



# Lessons Learned

## PHMSA Crack Detection Workshop

Chicago, IL

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# Conclusions

- **“Lessons Learned” usage:**
  - From major/minor pipeline incidents in all pipeline integrity, operational, and response matters
- **Take proactive approach:**
  - Confirmatory hydrostatic testing, replacements, etc. to eliminate potential in-service ruptures
  - Uncertainty in crack tool and direct examination results is too great to rely solely on a “pig and dig” approach
- **Make significant improvements in:**
  - Comprehensive pipeline risk, ILI, and direct assessments
  - How information from direct assessment findings are used



# PHMSA R&D Program

- Since 2002 - 36 projects for over \$18-million
- Project focus
  - Crack Detection, Stress Corrosion Cracking, Selective Seam Weld Cracking/Corrosion, Crack Arrestors and Crack Growth Rate Models
- Please see PHMSA Research Summary handout by registration desk



# PHMSA R&D Program

- **Hydrotest Protocols for Pipe Seams**
- **Enhanced ILI Detection & Sizing**
- **Establish Performance & Size Seam Anomalies**
- **Develop Models & Quantify Growth Mechanisms**
- **Develop Management Tools**



# Lessons Learned

**+ 20 years ago & past 4 years**



# PHMSA Crack Detection Advisory List

- ALN-88-01 – Pre-1970 ERW Pipe Seams – 145 failures
- ALN-89-01 – Actions to take for ERW Pipe Seams
- ALN-91-02 – Crack in a 4-inch Cast Iron Gas Main
- ALN-92-02 – Actions to take for Cast Iron Pipe
- ADB-03-05 – SCC Threat to Gas and Liquid Pipelines
- ADB-12-05 – Cast iron Distribution Pipelines – 12-inch
- ADB-2014-02 – Lessons Learned



# NTSB Recommendation List

## Pipeline Incidents – 62 rec. in 5 years

- Year 2010 - 7 recommendations
- Year 2011 – 32 recommendations
- Year 2012 – 19 recommendations
- Year 2013 - 0 recommendations
- Year 2014 - 4 recommendations



# Lessons Learned – Steel Pipe

- Data integration
- Conservative approach in sizing
- Tool tolerances
- Interaction of crack growth
- Material properties - toughness
- Fatigue crack growth model to predict remaining life
- Combination of tools used – ILI, Direct, & Pressure Test
- Continuous reassessment



# Lessons Learned – Cast Iron Pipe

- Unsatisfactory condition, but no immediate hazard exists, initiate program to recondition or phase out
- General graphitization found to a degree where fracture might result, replace
- Pipe excavated must be protected from damage
- Follow Section 192.613
  - Continuing surveillance
  - Appropriate actions
  - **Recondition, phase out / replace, or reduce operating pressure**



# Basic Questions for Crack Detection

- Where – do you look
- What – do you look for
- When – do you look for it
- How much – do you look at
- How often – do you look for it
- How do - assess it for safe pressure





# Our Current World



# Our Current World: Threat and Result

Seam Crack - MS

San Bruno, CA

Allentown, PA



Seam Crack – San Bruno, CA



Marshall, MI



Seam Crack - Arkansas





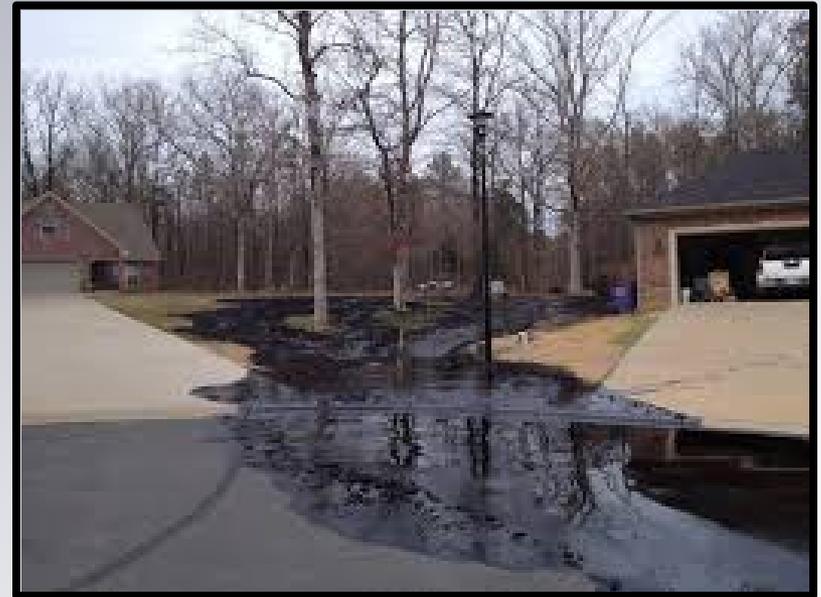
# High Profile Accidents 2010 to 2014

- **Marshall, Michigan (Federally Regulated)**
  - Major Crude Oil Spill Dramatically Impacted Several Communities in Michigan
- **San Bruno, California (State Regulated)**
  - Seam
- **Allentown, Pennsylvania (State Regulated)**
  - Cast Iron, low pressure
- **Mayflower, Arkansas (Federally Regulated)**
  - LF-ERW seam



# Mayflower, Arkansas Pipeline Accident

- March 29, 2012: A 20" crude oil pipeline ruptured in Mayflower, Arkansas;
- Estimated 5,000 bbl crude was spilled;
- 1947/1948 Construction.





# Our Current World: 2010 to 2014

- **PHMSA evaluating the need for new regulations:**
  - NTSB investigation results and PHMSA recommendations
  - Reauthorization includes multiple new mandates
  - Multiple OIG/GAO Audits
  - Numerous workshops held from 2011 to date
  - New studies related to effectiveness of current regulations
  - Secretary's "Call to Action"
  - **Gas Rule for IVP – draft written**



# Lessons Learned

## Past 4 years



# Lessons Learned

- **Operational**
  - Integrity Management
- **New Facilities**
  - Design
  - Field Construction Practices





# Lessons Learned

- **Integrity Management**

- Assessment results must be validated
  - Direct exams, unity charts for ILI, and data integration
- In-line Inspection (ILI) Tool findings must be based upon:
  - Protocols with conservative characterization procedures
  - Direct *in situ* examinations of crack length and depth (including pipe and seam toughness)
  - In-situ examinations must have protocols
    - to ensure accuracy of equipment being used
    - safe pressures being calculated
- ILI results (crack tools) are based on what's recorded
  - If an anomaly is not detected/reported, Operator cannot assess result



# Lessons Learned

- **Integrity Management**

- Threats must be fully evaluated based upon:
  - Seam type and coating types
  - Operating, environmental and local conditions
- Hydrotesting
  - Must be used to supplement In-line Inspection (ILI) for crack detection/ elimination
  - Hydrotest spike pressures must be at a high % of pipe yield strength
- **If one assessment tool does not fully assess the threat, multiple tools must be used:**
  - **Ex.: Cracking threats may require both ILI and Hydrotest**



# Lessons Learned – New Facilities

- **Design & Construction procedures must be thorough and rigorous**
  - Design/Materials
    - Coating
    - Seam Type and
    - Manufacturing Quality
      - Specifications and inspection
  - Field Construction Practices
    - Welding and NDE
    - Hydrotest pressures – must be high enough for defects
    - In-line tool runs after construction
    - Contractor Quality and Field Inspection



July 2011



## Lessons Learned

- **Does your company have a safety culture?**
  - Health & Safety Principles, Lifesaving Rules, Training, etc.
  - Integrated Management System with continuous improvement
    - Does Executive Management get involved beyond budgets?
    - Improved specifications and procedures based upon “Lessons Learned”
    - **Best practices with a safety and integrity focus includes:**
      - More than DOT Code minimums
      - All integrity threats
      - Direct examinations, hydrostatic tests, and pipe replacements, as needed



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U.S. Department of Transportation  
Pipeline and Hazardous Materials  
Safety Administration



# THANK YOU

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Know what's **below.**  
**Call before you dig.**

