CIPP Workshop Sponsored by NYSEARCH/Northeast Gas Association

PHMSA Technical and Research Perspectives for Cured-in-Place Liners

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New York City, NY

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Thank You!

- We appreciate the opportunity to share our perspective.
- We've seen a strong policy and research focus toward natural gas distribution pipelines since DIMP and the DOT Secretary's Call to Action following certain gas distribution incidents.
- We recognize that Public/Private partnerships have closed some technical and information gaps.

Post-Mortem Testing of Cast Iron and Steel Pipe Lined with CIP Liners

- David Merte, PE – NYSEARCH/NGA Senior Project Manager – CIPP Project Review
- Thomas O'Rourke – Cornell University
- Harry Stewart, PE – Cornell University
- Anil Netravali, Ph.D. – Cornell University

National Drivers Continue to Place the Focus on Gas Distribution

- DIMP
- US DOT Call to action
- Continued Incidents involving Cast Iron Mains
- Methane Emissions
- PHMSA Research and Development Activities

Distribution IM Impact

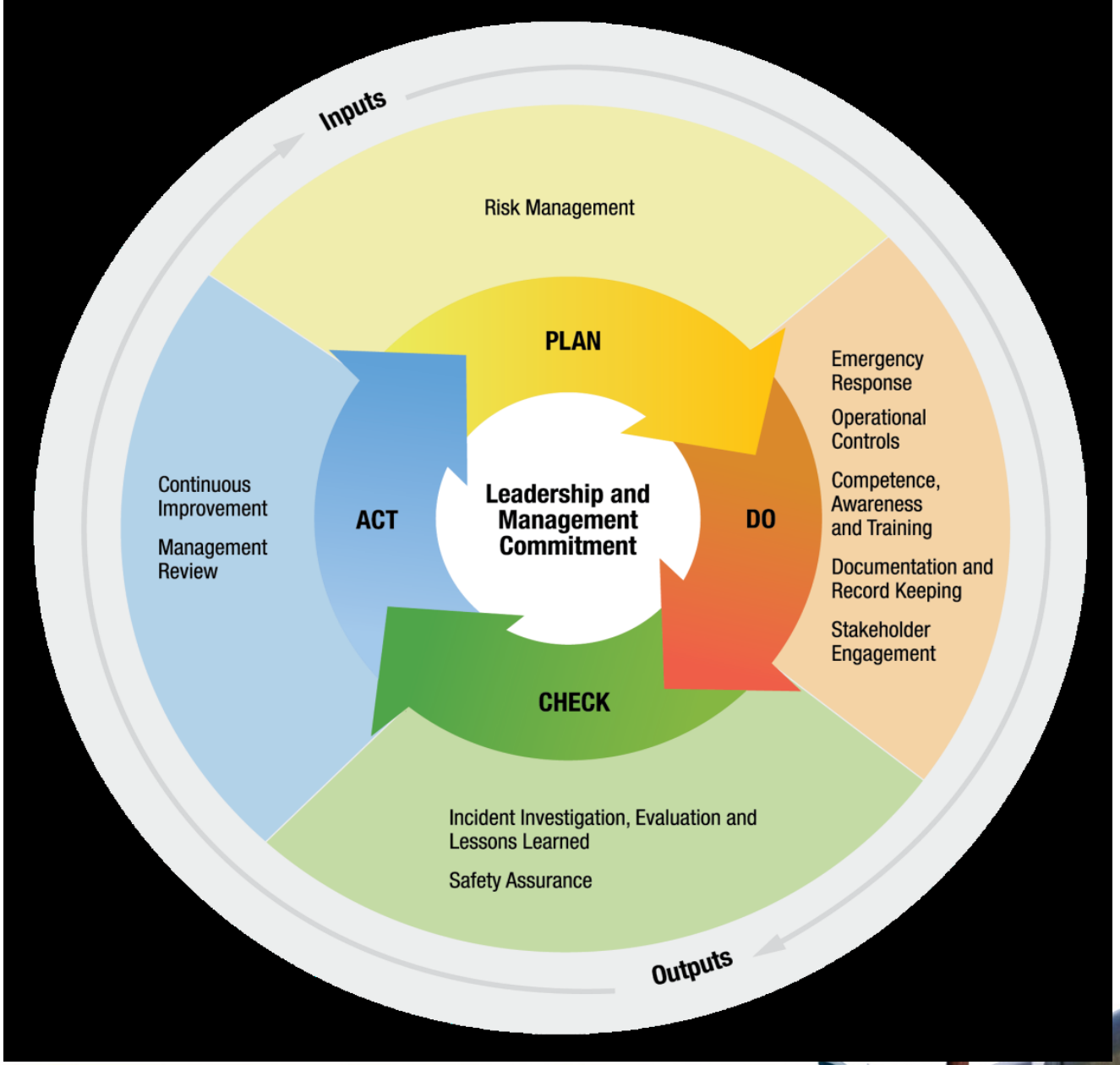
- The regulation requires distribution operators to develop and implement a distribution integrity management program with the following elements:
  - Knowledge
  - Identify Threats
  - Evaluate and Rank Risks
  - Identify and Implement Measures to Address Risks
  - Measure Performance, Monitor Results, and Evaluate Effectiveness
  - Periodically Evaluate and Improve Program
  - Report Results

Identify and Implement Measures to Address Risks

- Increased Leak Survey Frequency
- Replacement of Vintage Materials such as Cast Iron Mains is a Priority, and an acceleration in replacement programs is warranted
- Cured in Place Liners are a risk reduction measure that would lower the risk of leakage and reduce the relative risk of the lined pipeline below similar un-lined pipelines

Plan, Do, Check, Act - The core of SMS in API RP 1173

Continuous Improvement is the Goal



Cured in Place Liners

- “Pros” include reduced risk and ability to focus replacement programs on higher risk pipe and pipes that are more easily replaced
- “Cons” include diversion of resources away from replacement programs to rehabilitate cast iron mains that will eventually be replaced – R&D is trying to address these concerns
- Failures of installed CIP Liners must be understood with root causes identified to ensure process and procedure adjustments are made

Incidents Spur Regulatory Action

- 9/9/ 2010, San Bruno, California –
  - 30-inch-diameter natural gas transmission ruptured in a residential area. The released natural gas ignited, resulting in a fire that destroyed 38 homes and damaged 70. Eight people were killed, many were injured, and many more were evacuated from the area. Suspected cause: Material defect in line pipe.
- 1/19/2011 - Philadelphia, PA –
  - Building Destroyed -1 Fatality; 6 BI – 12” Cast Iron, 17 psig, 1943. Suspected cause: CI main break.
- 1/24/2011 - Fairport Harbor, Ohio –
  - 10 Buildings Destroyed or Damaged – No Injuries - 1-1/4” to 12”, Plastic & Steel, 0.5 psig. Suspected cause: over-pressurization of LP system.
- 2/9/2011 - Allentown, PA –
  - 8 Homes Destroyed - 50 Homes Damaged - 5 Fatalities – 12” Cast Iron, 0.5 psig, 1928. Suspected cause: CI main break.

Recent Incidents under Investigation

- Birmingham, Alabama
  - The explosion destroyed an apartment building in Birmingham's Gate City neighborhood December 17, 2013 was caused by a leak in a natural gas distribution pipe.
  - The cast iron pipe installed in 1951 was about 2 ½ inches in diameter and located underground several feet from the apartment building that exploded.
- East Harlem, New York Accident
  - On March 12, 2014, an explosion involving natural gas destroyed two adjacent buildings located near the intersection of Park Avenue and East 116th Street, in the East Harlem neighborhood of the Borough of Manhattan.
  - Eight people died and more than 48 people were injured as a result of this accident
  - Components: 2-inch High-Density Polyethylene (HDPE) pipe gas service line, 8-inch HDPE, 8-inch Cast Iron (CI) gas distribution main and 12-inch Cast Iron (CI) water main.

US DOT Secretary Call to Action

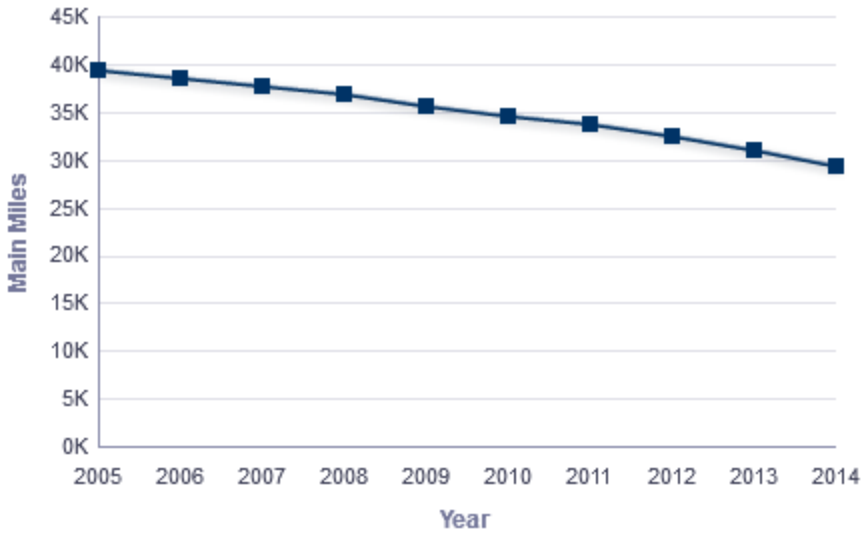
- In March 2011, former Secretary of Transportation Ray LaHood and PHMSA issued a Call to Action to engage all the state pipeline regulatory agencies, technical and subject matter experts, and pipeline operators in accelerating the repair, rehabilitation, and replacement of the highest-risk pipeline infrastructure.

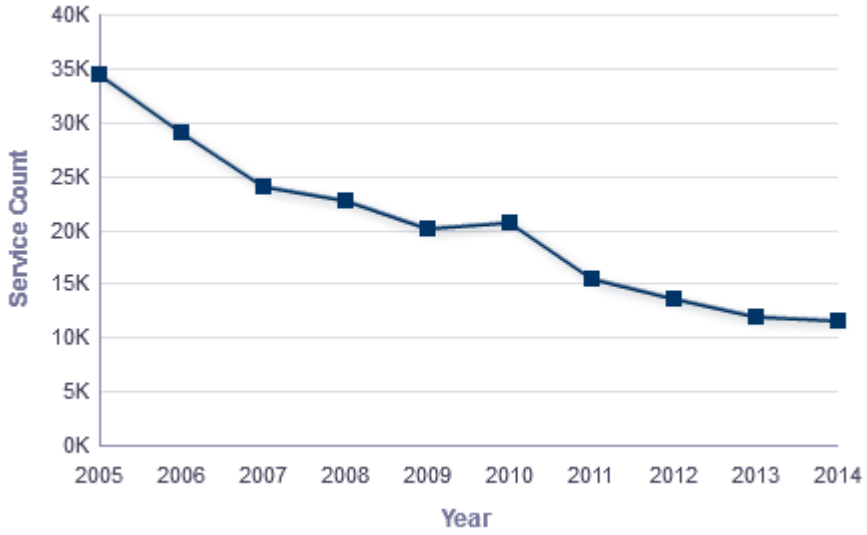
Call to Action Highlights

- Letters requesting for assistance with Cast Iron Replacement to Governors, State Regulators (NAPSR) & Commissioners (NARUC)
- Letters to Industry
- Letters to Technical, Safety, and Environmental Organizations
- Letters to Local and State Organizations
- Letter to Federal Energy Regulatory Commission (FERC)
- White Paper on State Replacement Programs
- Request for State Governors' Assistance with Cast Iron Replacement
- Call to Action - Action Plan

Progress in Modernization

- Gas Distribution Cast/Wrought Iron Main Miles and Service Count Trend
- More progress is needed in accelerating replacements





Progress in Modernization

- Pipeline Miles by Material - Gas Distribution

		2014	
System Type	**Pipe Material**	**Total Miles**	**% of Miles**
MAIN	STEEL	544,520.3	25.1%
	PLASTIC	689,344.1	31.8%
	OTHER MATERIALS	930.2	0.0%
	IRON	29,982.8	1.4%
	COPPER	19.9	0.0%
SERVICES	STEEL	233,335.4	10.8%
	PLASTIC	637,180.1	29.4%
	OTHER MATERIALS	19,750.7	0.9%
	IRON	152.3	0.0%
	COPPER	12,104.6	0.6%
Grand Total		**2,167,320.4**	**100.0%**

Distribution Annual Report Revisions

- Revisions in effect for CY 2015 and beyond reporting
- modifications to align leak causes with the Incident Report
- Other modifications implemented include:
  - Easier data input fields for mileages and services
  - Definition of the type of operator
  - Definition of the commodity transported.
  - New material category [“Reconditioned Cast Iron”] to gather information on the amount of cast iron that has been lined (e.g., cured in place liners).

Distribution Annual Report Revisions

- "Reconditioned Cast Iron" means cast iron gas distribution pipe that has been lined internally by use of suitable materials that ensure safe operation at an MAOP not to exceed the previously established MAOP. "Reconditioned Cast Iron" does not include cast iron pipe inserted with a gas pipe that is, by itself, suitable for gas service under Part 192, e.g., an ASTM D2513 pipe meeting code requirements for the intended gas service. Such insertions shall be reported as the material used in the insertion.
- The intent of the definition is to make a clear distinction between a liner and inserted pipe. An example of "Reconditioned Cast Iron" would be the insertion of a liner inside cast iron pipe where the liner relies on the structural integrity of the cast iron pipe. For details on liner insertion, see ASTM F2207, Standard Specification for Cured-in-Place Pipe Lining System for Rehabilitation of Metallic Gas Pipe. Methods of installation like pipe-splitting or bursting that involve the installation of a new stand-alone pipe while the host pipe is destroyed does not result in "Reconditioned Cast Iron".

Repair of Localized Graphitization

- PHMSA does not consider the insertion of a liner into a host pipe as a new “composite” structure. §192.489(b) allows for cast or ductile iron with localized graphitization to be sealed by internal sealing methods adequate to prevent or arrest any leakage. Operators using liners would still need to operate and maintain the host pipe in the context of Part 192 requirements.

Waivers and Special Permits

- A state waiver or PHMSA special permit is not needed when using non-structural liners to help prevent or arrest any leakage but not hold pressure, as liners are a generally recognized repair technique.
- There may, however, still be long term integrity issues for both the liner and host pipe that an operator would need to consider that may require revisions or additions to construction, operation and maintenance, and/or emergency response plans and procedures.
- The operator would still need to declare the host pipe material on the annual report.

ASTM F2207

- ASTM F2207−06 (Reapproved 2013), titled “Standard Specification for Cured-in-Place Pipe Lining System for Rehabilitation of Metallic Gas Pipe”, covers requirements and methods of testing for materials, dimensions, hydrostatic burst strength, chemical resistance, adhesion strength and tensile strength properties for CIP pipe liners installed into existing metallic gas pipes.
- The CIP pipe liners covered by this specification are intended for use in pipelines transporting natural gas, petroleum fuels (propane-air and propane-butane vapor mixtures), and manufactured and mixed gases, where resistance to gas permeation, ground movement, internal corrosion, leaking joints, pinholes, and chemical attack are required.
- While the word composite is used throughout ASTM F2207−06, through its own definition composite is only the combination of the cured adhesive system, the elastomer skin, and the jacket comprising the liner. Elsewhere in ASTM F2207−06, it considers the host pipe separately from the composite liner system, and a key section on issues to consider is Section 1.2.1 regarding the need for the operator to maintain the structural integrity of the host pipe so that the liner does not become free standing.

Climate Change Impact

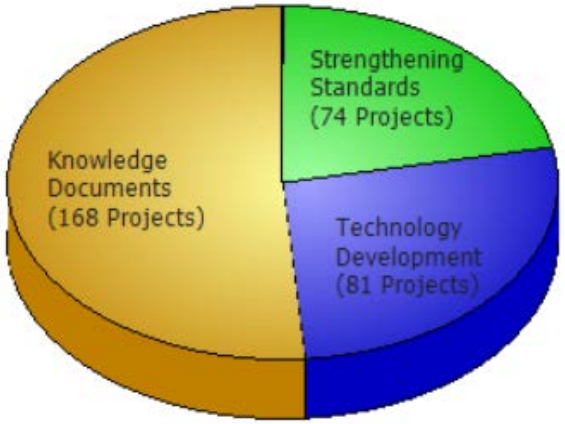
- Growing focus on mitigating fugitive methane
- EPA to potentially regulate LDCs via the Clean Air Act
- Studies by the Environmental Defense Fund illustrate volumes released by LDCs and that replacement/rehabilitation of old pipe breeds rapid/large reductions

CIPP Project Live Demonstration

- Cured-in-Place Liner Installation Demonstration in Mt. Vernon, N.Y. on October 21, 2014
- Starline 2000 product per ASTM 2207 successfully installed in 6” sections of cast iron main
- Curing took place overnight without using UV light or Steam to accelerate curing process

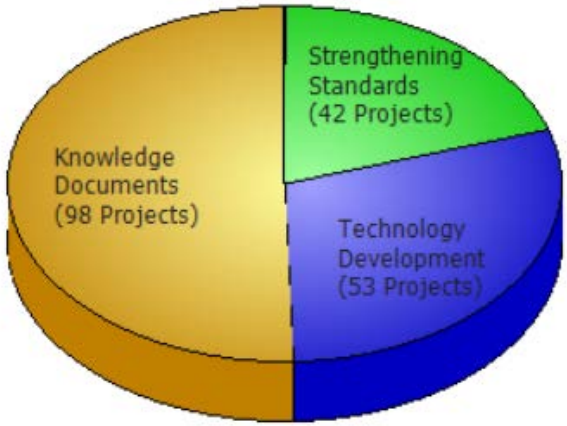
Large R&D Focus on Distribution

Focus:
All Challenges/Pipeline Types



Objective	Projects	PHMSA	Co-Share	Total
Strengthening Standards	74	$28.27M	$23.36M	$51.63M
Technology Development	81	$45.07M	$45.47M	$90.55M
Knowledge Documents	168	$54.76M	$51.98M	106.74M

Focus:
Natural Gas Distribution



Objective	Projects	PHMSA	Co-Share	Total
Strengthening Standards	42	$16.18M	$12.49M	$28.68M
Technology Development	53	$30.50M	$30.15M	$60.65M
Knowledge Documents	98	$31.77M	$24.70M	$56.47M

Focus on distribution since 2002 with bumps in focus after DIMP, DOT Call to Action and Methane reduction drivers. Many projects relevant to more than one pipeline type!

Ongoing Research – Cast Iron

Projects are sortable by threats and material types at: https://primis.phmsa.dot.gov/matrix/

Seq.	Program Category	Project ID and Title	Status	Contractor	PHMSA	Resource Share	Report Release
1.	Anomaly Detection	DTPH56-13-T-000011, Above-ground Detection Tools Including Disbondment and Metal Loss for all Metals Including Cast-Iron Graphitization	Active	Gas Technology Institute	$415,121	$230,709	Feb 2016
2.	Pipe Remediation/ Rehabilitation	DTPH56-13-T-000012, Evaluation of Structural Liners for the Rehabilitation of Liquid and Natural Gas Piping Systems	Active	Operations Technology Development NFP	$425,650	$185,000	Aug 2015
3.	Pipe Remediation/ Rehabilitation	DTPH56-13-T-000013, Technology Transfer, Demonstrations and Post-Mortem Testing of Cast Iron and Steel Pipe Lined with Cured-in-Place Pipe Liners	Active	Northeast Gas Association	$477,571	$253,728	Aug 2015
				Total:	**$1,318,342**	**$669,437**	

What's Next For Cast Iron in Distribution Systems?

New Research to be Awarded!

Solicited Topic	Topic Objective	Notes
Evaluation of Corroded Cast Iron Pipe	Develop/strengthen methodologies to characterize the structural significance of graphitic corrosion in cast iron pipes.	Project Award By Sept 2015
Engineering Critical Assessment of Cured in Place Pipe Liners at Bends, Valves and Service Taps	The project must move beyond investigations of just the liners and investigate liner interaction with the host pipe at bends, valves, service taps and other complex configurations in order to demonstrate liner capability to carry the loads when the host pipe is degraded or such as when the liner is tapped.	No submissions were received for PHMSA's consideration. No award can be made.
Refine/Enhance/Develop Leak Survey Technologies and Methodologies to Quantify Detected Emissions from Relatively Small Volume Rate Leaks to Prioritize a Remedial Action Plan	Develop/enhance technology and methodology to volumetrically quantify non-hazardous or Grade 3 Leaks to enable risk ranking that is congruent to current Green House Gas reporting requirements.	Multiple Project Awards By Sept 2015

Mitigating Fugitive Methane

- PHMSA closely following issues and policy development by others - White House, Congress and Industry Trade Orgs.
- Coordinating with EPA with data sharing, meetings and PHMSA participation at EPA Gas Star Program events
- Coordinating with the Environmental Defense Fund efforts and added EDF representation on PHMSA's congressionally mandated Pipeline Advisory Committee
- Reviewing natural gas regulations to understand leak paths and possible actions germane to our statutory mission
  - However, safety case largely already made in support of hazardous leak reductions
  - Remaining non-hazardous leaks generally economic in nature
    - NARUC, FERC and the Congress

NG Distribution R&D Successes

- The collaborative focus on NG Dist has seen success!
- Improvements:
  - Damage Prevention (2x)
  - Cased Crossing inspection
  - Robotic solutions for unpiggable

R&D Forums – A Good Mechanism

- R&D Forums in 2012 and 2014 are crafting key research for distribution.
  - 2012 https://primis.phmsa.dot.gov/rd/mtg_071812.htm
    - Nine out of 20 projects addressing distribution issues
  - 2014 https://primis.phmsa.dot.gov/rd/mtg_080614.htm
    - TBA - Nine out of 20 projects to be awarded addressing distribution issues
- More distribution representation desired!

Competitive Academic Agreement Program Objectives

1. Spur innovation through enabling an academic research focus on high risk and high pay-off solutions for the many pipeline safety challenges
   - Intended to potentially deliver desired solutions that can be a "hand-off" to further investigations in this or PHMSA's core research program
2. Expose "students" to subject matter common to pipeline safety challenges and illustrating how their engineering or technical discipline is highly desired and needed in the pipeline field

Performance to Date (FY13&FY14)

- Two solicitations issued, 45 Applications, 15 Awards
  - $1.5M PHMSA + $745K Resource Sharing
  - 79 involved students!!!
- Nine student poster papers at Aug 2014 R&D Forum https://primis.phmsa.dot.gov/rd/mtg_080614.htm
  - 1 confirmed internship reported. More anticipated!

Annual Announcement	# Awards	PHMSA	Resource Sharing	# U-Grad Students	# Grad Students	# PhD Students	Total # Students	# Interns (a)	# Career Employed (b)
CAAP-1-13	8	$814K	$353K	21	18	14	53	1	
CAAP-2-14	7	$699K	$391K	4	12	10	26		
Grand Totals:	**15**	**$1,513K**	**$745K**	**25**	**30**	**24**	**79**	**1**	**0**

Footnotes:
(a) Denotes the number of internships offered by engineering firms, research organizations, government agencies or pipeline operators to students involved with CAAP research projects.
(b) Denotes the number of full time career employment/jobs offered by engineering firms, research organizations, government agencies or pipeline operators to students involved with CAAP research projects.

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PHMSA RD&T Providing/Supporting:

THANK YOU FOR YOUR PARTICIPATION!