PHMSA Research, Technical and Policy Perspectives

Working Group #1

Improving Assessment Methods for Dents & Cracks

Steve Nanney

Pipeline Research and Development Forum

September 11-12, 2018

Dent and Crack Assessment

- **Program Objective:** Research in this area will develop new or improved assessment tools/methods that can determine the severity of such defects both simple, complex and interacting in order to calculate remaining life.
- PHMSA's Research Portfolio:
  - 9 Awarded Projects since 2002 – All completed
  - $11.6M PHMSA + $2.3M Resource Sharing
  - 1 Commercialized Technologies to measure the severity of stresses near dents and damage regions.
  - Crack Assess Software enabling evidence based repair and replacement decisions.
  - 1 Project winning 2017 R&D 100 Award!
  - Knowledge gained supported policy action in rulemaking and favorable closure of NTSB recommendation.

Dent Research

Significant data available

Commercialized Technology

	Project ID and Title	Contractor	PHMSA	Resource Share
1.	DTRS56-04-T-0001, Nonlinear Harmonic-based Mechanical Damage Severity Criteria for Delayed Failures in Pipelines	Southwest Research Institute	$333,230	$354,000
2.	DTPH56-08-T-000011, Structural Significance of Mechanical Damage	Electricore, Inc.	$616,490	$1,068,856
3.	DTPH56-08-T-000023, Validation for Flaw Acceptance of Mechanical Damage to Low Stress Natural Gas Pipelines	Operations Technology Development	$381,306	$397,816
4.	DTPH56-10-T-000013, Dent Fatigue Life Assessment - Development of Tools for Assessing the Severity and Life of Dent Features	BMT Fleet Technology Limited	$67,500	$67,500
5.	A Quantitative Non-destructive Residual Stress Assessment Tool for Pipelines	Generation 2 Materials Technology LLC	$1,000,000	N/A
		TOTALS:	$2,398,526	$1,888,172

Crack Research

	Project ID and Title	Contractor	PHMSA	Resource Share
1.	DTPH56-08-T-000001, Development of a Commercial Model to Predict Stress Corrosion Cracking Growth Rates in Operating Pipelines	Southwest Research Institute	$386,524	$400,000
2.	DTPH56-11-T-000003L, Comprehensive Study to Understand Longitudinal ERW Seam Failures	Battelle Memorial Institute	$4,562,858	$31,980
3.	DTPH56-14-H-00002L, Consolidated Project Full Scale Testing of Interactive Features for Improved Models	Electricore, Inc.	$3,297,555	
4.	DTPH5615T00007, Slow Crack Growth Evaluation of Vintage Polyethylene Pipes	Gas Technology Institute	$995,191	
		TOTALS:	$9,242,128	$431,980

Crack Assessme Software

R&D 100 Award

Significant test data available

U.S. Patent Application

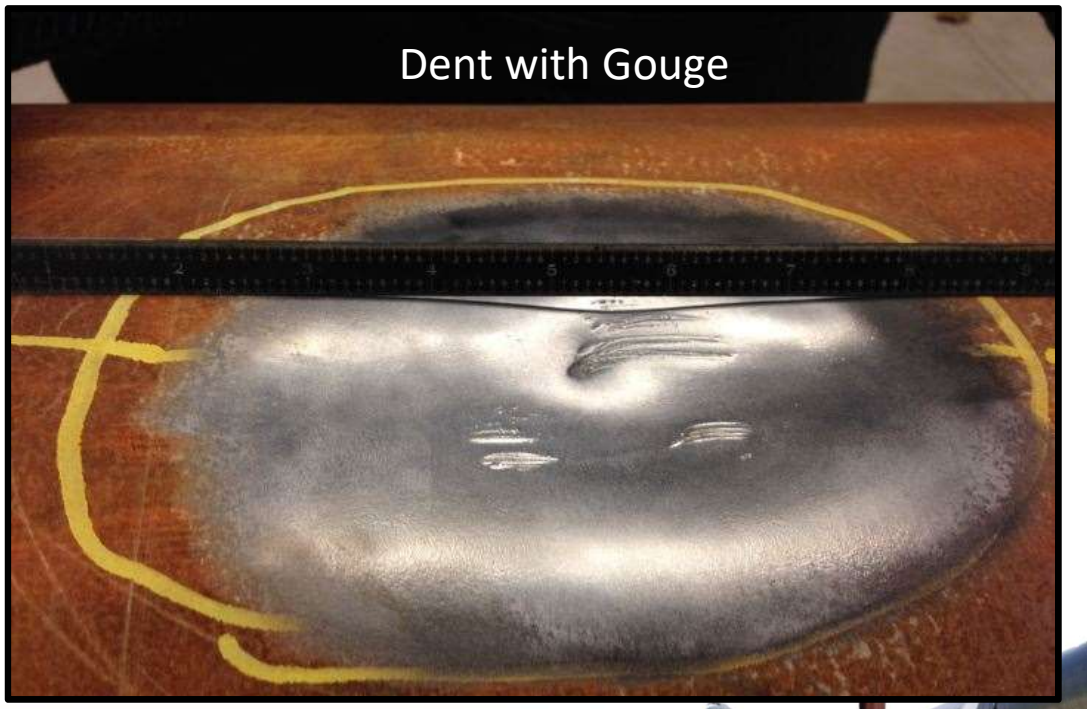
New/Ongoing Research

Improvements to Pipeline Assessment Methods and Models to Reduce Variance

Main Objective: This project will develop, validate, and demonstrate improved assessment methods and models to lower the variance of model outputs when assessing the impact of interactive threats. This project will provide general knowledge, models, and methods pertaining to the assessment of overlapping defects in natural gas pipelines not currently available. The project deliverables will be directly applicable to fitness-for-service standards.

Results: July 31, 2021

PHMSA: $1,619,065



Future Research Needs

- **Research critical strain levels for various dent-related defects to determine maximum dent strain to use-as-is (vs. repair) as a function of pipe grade and material toughness**
  - Plain dents
  - Dents with corrosion metal loss – incidental vs consequential metal loss
  - Dents with damage-induced metal loss (e.g., scrapes, gouges, etc.)
  - Dents with cracks
- **Further develop analytical techniques for critical engineering assessment of dent type defects**
- **Further develop cyclic fatigue analysis techniques to estimate growth of cracks in dents**
- **Develop better operational and maintenance programs to monitor dent fatigue growth**

Thank You!/RD&T Program Contacts

Kenneth Lee
Director – Engineering & Research
Department of Transportation
Pipeline & Hazardous Materials Safety Administration
Office of Pipeline Safety
P(202) 366-2694
Email kenneth.lee@dot.gov

Robert Smith
Department of Transportation
Pipeline & Hazardous Materials Safety Administration
Office of Pipeline Safety
P(919) 238-4759
Email robert.w.smith@dot.gov
LinkedIn https://www.linkedin.com/in/robert-smith-935aa033

Joshua Arnold
Department of Transportation
Pipeline & Hazardous Materials Safety Administration
Office of Pipeline Safety
P(202) 366-6085
Email joshua.arnold@dot.gov

PHMSA RD&T Providing/Supporting: