

# **Government & Industry Pipeline Research and Development (R&D) Forum**



## **Event Summary Report**

**Crowne Plaza Chicago O'Hare  
Rosemont, IL**

**August 6-7, 2014**

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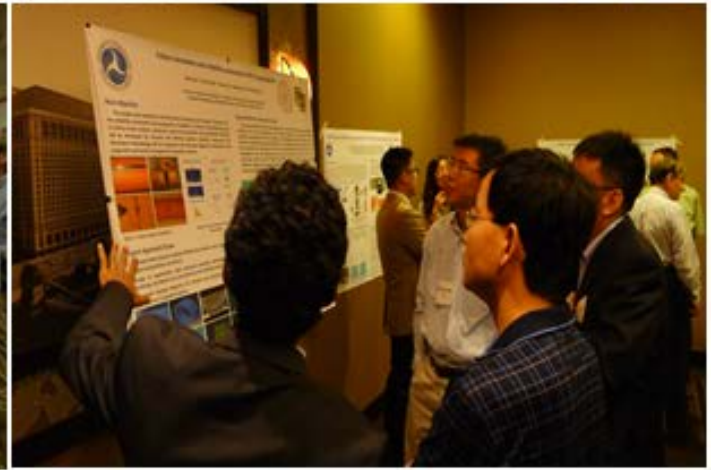
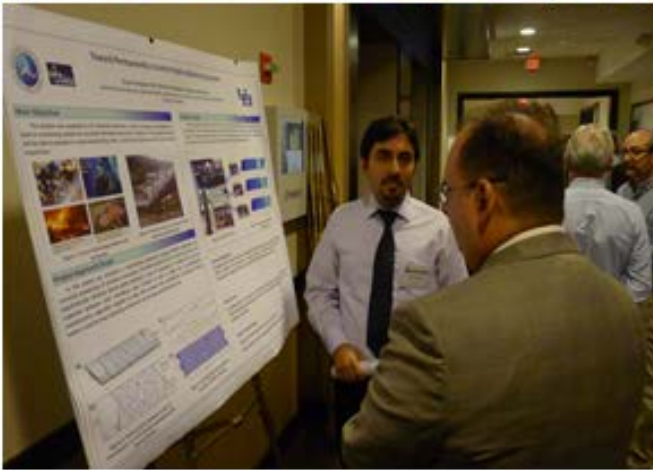
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## Event Forward

The Government/Industry Pipeline Research and Development (R&D) Forum was held in Rosemont, Illinois on August 6-7, 2014. The 2 day event is held periodically to generate a National research agenda that fosters solutions for the many challenges with pipeline safety and with protecting the environment. The forum allows public, government and industry pipeline stakeholders to develop a consensus on the technical gaps and challenges for future research. It also reduces duplication of programs, factors ongoing research efforts, leverages resources and broadens synergies. The national research agenda coming out of these events is aligned with the needs of the pipeline safety mission, makes use of the best available knowledge and expertise, and considers stakeholder perspectives. Specifically the forum:

1. Identifies key pipeline technical challenges facing industry and government;
2. Disseminates information on current research efforts; and
3. Identifies new research that can help to meet known challenges.





**Enhanced Mitigation of Pipeline Biocorrosion Using A Mixture of D-Amino Acids with A Biocide**

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**Main Objective**  
Microbiologically Influenced Corrosion (MIC) is more prevalent in wetland basins of aging infrastructure. Studies on the impacts of MIC on oil and gas pipelines, its effects, environmental threats, and economic approach is highly desired. D-amino acids can trigger surface bioactivity (Bostrom et al., 2010). It has been reported that D-amino acids and D-phenylalanine can enhance biocorrosion of galvanized steel (Zhang, 2010), a major green biocide, against the bioactive surface of surface reducing bacteria (Zhang et al., 2012 and 2015).

A project was awarded to Ohio University to develop a new biocorrosion inhibitor technology (then laboratory tests) for field application for the mitigation of microbial corrosion in pipelines. Experimental tests will evaluate the field D-amino acids as well as additional D-amino acids in combination with TMS to track field pipeline corrosion.

**Results to Date**

1. D-amino, D-phenylalanine, and D-phenylglycine promoted the efficacy of 50 ppm TMS in mitigation of MIC against low concentration of individual D-amino acids such as D-lysine and D-methionine did not promote MIC even in mitigation of high biocide amounts.
2. An Absolute mixture of D-tyrosine, D-methionine, D-glutamine, and D-tyrosine (20:40:40) was tested. It was found that the 20 ppm D-amino acid mixture promoted MIC more in the mitigation of low field pipeline corrosion in both concentration and biocorrosion tests.

**Figure 1. Mitigation of corrosion by 20 ppm TMS with addition of 200 ppm range of D-amino acids being tested with 50 ppm TMS in 40 ppm D-amino acid mixture in 20 ppm TMS and 20 ppm TMS.**

**Figure 2. Mitigation of corrosion by 20 ppm TMS with addition of 200 ppm range of D-amino acids being tested with 50 ppm TMS in 40 ppm D-amino acid mixture in 20 ppm TMS and 20 ppm TMS.**

**Acknowledgments**  
This project is funded by OGI/OT/ET/LE/CS/Engineering/Science Agreement Program.

**References**  
Bostrom, J., Kaurin, S., and S. J. Smith, et al. (2010) D-amino acids trigger biocorrosion. *Corrosion* 66(10): 915-918.  
Zhang, H. H. (2010) A synergistic biocorrosion and biocorrosion inhibitor (BICI) from biocorrosion in the mitigation of pipeline corrosion. *Energy* 35(10): 2800-2808.  
Zhang, H. H. (2012) D-amino acids as a biocorrosion inhibitor against microbial corrosion in pipelines. *Energy* 37(10): 3200-3208.  
Zhang, H. H. (2015) D-amino acids as a biocorrosion inhibitor against microbial corrosion in pipelines. *Energy* 80(1): 100-108.

**Public Project Page:** <http://corros.ohio.edu/graduate/Programs/undergrad>



## **Key Challenges Executive Summary**

The Department of Transportation (DOT) Pipeline and Hazardous Materials Safety Administration (PHMSA) led a steering committee of ten government and industry organizations that organized, planned and executed this forum. The forum brought together approximately 230 representatives from Federal, State and foreign government offices along with domestic and foreign natural gas and hazardous liquid pipeline operators. The forum's goals included identifying key challenges facing industry and government, sharing information on current research efforts, and identifying research that can help meet known challenges.

Within Panel 1 addressing national perspectives on key pipeline challenges, we first heard a perspective from PHMSA that their position as regulator of all pipeline types puts them in a unique position since they have a research program that through engagement with all pipeline stakeholders can manifest solutions. We also heard about PHMSA's perspective on technical needs for future research in crack detection, in addressing legacy materials such as cast iron pipe and with improving leak detection including the need to reduce fugitive methane releases.

The perspective from the National Association of Pipeline Safety Representatives (NAPSR) identified several challenges for distribution piping made of non-metallic materials and cast iron. Some challenges included the ability to detect cracks in plastic pipes and other defects in small diameter piping and the ability to lessen the disruption of street closures during repairs via key-hole technology. We also heard the need for more work on cured in place lines so that they can better aid in the replacement of cast iron pipes and that there are still challenges for cased pipes

Next up was the hazardous liquid pipeline perspective which put a strong focus on improving In-Line Inspection (ILI) technology capabilities to detect and diagnose cracking. In addition to cracking, we also heard that improved ILI detection of defects in Electric Resistance Welded pipe seams, more technology to find small leaks, better methods to prevent damage to pipes and improved mechanical damage assessment is hoped for future research.

The perspective from the natural gas transmission pipelines noted that advances in ILI technology are occurring through research however gaps remain. One area of focus was on improving ILI tool(s) capable of meeting performance specification for detecting and characterizing target



defects/properties for girth welds and the long seam. We also heard that improvements to In-the-ditch Non Destructive Testing tools and techniques are needed to better assess condition, that defect modeling/assessment tools and techniques must do better to assess remaining strength and that the overall process validation and protocols/standard should be developed that systematically addresses integrity questions from the inspection data. Finally, we heard a strong focus was needed in reducing fugitive methane along the transmission infrastructure.

The perspective from the natural gas distribution pipelines noted some similarities to the transmission pipelines such as with reducing emissions from fugitive methane. It also noted the need for cost effective replacement technologies such as for live insertions of plastic distribution pipelines, split and pull technology and for in-place pipe rehabilitation. We heard about a strong focus needed for damage prevention via improved maps, records, line locating accuracy and look ahead technology for trenchless installations. Key needs within this area were noted as the ability to detect before the damage occurs, detect when the damage occurs to capture real-time situational assessment after the damage occurs and for the development of emergency response tools, techniques and systems.

All presentation material from the forum is available for download from the following webpage:  
[https://primis.phmsa.dot.gov/rd/mtg\\_080614.htm](https://primis.phmsa.dot.gov/rd/mtg_080614.htm) .

## Introduction

Approximately 230 people attended the Government/Industry Pipeline R&D Forum held in Rosemont, Illinois on August 6-7, 2014. The 2 day event is held periodically to generate a National research agenda that fosters solutions for the many challenges with pipeline safety and with protecting the environment. The forum allows public, government and industry pipeline stakeholders to develop a consensus on the technical gaps and challenges for future research. It also reduces duplication of programs, factors ongoing research efforts, leverages resources and broadens synergies. The national research agenda coming out of these events is aligned with the needs of the pipeline safety mission, makes use of the best available knowledge and expertise, and considers stakeholder perspectives.

The forum was structured so attendees would hear national perspectives on key challenges from federal and state regulators and the entire pipeline industry. The forum factored other panel discussions about current industry research roadmaps and the challenges with transferring solutions into the marketplace. Finally the forum provided public roadmapping sessions in the following five subject working groups:

1. Damage Prevention
2. Leak Detection/Fugitive Methane
3. Anomaly Detection/Characterization
4. Improving Risk Models
5. Addressing Legacy Materials Challenges

These five groups were charged with developing a consensus agenda of technical gaps and challenges for future research that does not duplicate existing efforts. The output must identify both short and long term research objectives for hazardous liquid/natural gas and transmission and distribution pipelines. Basic roadmapping was conducted on identified technical gaps so identified research is addressing the need effectively. Details were then provided of the ultimate research goals so appropriate end users are factored into project scopes.

The forum was successful in identifying key pipeline technical challenges facing industry and government and disseminating information on current research efforts. It also did well in identifying new research that can help meet known challenges. See the working groups 1-5 report out file posted on the below webpage for much more information.

All presentation material from the forum is available for download from the following webpage:  
[https://primis.phmsa.dot.gov/rd/mtg\\_080614.htm](https://primis.phmsa.dot.gov/rd/mtg_080614.htm) .

## Competitive Academic Agreement Program

After Panel 1 on National Perspectives on Key Challenges, PHMSA presented an overview of its new basic research program with universities entitled the “Competitive Academic Agreement Program” (CAAP) launched in CY 2013. The CAAP is intended to spur innovation through enabling an academic research focus on high risk and high pay-off solutions for wide ranging pipeline safety challenges. The CAAP is different in focus, execution and reporting than PHMSA’s core program on Pipeline Safety Research. It is intended to potentially deliver desired solutions that can be a “handed-off” to further investigations in CAAP or in PHMSA’s core research program that employs partnerships with a variety of public/private organizations. One goal in this strategy would be to validate proof of concept of a thesis or theory potentially all the way to commercial penetration into the market.

Another goal for CAAP is to expose undergraduate, graduate and PhD research students to subject matter common to pipeline safety challenges for illustrating how their engineering or technical discipline is highly desired and needed in the pipeline field. The pipeline industry and federal/state regulators are all experiencing low numbers of entry level applications to positions that are engineering or technically focused. Public conferences, meetings and journals have identified similar shortfalls.

PHMSA presented that this new program is beginning to achieve its goals by involving 28 students total into the execution of the CAAP award work scopes from the 8 awards made last year. These projects are addressing a wide variety of pipeline challenges including those for corrosion or preventing damage to pipelines.

### CAAP Summary Totals

Annual Announcement	# Awards	PHMSA	Resource Sharing	# U-Grad Students	# Grad Students	# PhD Students	Total # Students
CAAP-1-13	8	\$ 792K	\$ 353K	5	14	9	28
<b>Grand Totals:</b>	<b>8</b>	<b>\$ 792K</b>	<b>\$ 353K</b>	<b>5</b>	<b>14</b>	<b>9</b>	<b>28</b>

Each project was given an opportunity for the principle investigator to summarize the work scope and objects and more importantly, introduce the student brought to the forum.

The forum then had a student poster paper session where the entire forum audience could meet the students and hear about the various technical aspects with their research project. Much more information on this program is available from the below website:

<https://primis.phmsa.dot.gov/rd/universitypartners.htm>



## **Panel 2 Current Industry Research Roadmaps**

Research roadmaps are plans that match short-term and long-term goals with the specific technical solutions needed to help meet those goals. In general research roadmaps have three major uses. They help convey a consensus about a set of technical needs or gaps and the solutions required to satisfy those needs; they provide a mechanism to help forecast technology developments; and they provide a framework to help plan and coordinate technology developments both in time and resources. The organizations participating on this panel are three different private pipeline research funding organizations. Each organization roadmap is at varying levels of completeness, is considered a living document and is revised as needed. Each organization has different member company interests and may not focus on the same pipeline types or challenges. These differences drive a more or less focus on technology development, materials testing and impact on standards developing organizations.

The active research dove tailed nicely into the core research gap areas identified by Panel 1. Agreeably still, much more work is needed beyond what was presented. In general, each organization agreed that...

- Leveraged funding is critical in providing adequate funding to achieve desired outcomes for all roadmap focus areas
- Stakeholder based consensus on priorities – topic, sector and or regionally based
- Assurance of a rigorous process; Peer Review
- Managing deployment and transfer of technology with info sharing – Products, Standards, Best Practices, Rules
- Achieving transparency with better & wider communication of progress and impact
- Provide faster returns through research planning
- Develop and maintain partnerships with key industry groups & government agencies

Please find the specific roadmap areas within each presentation file posted on the PHMSA research program webpage at [https://primis.phmsa.dot.gov/rd/mtg\\_071812.htm](https://primis.phmsa.dot.gov/rd/mtg_071812.htm).

## **Five Focused Working Groups**

The working groups each addressed focused areas for research roadmapping. Some subject overlap is possible but was kept to a minimum. These groups were charged with three phases of operation in order to generate the desired output.

Phase 1 sets the stage and identifies the challenges for the working group subject matter via an appropriate number of short presentations and group discussion. This period of time is also used to identify the top priorities for new research and begins to review if any ongoing work will address the specifics of each challenge.

Phase 2 can continue Phase 1 activities but quickly transitions to road mapping the identified priorities. As part of the charge for this phase the specifics to the desired output from the research priorities will be determined including the output type. For instance, is the gap best

addressed by a technology, an improvement to a consensus standard or a paper study to gather more information or create a new process with some goal? Gathered details are critical here for soliciting for good research projects.

Phase 3 can continue Phase 2 activities but quickly transitions to populating a provided template output presentation using audience participation. The template categories coincide with the data that the working group is gathering.

A PHMSA facilitator was assigned to each group to assist the working group leaders in executing these three phases and in capturing the necessary details that were reported out. The scope of and top gaps defined by each working group are provided below.

### WG#1 - Damage Prevention

**Leaders:** Rex George Cullen, Jr. Field Services Mgr., Customer Services, Southern California Gas Company & François Rongere, R&D and Innovation Manager - Gas Operations, PG&E

**PHMSA Rep:** Jim Merritt, R&D Program Manager

Audience participants in this group discussed the following areas: excavation damage/pipeline locating/ROW monitoring/protecting or adapting pipelines to the potential impacts of climate change.

The group identified five gaps for future research depicted below. More details on the presentations given within the group and the identified gaps are available for download in the working group report-out file on the PHMSA research program webpage for this forum.

**Gap #1 – Need (pro-active) system-defense of new and existing pipelines** (Technology)

**Gap #2 – Intrinsically locatable plastic materials (New and replacement)\***(Technology)

**Gap #3 – Horizontal Directional Drilling and other excavation tools with look-ahead technology to detect and avoid subterranean conflicts** (Technology)

**GAP#4 – Analysis of damage (Ex: DIRT/CGA database) big data (semantics, analytics and filtering) to develop a detailed risk model (Excavators, areas or equipment)** (Knowledge/Model)

**GAP #5 – GPS-based damage defense system installed on excavating tools to detect ROW encroachment** (Technology)

\* Means topic suggested for university investigation

### WG#2 – Leak Detection/Fugitive Methane

**Leaders:** David Burnett, Engineering Manager, CenterPoint & Paul Armstrong, Director, Gas Technology Institute

**PHMSA Rep:** Max Kieba, Engineer

Audience participants in this group discussed the following areas: leak detection technology development for all pipeline types from any deployment platform and Understanding capabilities

and limitations. A strong focus was also inserted into the agenda for addressing the fugitive methane challenge.

The group identified four gaps for future research depicted below. More details on the presentations given within the group and the identified gaps are available for download in the working group report-out file on the PHMSA research program webpage for this forum.

**Gap #1 – Establish verification and validation framework for assessing the viability and performance of new gas/liquid leak detection and quantification technologies and methodologies.** (Technology/Knowledge)

**Gap #2 – Conduct field validation studies to verify gas/liquid leak detection and quantification technologies and methodologies.** (Technology/Knowledge)

**Gap #2 – Refine/enhance/develop leak survey technologies and methodologies to quantify detected emissions from non-hazardous leaks to prioritize for remedial action.**

(Technology/Knowledge)

**Gap #3 – Develop a “Decision Support System” that integrates leak detection, quantification and integrity related data to enable predictive response.** (Technology/Knowledge)

**Gap #4 – Residential Methane Detectors – Expand upon existing efforts** (Technology)

### WG#3 – Anomaly Detection/Characterization

**Leaders:** Mark Piazza, Manager, Integrity Programs, Colonial Pipeline & Craig Sisco, Director, Engineering & Project Support Staff, Southwest Gas Corporation

**PHMSA Rep:** Joshua Johnson, Materials Engineer

Audience participants in this group discussed the following areas: solutions for inside or outside (through coating) the pipe technology to better detect, size and shape anomalies/Burst testing to improve remaining strength calculations/difficult to inspect pipelines (i.e. unpiggable). Cast Iron will be discussed in WG#5.

The group identified 5 gaps for future research depicted below. More details on the presentations given within the group and the identified gaps are available for download in the working group report-out file on the PHMSA research program webpage for this forum.

**Gap #1 – Non-destructive methods for Determining Material properties** (Technology/Consensus Standard/General Knowledge)

**Gap #2 – Improve ILI technology for coincident and challenging features** (Technology)

**Gap #3 – Improve NDE performance/reliability through reducing human effects on NDE measurement systems** (Technology/General Knowledge)

**Gap#4 – Develop/Enhance Inspection Technology for small diameter (2”-8”) and Difficult to Inspect pipelines** (Technology)

**Gap #5 – Develop Comprehensive Pressure Test Design Guidelines** (Consensus Standard/General Knowledge)

## WG#4 – Improving Risk Models

**Leaders:** Oliver Moghissi, Vice President, Technology, DNV GL North America Oil & Gas & Chris Foley, Sr. Pipeline Risk Engineer, Phillips 66 Pipeline LLC

**PHMSA Rep:** Robert Smith, R&D Manager

Audience participants in this group discussed the following areas: how models need to evolve from relatively coarse “index” type of risk models used to rank line pipe segment baseline assessment scheduling priority to more investigative-oriented approaches/ models. In addition topics generated from this group aid in the development of meaningful methods to evaluate risk from non-line pipe facilities and address ways to facilitate the analytical use of risk approach/model results.

The group identified four actions as depicted below. More details on the presentations given within the group and the identified gaps are available for download in the working group report-out file on the PHMSA research program webpage for this forum.

**Gap #1 – PHMSA/NAPSR to hold Risk Management Workshop(s)** (Knowledge)

**Gap #2 – Paper study on a Critical Review of Candidate Models** (Knowledge)

**Gap #3 – Paper study on Review of Current Approaches for Preventing Catastrophic Events** (Knowledge)

**Gap #4 – Paper study on Risk Tolerance** (Knowledge)

## WG#5 – Addressing Legacy Materials Challenges

**Leaders:** Dawn Neely, Manager – Field Operations South District, Integrys-People’s Gas & Brian Leis, President, B N Leis, Consultant, Inc.

**PHMSA Rep:** Steve Nanney, Senior Engineer

Audience participants in this group discussed the following areas: technology solutions and identify integrity issues with cast iron, develop methodologies to prioritize cast iron replacement programs and further identify areas of investigation for using cured in place liners. It will also focus on solutions for mitigating the integrity challenges of manufacturer defects such as ones in pipeline seam welds and address solutions for the challenges that an aging infrastructure may bring.

The group identified six gaps for future research depicted below. More details on the presentations given within the group and the identified gaps are available for download in the working group report-out file on the PHMSA research program webpage for this forum.

**Gap #1 – Develop inspection tools to quantify strength and toughness to improve integrity management process** (Technology)

**Gap #2 – Develop operational guidelines/standards for usage (taking into account limitations) of ILI and pressure testing: based upon MAOP/MOP and an operating safety factor, for defect**

**types, dimensions, inspection parameters, material properties, anomaly dimensions, failure modes, fatigue models, validation(unity plot), and re-assessment intervals, etc. (Consensus Standard)**

**Gap #3 – In-the-ditch tools – qualification standards and training for NDE including strength & defect specific training and seam type (Consensus Standard/General Knowledge)**

**Gap #4 – Evaluation of Cast Iron Pipe (Technology)**

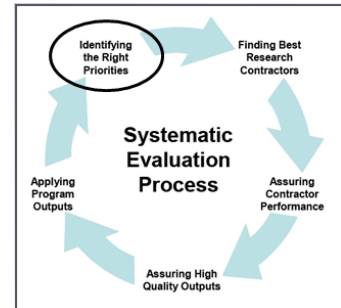
**Gap #5 – Vintage PE – such as Aldyl A – standards for direct evaluations, slow crack growth evaluation, FFS, FEM, pressure tests for replacement prioritization (Technology/Consensus Standard)**

**Gap #6 – Composite Pipe and Liners – develop & standardize (Technology/Consensus Standard)**

Please see the report out file for each working group for much more details on these topics. Please also see the asterisk (\*) that may be tagged to some of the main gaps and to some additional gaps if noted. These are suggested for university investigation and will be used by PHMSA as possible topics for the annual CAAP solicitations.

## Next Steps

The forum is Step 1 in PHMSA's process for successful research outcomes. It should be noted that identifying the right priorities in this manner is a form of peer review prior to soliciting for new research. Stakeholder driven consensus on what topics to solicit is key in leveraging resources, existing efforts and for removing duplication. PHMSA will now review the findings from the forum in preparation of its next research solicitation. The details illustrated in the working group report out files will drive the development of synergies necessary for comprehensive proposals and ultimately good research projects that align with the current needs for pipeline safety. When ready the solicitation will be posted at <https://www.fbo.gov/> with additional requirements posted therein.



## Acknowledgments

The forum would not be possible without the volunteered time and efforts coming from the steering committee. The representation coming from these organizations were instrumental in searching and securing speakers and working group leaders. Both PHMSA and NAPSR are grateful for this effort and comprehensive recommendations for the forum.

American Gas Association

American Petroleum Institute

American Public Gas Association

Department of Commerce National Institute of Standards and Technology

Department of Transportation Pipeline and Hazardous Materials Safety Administration

Interstate Natural Gas Association of America

National Association of Pipeline Safety Representatives

Northeast Gas Association/NYSEARCH

Operations Technology Development

Pipeline Research Council International