrity Work Group to understand
- Focus on seams first – several large failures, of broad interest
- First, the PHMSA record
  - 29 out of 1373 long form releases, 2002-2008
- Needed more detailed data
- Asked 15 operators of the 29 incidents to drill down in post accident info
- Responses from 11, covering 21 incidents
- Subsequently received additional information/incidents from two noted consultancies (Kiefner and DNV/Columbus)

Initial Seam Failure Data Mining Efforts

- **Initially Provided Data was Mined for Trends**
  - **Pipe Data**
    - **Pipe MFG date, Seam Type & Freq., Manufacturer**
    - **Line OD, ID, D/t Ratio**
  - **Pressure Data**
    - **Pipe SMYS vs Failure psi, MOP, & normal operating**
    - **Hydrotest Dates & Pressures**
  - **Commodity Shipped**
  - **Inspection Dates & Type**
  - **Leak Type**
    - **Provided Failure Cause**
    - **Leak vs. Rupture**

Original Data Problems

- **Existing Data Did Not Identify Trends**
  - **Provided data often incorrect or incomplete**
  - **Insufficient data to understand contributing factors**
  - **Inability to determine if ILI was able to identify anomalies at the failure sites**
- **Supplemental Data Recommended**
  - **Fix incorrect/incomplete data**
  - **Update failure mode information (lack of fusion, fatigue cracking, etc.)**
  - **Provide details that specifically relate to seam failures**

Supplemental Seam Failure Survey Goals

- **Supplemental Survey Data Requested to Review**
  - **Seam Susceptibility Assessment Categories**
  - **Pressure Cycling Category (site)**
  - **Failure Mechanism**
  - **Role of Pressure Cycling**
- **Anonymous Seam Failure Survey**
  - **Role of ILI in detecting anomalies**

Supplemental Seam Failure Survey Findings

- **Seam Susceptibility Review**
  - **Out of 21 Incidents**
    - **10 "Not Susceptible" based on history and materials**
    - **7 "Susceptible" based on failure history**
    - **1 "Susceptible" based on materials & operation**
    - **3 Susceptibility was not determined**
  - **Take-Away**
    - **~50% of failures on lines deemed "Not Susceptible"**

Supplemental Seam Failure Survey Findings

- **Pressure Cycling Review**
  - **Out of 21 Incidents**
    - **10 Cycling Not Determined**
      - **– 6 of the 10 operate at >50% SMYS**
    - **5 Light to Moderate**
    - **5 Aggressive to Very Aggressive**
    - **1 Unreported**
  - **Take-Away**
    - **Failures have occurred across the spectrum of cycling aggressiveness categories**

Supplemental Seam Failure Survey Findings

- **Failure Mechanism Review**
  - **Out of 21 Incidents**
    - **7 Lack of Fusion**
    - **3 Hook Cracking**
    - **3 Selective Seam Corrosion**
    - **9 Other Failure Mechanisms diverse & included**
      - **1 burnt steel, 1 RR fatigue, 1 H2-induced cracking**
  - **Take-Aways**
    - **Lack of Fusion accounts for 1/3 of all failures**
    - **Hook Cracking only in 3 of 21 failures**

Supplemental Seam Failure Survey Findings

- **Role of Pressure Cycling in Failures**
  - **Only 4 of 21 Reported Cycling as a Contributing Factor**
- **Reported as Having Contributed to Failure**
  - **0 of 7 Lack of Fusion**
  - **2 of 3 Hook Cracking**
  - **1 of 1 Burnt Steel**
  - **1 of 1 Railroad Fatigue**
- **Take-Aways**
  - **Cycling did NOT contribute to Lack of Fusion failures**
  - **Cycling DID contribute to 2 of 3 Hook Crack failures**

Supplemental Seam Failure Survey Findings

- **Other Take-Aways**
  - **Seam-specific ILI in only 2 cases**
    - **Seam tools indicated 1 "unknown", and 1 "seam anomaly" plus metal loss indication from HRMFL**
  - **% SMYS for normal operating**
    - **6 of 21 above 60% (incl. 2 where cycling contributed)**
  - **Pipe Type/Vintage**
    - **13 of 21 are "vulnerable" types: lap weld, butt weld, LF ERW, flash weld**
    - **4 were on HF ERW**
  - **Failures did not occur shortly after pressure tests**

Anonymous Seam Failure Survey

- **Anonymous Data Request**
  - **Basic Data for Non-reportable Seam Failures**
    - **Hydrotests, non-DOT lines, etc.**
- **Goal**
  - **Obtain a larger data set**
  - **See if ILI tools reported anomalies at the failure sites**
  - **Review what was reported and by what tools**
- **Results**
  - **Only 1 of 10 responders noted ILI had any indications**
  - **Inconclusive data**

NEXT STEPS

- **Future Steps**
  - **PPTS Incident Reporting Form has been revised**
    - **Adds fields for items in the Supplemental Request**
    - **Data needs have been clarified**
    - **Should provide better data to the DMT for future trend analysis**
    - **Data should be able to assist in understanding the capabilities of ILI to detect items at failure sites**
  - **Incorporate Data from Future Failures**
    - **Added data points may lead the DMT in clearer directions (not yet undertaken)**
  - **Add additional data from consultants and analyze for any changes in results (ongoing)**

The Data Mining Team & Integrity Work Group

Seam Failure Work Group Members

- **Rich Dalasio (Sunoco Logistics)**
- **Frank Gonzales (Colonial Pipeline)**
- **Mike Scurlock (BP Pipelines North America)**
- **Cheryl Trench (Allegro Energy Consulting)**
- **Peter Lidiak (API)**