# Seam-Weld Research Project & Input/Refinement of The Research

## Managing Challenges with Pipeline Seam-Welds

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in conjunction with

John Kiefner (KAI) & John Beavers (DNV)

# Outline

- PHMSA Research Announcement (RA) & Expectations
  - Main Objectives and Drivers
- The Project Team - Organizations and Co-PIs
- Programmatic Aspects
  - Main objectives
  - Allocated Funding
  - Deliverables & Timeline
- Proposed Tasks & Work Scope
- Project's Expectations from this Public Meeting
  - What/how can you contribute (data / LFERW pipe / …)
  - Insights in the Working Group Breakouts
  - Scope Refinement?
  - Needs / Expectations beyond current work scope
- Closure – Q&A

# PHMSA RA

- Main Objective & NTSB Driver for PHMSA's RA:
  - PHMSA: "at a minimum provide a deliverable to assist in closure of the NTSB recommendation one (i.e., P-09-1)"
  - NTSB P-09-1 Recommends
    - "comprehensive study to identify actions that can be implemented by pipeline operators to eliminate catastrophic longitudinal seam failures in ERW pipe"
    - "at a minimum, … include:
      - 1) assessments of the effectiveness & effects of in-line inspection tools, hydrostatic pressure tests, and spike pressure tests;
      - 2) pipe material strength characteristics and failure mechanisms;
      - 3) the effects of aging on ERW pipelines;
      - 4) the effects of operational factors on ERW pipelines; &
      - 5) data collection and predictive analysis"

# PHMSA RA Expectations

- RA Expectations:
  - "include investigations relevant to both natural gas transmission and hazardous liquid pipelines"
  - "submissions addressing only technology development will be deemed non-responsive"
  - a LFERW focus .. but noting also "overall scope can address a broader spectrum of seam weld issues "e.g., statistical review of seam weld failures"… "but only after addressing NTSB recommendations"
  - "consider impact on consensus standards" "stimulate development & commercialization of related technology"
- P-09-01 preamble included direct reference to use of ILI and hydrotests as basis to assess/verify integrity, so both must be considered to address this NTSB recommendation.

# The Project Team

- Companies & Co-PIs
  - Battelle's Pipeline Technology Center
    - Project management/organization
    - Primary to full-scale (hydro) testing & inspection aspects
    - Key Players: Brian Leis & Bruce Nestleroth
  - DNV Columbus
    - Primary to Grooving Corrosion
    - Key Players: John Beavers & Tom Bubenik
  - Kiefner & Associates
    - Primary to data development and trending
    - Key Players: John Kiefner & Kolin Kolovich
  - All companies involved in modeling and mechanisms & each collaborates in reporting

# Programmatic Aspects

- Funding: $750,000 (ceiling) – proposed at $724,206
- Timeline: 18 months to draft report submission
- Deliverables (per RA):
  - Project meetings as needed
  - Attendance & presentation at two PHMSA sponsored public events
  - Quarterly progress reports
  - Draft report on PHMSA & industry statistics for ERW failures, with revision leading to Final Report
  - Draft report on comprehensive study for the NTSB, with revision leading to Final Report
  - Draft project final report and with revision an integrated Final Report

# Four Technical Tasks

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- Task 1 – Data Collection and Analysis
- Task 2 – Testing to Quantify Seam Failure Response
- Task 3 – Grooving (Selective Seam) Corrosion (GC)
- Task 4 – Inspection Technology Evaluation (via Task 2 data)
- Reporting

- Needs recognized beyond this scope -
  - Technology Needs:
    - ERW Seam Modeling / Validation (cycle / time dependence)
  - Hardware (detect/size) Development:
    - ILI & NDE – full capabilities assessment study
- These high-level descriptors are known needs that require prioritization & better/precise definition

# Task 1 – Data Collection & Analysis

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## Develop database (Collection Aspect)

- Sources of Data
  - DOT
  - Operator records
  - Contractors (under auspices of API)
  - Prior studies – OPS ‘89, Baker et al ’04, Literature
- Types of Data (Statistics vs Detailed Study)
  - ERW Seam Failures – DOT, API PPTS, Contractor failure analyses – Seam failures more generally?
  - Hydrotests
  - ILI with field digs
  - Full-scale testing data
- Approach / Plan
  - Contractor records
  - Survey & Scheduled visits – based on replies to call for information
  - Tell us what you can bring to bear in the W/Gs

# Task 1 – Data Collection & Analysis

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## Develop Understanding & Trends (Analysis Aspect)

- The basis to quantify understanding ERW seam anomaly response and behavior in operating systems

- Analysis/Synthesis
  - Effectiveness of ILI, NDE, hydrotest (spike tests, pressure reversals, …)
  - Trend ERW seam failure data observations
  - Integrate with existing outcomes
- A Major Effort
  - Runs for 15 of the 18 months
  - Good indicators for support (& success) to date
  - Always seeking data/info sources
- Delivers
  - Basis to assess cause-effect relationships for ERW seam features & define/quantify related mechanisms

# Task 2 – Quantify Seam Response

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## Develop validation data & quantify anomaly response – testing at full-scale with laboratory scale follow-up

- Compile/Prioritize ERW pipe samples
  - Good initial response – more pipe likely needed
  - 8” to 20” offered to date
  - Some with “known” features (field ILI or Digs), others unknown
  - Different manufacturers & vintage – LoneStar, Youngstown, …
- Pre-Test ILI and “in the ditch” NDE Inspection
  - Features to be selected from initial screening
  - Involves Industry & Supplier Teams
    - Calibration standards available
  - in the ditch NDE via shear wave UT, phased array UT, …
  - Pull-rig for representative ILI technologies (dry only)

# Task 2 – Quantify Seam Response

- Full-scale testing
  - Quantify the factors that affect seam feature growth/stability
  - Matrix to be defined by screening results
  - Matrix to be confirmed with DOT and Steering Committee at Kick-off meeting
  - Standard full-scale testing program, data to be applied to models
- Lab-scale testing
  - Characterize ERW seam properties
  - Current practices and possible new methods
  - Pipe vs bondline
  - Notched vs fatigued pre-cracked samples
  - Develop standard guidance for failure analysis

# Task 2 – Quantify Seam Response

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- Model Evaluation
  - predictive models for ERW seam-feature response
  - evaluating existing models to validate or point to aspects that need to improve or be redeveloped
  - various levels considered / empirical through driving force & resistance aspects, burst-pressure focus
- Lab Evaluation
  - characterize features & properties and causative factors & mechanisms
- Delivers
  - database to quantify predictive effectiveness of key tools
    - assesses viability of predictive tools for hydrotest
    - feedstock for Task 4 that assesses viability of inspection
  - understanding of cause-effect relationships & seam features
  - the basis to address the inspection-related concerns of P-09-1
  - a path forward to ensure more certain management of seam features

# Task 3 – Grooving Corrosion (GC)

## Develop Tools to Help Manage GC

- Two levels: a field-deployable methodology to characterize susceptibility & guidelines for mitigating GC

- Comprehensive review of the mechanism(s) of GC & evaluation of conditions where field failures have occurred
- Develop a field-deployable methodology to quantify susceptibility to GC & validate literature-reported / alternative mechanisms in a laboratory setting, then via field tests
- Develop guidelines to mitigate GC & validate
- Delivers
  - field deployable management tools for GC

# Task 4 – Inspection Technology

Develop guidance regarding current capabilities in applications to various types of ERW seam features

- Assess Task 2 inspection database to identify successes and shortfalls
- Based on Task 2 database, make preliminary assessment of the accuracy of inspection technologies to detect and size features in vintage ERW longitudinal seam pipe
  - address ILI and NDE (in ditch)
- Trend to develop foundation for a comprehensive study of performance capabilities for ILI and in-ditch technology to detect, size, and characterize ERW seam features as a function of feature type, size, …
- Delivers
  - the basis to address the inspection-related concerns of P-09-1
  - a path forward to ensure more certain management of seam features

# Expectations from this Meeting

- What/how can you contribute
  - data / LFERW pipe / …
- Needs / Expectations beyond current work scope
  - Technology Needs:
    - ERW Seam Modeling / Validation (cycle / time dependence)
  - Hardware (detect/size) Development:
    - ILI & NDE – full capabilities assessment study
  - Others ?
- Working Group Breakouts
  - purpose is to communicate understanding and identify shortfalls/issues
  - establish dialog to gain new/broader insight & develop scope refinement and/or broader definition