Government and Industry Pipeline R&D Forum Report

Crystal City, Virginia
June 24-25, 2009

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Executive Summary

Nine government and industry organizations via a steering committee organized, planned and executed this forum. The forum brought together approximately 215 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 to meet the challenges.

We heard a perspective on energy pipelines from the Department of Transportation (DOT) Pipeline and Hazardous Materials Safety Administration (PHMSA) which reminded the audience that progress was made toward safety and integrity in some areas but new challenges seen from the recent pipeline construction boom is raising old questions about welding and materials. This presentation highlighted other new challenges with alternative fuels and climate change and praised the audience for the continued coordination, collaboration and co-funding in research as a true bright spot and constituted those attributes as hallmarks of a plan necessary to remove these challenges.

We were reminded that desired impacts are occurring in technology development, in the strengthening of industry consensus standards and the generation and promotion of new knowledge to decision makers since the passage of the Pipeline Safety Improvement Act of 2002. Positive change is occurring through each organization funding research but in many cased is not measured. The DOT/PHMSA program presented how the coordination, collaboration and co-funding in research since 2002 is impacting the industry and how they are measuring these impacts.

The forum was successful in identifying key challenges facing industry and government. Many high level or overall challenges were noted. These were just some of the identified challenges presented by government and industry leaders:

- Predicting the future performance of non-metallic distribution pipeline materials
- Monitoring the impact of environmental conditions on cast iron pipes
- Understanding the integrity impact on pipes from deepwater installations
- Repairing deepwater systems and understanding impacts from hurricanes and mudslides
- Deepwater pipeline flow assurance and mitigation of hydrate plugs
- Integrity management of steel catenary risers
- Safely transporting biofuels in new and current systems
- Managing seam weld anomalies
- External corrosion, particularly stress corrosion cracking in gas transmission systems
- Reliability-based integrity management
- Excavation damage prevention and finding more efficient monitoring of right of ways
- Greenhouse gas emission mitigation from compressors/pumps and fugitive sources
- Volatile gas prices and the impact on addressing threat prevention/integrity management
- New construction and difficulties in obtaining authorizations and permits
- The impact from the aging workforce and inexperienced new staff
- Managing environmental impacts on systems from climate change or global warming
- Understanding how economic downturns and the “credit crunch” affect pipeline operations
- The impact of new regulations, including distribution integrity management and State oversight of integrity management
- Plastic pipe joining integrity beyond visible means

Later that morning we heard that our efforts through research are paying off with four presentations documenting how difficult it is to commercialize technology, how research is impacting consensus standards and about two technologies which were under research are now commercially available to pipeline operators.

Finally we heard about the charge for the audience and goals of the six focused Technical Track Sessions. These track sessions were to develop a consensus agenda of technical gaps & challenges for future R&D. In doing that they needed to identify both short and long term research objectives for liquid/gas transmission and distribution pipelines. During the track sessions, basic road mapping was conducted on identified technical gaps so that any identified research addresses the need effectively. Finally

details of the ultimate research goals were to be provided so appropriate end users can be factored into project scopes. The six Technical Track Sessions were:

1. Threat Prevention
2. Leak Detection
3. Anomaly Detection/Characterization
4. Anomaly Remediation/Repair
5. Pipelining in Challenging Areas
6. Alternative Fuels/Climate Change

The final forum agenda is found in Appendix A.

Backgrounds for these Technical Track Sessions are found in Appendix B.

The Technical Track Session Report-Outs are found in Appendix C. The report-outs will be used to craft the next research solicitation by DOT/PHMSA. The report-outs reflect the current consensus technical needs for addressing our mutually identified challenges.

All presentation files from the forum are available at:
http://primis.phmsa.dot.gov/rd/mtg_062409.htm

Background

Forum Objectives, Approach, Organization and Sponsorship

What was the forum designed to achieve?

Our nation, and indeed the world, is strongly dependent on pipelines to deliver the energy needed to sustain economic well being and to promote economic growth. As the current pipeline infrastructure continues to age and as increasing energy demand necessitates new pipelines, we must redouble our efforts to assure pipeline safety, integrity and reliability. Research and development represents a critical component in increasing that level of assurance.

The objective of the forum was to facilitate government and industry pipeline stakeholders to develop a consensus on the technical gaps & challenges for future R&D. It addressed both short and long term research objectives for liquid and gas and transmission and distribution pipelines, covering onshore, offshore and Arctic environments. In addition, details of the ultimate research goals, technology demonstrations, and transfer and commercialization were discussed.

How did the forum approach assist attainment of its objectives?

To achieve its objectives, the forum was structured to explore the challenges facing the pipeline industry, to share information on recently completed and ongoing activity to address these challenges, and to identify potential gaps and overlaps in the set of projects currently underway or in planning. The result was intended to be an information resource to help the various sponsors of research and development in defining their priorities and in selecting related projects by developing a clearer picture of the ongoing and planned efforts of other sponsors. In addition, new discussions were factored in to the agenda showing how the research partnership is impacting our mutual challenges with new technology on the market and strengthened more relevant consensus standards.

How was the forum organized?

To design and host a successful forum, a diverse steering committee was formed with representation from many government and industry stakeholders. This provided equal representation and stakeholder involvement of critical technical topics and implemented the forum objective. The steering committee had representation from the following organizations:

1. American Gas Association
2. American Petroleum Institute
3. Interstate Natural Gas Association of America
4. National Association of Pipeline Safety Representatives
5. National Institute of Standards and Technology
6. Northeast Gas Association/NYSEARCH

7. Operations Technology Development
8. Pipeline and Hazardous Materials Safety Administration
9. Pipeline Research Council International

How was the forum sponsored?

The Department of Transportation, Pipeline & Hazardous Materials Safety Administration provided the administrative funding to hold the forum.

Breaks were graciously sponsored by the following organizations:

1. American Gas Association
2. American Petroleum Institute
3. American Public Gas Association
4. Gas Technology Institute
5. NYSEARCH/Northeast Gas Association
6. Operations Technology Development
7. Pipeline Research Council International

These breaks provided ample opportunities to discuss topics identified from the agenda, network on various other issues and a time to refresh before re-entering the forum.

Follow up Actions

These forums are not intended as annual events. New research projects generated from these forums must be solicited, reviewed by a merit review panel comprised of industry and government representatives, awarded and then given some period of time to begin executing their scopes in order to understand if they are addressing the needs as desired.

It is time to hold the next forum once those items are executed. The forum steering committee is formed and coordinated by DOT/PHMSA and we are well on our way to organizing the next forum.

The forum output is intended to be an information resource for organizations funding pipeline research. It helps in defining their priorities and in selecting complementary projects as it provides a clearer picture of the ongoing and planned efforts is known.

DOT/PHMSA will best use the topics generated and recommended at the forum to craft its next research solicitation. Only topics most relevant to DOT/PHMSA's mission will be utilized in future solicitations.

All presentation files from the forum are available at:
http://primis.phmsa.dot.gov/rd/mtg_062409.htm

Register for notification of DOT/PHMSA research solicitations at: https://www.fbo.gov/

Appendices

Appendix A

Final Forum Agenda

Day 1, June 24, 2009			
7:00 AM	**Registration**		
8:00 AM	**Welcome/Opening Remarks – Forum Moderator**		
8:05 AM	**Perspective on Energy Pipelines**		
	Jeff Wiese	Associate Administrator	DOT/PHMSA
8:15 AM	**IMPACT: Collaboration, Coordination, Competitive Review and Co-Funding Since 2002**		
	Robert Smith	R&D Manager	DOT/PHMSA
8:30 AM	**Key Challenges Facing Government & Industry**		
Pipeline Safety State Partners	Tom Stemrich	Pipeline Safety Program Manager	NAPSR - Wisconsin Public Service Commission
Offshore Pipelines	Elmer P. Danenberger III	Chief, Offshore Regulatory Programs	Department of the Interior, Minerals Management Service
Liquid Trans.	Kevin Bodenhamer	Vice President, Technical Services	EPCO, Inc.
Gas Trans.	David Chittick	Director of Pipeline Integrity	TransCanada Pipelines Ltd.
Gas Dist. Private	Susan Fleck	Vice President, Engineering Standards and Policy	National Grid
Gas Dist. Public	John Leary	Gas Superintendent	Chambersburg Utilities
9:50 AM	**Break**		
10:10 AM	**Research Success Stories and Challenges**		
	Opportunities and Challenges of Transferring Successful R&D Products		
Speaker 1	Daphne D'Zurko	Executive Director	NYSEARCH/Northeast Gas Association
	Research is Impacting Consensus Standards!		
Speaker 2	Linda Goldberg	Director, Technical Activities	NACE International
	Polyethylene Pipe Non-Destructive Testing – How do you Define Success?		
Speaker 3	George Ragula	Distribution Technology Manager	PSE&G
	New Technology: Cathodic Protection and Current Mapping In-line Inspection Tool		
Speaker 4	Jeff Whitworth		Shell Oil Products US
11:25 AM	**Direction on Track Sessions – Forum Moderator**		
11:30 AM	**Lunch (on your own)**		
1:00 PM	**Technical Track Sessions (Phase 1)**		
1.	**Threat Prevention**		
Leaders	Joe Vitelli	Principal Engineer	National Grid
	Louis Panzer	President	Locate Support Systems LLC.
2.	**Leak Detection**		
Leaders	Mark Piazza	Program Manager	Pipeline Research Council International
	James Merritt	R&D Program Manager	DOT/PHMSA
3.	**Anomaly Detection/Characterization**		

Leaders	Daphne D'Zurko	Executive Director	NYSEARCH/Northeast Gas Association
	Craig Swiech	Superintendent, Operations	National Fuel
4.	**Anomaly Remediation/Repair**		
Leaders	Dave Johnson	Technical Consultant	Panhandle Energy
	Satish Kulkarni	Consulting Engineer	El Paso Corp.
5.	**Pipelining in Challenging Areas**		
Leaders	Joe Zhou	Engineering and Technology Leader	TransCanada Pipelines Ltd.
	John O'Brien	Upstream NDE Expert	Chevron ETC
6.	**Alternative Fuels/Climate Change**		
Leaders	Jake Haase	Integrity Management Program Engineer	Colonial Pipeline Company
	Bob Wilson	Director, Materials and Standards	National Grid
5:00 PM	**Day 1 Adjourn**		

Day 2, June 25, 2009			
9:00 AM	**Technical Track Sessions (Phase 2)**		
1.	Threat Prevention		
2.	Leak Detection		
3.	Anomaly Detection/Characterization		
4.	Anomaly Remediation/Repair		
5.	Pipelining in Challenging Areas		
6.	Alternative Fuels/Climate Change		
12:00 PM	**Lunch (on your own)**		
1:00 PM	**Technical Track Sessions (Phase 3)**		
1.	Threat Prevention		
2.	Leak Detection		
3.	Anomaly Detection/Characterization		
4.	Anomaly Remediation/Repair		
5.	Pipelining in Challenging Areas		
6.	Alternative Fuels/Climate Change		
3:00 PM	**Break**		
3:15 PM	**Session Leader Report-Outs**		
	1. Threat Prevention 2. Leak Detection 3. Anomaly Detection/Characterization 4. Anomaly Remediation/Repair 5. Pipelining in Challenging Areas 6. Alternative Fuels/Climate Change		
4:15 PM	**Final Remarks/Next Steps**		
	Jeff Wiese	Associate Administrator	DOT/PHMSA
4:30 PM	**Day 2 Adjourn**		

Appendix B

Background on the Technical Track Sessions

Each Technical Track Session should anticipate presentation and discussion within the subject areas shown and their impacts on all relevant pipeline types during the forum.

1. Threat Prevention

Preventing damage via underground, above ground, airborne and satellite based systems; risk assessments; and prevention of excavation damage through improved design, materials or process.

2. Leak Detection

Detecting leaks via underground, above ground, and/or airborne systems.

3. Anomaly Detection/Characterization

Detecting anomalies in metallic/non-metallic line pipe or from the welding/joining process. Detection is possible from either the pipe's interior or exterior. Characterizing or screening the severity of anomalies found in line pipe or in welds.

4. Anomaly Remediation/Repair

Remediating anomalies requiring immediate action, to include the use of composites. The processes for and apparatus used with repairing pipes are included.

5. Pipelining in Challenging Areas

Looking at Arctic, offshore or other areas where the design, materials selection, installation and operation of pipelines are significantly challenged. This includes any areas where geotechnical, ice mechanics or wind/water currents challenge long-term integrity.

6. Alternative Fuels/Climate Change

Looking at new economic, integrity or quality challenges seen from ethanol, biodiesel, biogas or hydrogen transportation in pipelines, and the impact on climate change from all aspects of pipelining.

Track Session Phases 1, 2 & 3

Technical Track Session Objectives (High Level):

To develop a consensus agenda of technical gaps & challenges for future R&D. Identify both short and long term research objectives for liquid/gas transmission and distribution pipelines. Conduct basic road mapping on identified technical gaps so identified research are addressing the need effectively. Provide details of the ultimate research goals so appropriate end users are factored into project scopes.

Wednesday, June 24, 2009 (1:00 PM – 5:00 PM) Technical Track Session (Phase I):

Convey session objectives to audience. Identify/clarify any related high level gaps or challenges presented from the morning session. Review existing research efforts via invited presentations or discussions. Eliminate any challenges due to existing research efforts and identify remaining challenges requiring new research projects.

Thursday, June 25, 2009 (9:00 AM – 12:00 PM) Technical Track Session (Phase II):

Restate the list of remaining challenges identified during Phase I session. Identify the top three challenges, identifying if they address technology development, consensus standards strengthening or general knowledge. Identify if the challenge is short term (1-5 years) or long term (more than 5 years) in nature. Identify the impacted pipeline type (identify all that apply: liquid transmission, gas transmission, gas distribution metallic, gas distribution non-metallic) and operation area (identify all that apply: offshore or onshore).

Road Mapping Guidance: Categorize at least the top three remaining gaps and challenges into one of these areas and work out the following details:

1. New or Improved Technology
a. What pipeline type(s) does the technology target?
b. What operating environment(s) would the technology operate?
c. What are any functionality and or performance requirements?
d. What road blocks or barriers prevent the technology deployment?
e. What are anticipated targets or timeframes to complete this research?

2. New or Revised Consensus Standards (standards, guidelines or recommend practices)
a. Does the need address safety or specification related consensus standards?
b. Which standard developing organization and which consensus standard name and number is affected?
c. What pipeline type(s) does the consensus standard target?
d. What operating environment(s) does the consensus standard target?
e. What technical details are necessary and recommended?
f. Can any targets or timeframes be identified to complete this research?

3. Creation and Dissemination of General Knowledge
a. What pipeline type(s) does the new knowledge target?
b. What operating environment(s) does the new knowledge target?
c. What technical details are necessary and recommended?
d. Can any targets or timeframes be identified to complete this research?

Thursday, June 25, 2009 (1:00 PM – 3:00 PM) Technical Track Session (Phase III):

Continue and wrap up discussions on the road mapping details for the top three gaps and challenges. Begin to use the remaining time and audience members to assist you on the report out for the session. (See report out guidance and template report-out presentation)

Thursday, June 25, 2009 (3:15 PM – 4:15 PM) Technical Track Session Report-Outs:

Each session chair may select/elect a reporter for the report outs. The session has 10 minutes to make this presentation. Each presentation reports on the subject(s) discussed, who/how many (ballpark number) attended and an itemization of the top three gaps and challenges illustrating the consensus answers to the road mapping details.

Appendix C

Technical Track Sessions
Challenges and R&D Opportunities

Track # 1
Threat Prevention

Joe Vitelli
Louis Panzer
Maureen Droessler

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Track #1 – Threat Prevention

Attendance Breakdown

Approximate total attendance	20 persons
Federal Regulators	1 persons
State Regulators	2 persons
International Regulators	0 persons
Pipeline Industry	10 persons
Standard Organizations	0 persons
Researchers	3 persons
Academics	0 persons
Other	4 persons

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Track #1 – Threat Prevention

Top 4 Identified R&D Gaps

Gap #1 – Educate the Excavators and Evolve the Technologies Developed for the VUPS One Call Pilot – General Knowledge and Improved Technology

- •Spread the Virginia experience to other states
- •Push for phase 1, white lining
- •Add GPS equipment to all excavating equipment
- •Add a warning notice on all excavating equipment
- •Add GPS to HDD equipment and trenchers

Gap #2 – Early Monitoring Systems – Improved Technology

- •Reduce cost, improve range, improve response time, triangulate
- •Algorithms, response times, miniaturize
- •Discriminate between dig and bucket movement
- •Guidelines to support selection of appropriate system
- •In ground, mounted, aerial, satellite

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Track #1 – Threat Prevention

Top 4 Identified R&D Gaps

Gap #3 – Distribution Integrity Management - General Knowledge
- •Advanced Risk Assessment Tools
- •Priority Risk Mitigation Techniques
- •Risk Based Inspection Techniques
- •Get this to the market quickly- 6 months
- •Process sharing with transmission industry

Gap #4 – Pipe Location for All Materials – Improved Technology
- •Plastic pipe with no tracer wire
- •Bridging the gap between practical deployment and cost effectiveness

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Track #1 – Threat Prevention

Associated Details

Gap #1

Educate the Excavators and Evolve the Technologies Developed for the VUPS One Call Pilot

1. New or Improved Technology
a. What pipeline type(s) does the technology target? **Transmission and Distribution**
b. What operating environment(s) would the technology operate? **Onshore**
c. What are any functionality and or performance requirements?
d. What road blocks or barriers prevent the technology deployment?
e. What are anticipated targets or timeframes to complete this research? **Short Term**
3. Creation and Dissemination of General Knowledge
a. What pipeline type(s) does the new knowledge target? **Transmission and Distribution**
b. What operating environment(s) does the new knowledge target? **Onshore**
c. What technical details are necessary and recommended? **Standards need to be decided to accept the same phone and software (xml) in each state. Maps may not be available in each state.**
d. Can any targets or timeframes be identified to complete this research? **Short term**

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Track # 1- Threat Prevention

Associated Details

Gap #2

Early Monitoring Systems

1. New or Improved Technology

a. What pipeline type(s) does the technology target? **Transmission and Distribution**
b. What operating environment(s) would the technology operate? **Onshore, Offshore**
c. What are any functionality and or performance requirements? **Range, accuracy, reliability, response time, Real-time, miniaturization, data processing**
d. What road blocks or barriers prevent the technology deployment? **Cost, algorithms, friend or foe**
e. What are anticipated targets or timeframes to complete this research? **Short term and Long term**

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Track #1 – Threat Prevention

Associated Details

Gap #3

Distribution Integrity Management

3. Creation and Dissemination of General Knowledge

a. What pipeline type(s) does the new knowledge target? **Distribution and Transmission**
b. What operating environment(s) does the new knowledge target? **Onshore**
c. What technical details are necessary and recommended? **Data warehousing, open architecture, flexibility**
d. Can any targets or timeframes be identified to complete this research? **Near term**

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Track #1 – Threat Prevention

Associated Details

Gap #4

Pipe Location for All Materials

1. New or Improved Technology

a. What pipeline type(s) does the technology target? **Distribution and Transmission**
b. What operating environment(s) would the technology operate? **Onshore**
c. What are any functionality and or performance requirements? **Depth, realtime, practical, handheld, user-friendly**
d. What road blocks or barriers prevent the technology deployment? **Laws of Physics, congestion**
e. What are anticipated targets or timeframes to complete this research? **Long term**

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Track #1 – Threat Prevention

Additional Identified Gaps

- Improve/reduce cost of early warning systems
- Pipe location for all materials
- Technology transfer for existing technologies in final stages
- Distribution integrity data including
  - Data mining
  - Advanced risk assessment tools
  - Integrate with transmission data
- Extend range of early warning systems
- Enhance capabilities and reduce cost of early warning systems
- Discriminate between actual dig v. bucket movement on A-Gas technology
- Triangulate or ID actual threat location on Senstar system
- DIMP programs must come to market very quickly
- Time lags for response on warning systems
- Involved people, processes and technology
- Bring to market technology for locating and warning:
  - In the ground
  - In the air
  - On the ROW
  - From space (satellite)

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Track #1 – Threat Prevention

Additional Identified Gaps

- Best practices that energize technology and people
- Guidelines for vacuum / soft dig excavation (some states/cites have banned it)
- How to spread the Virginia One Call experience to other states? Possible next phase to pick another state.
- Push for phase 1 (of VUPS) adoption by all excavators
- How to get info out to other states regarding VUPS
- Add GPS equipment on all excavation equipment, even rental equipment and Mom and Pop
- Improve understanding of current systems
- Data mining- predictive modeling
- New technologies – emerging technologies
- Advanced sensors –robotic threat sensors
- Guidelines to support selection of appropriate monitoring method. When and where to use different systems.
- Real time processing
- Public awareness
- Research to support enforcement/new info to help repeal bad legislation (such as to remove marks)

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Track #1 – Threat Prevention

Additional Identified Gaps

- Development of algorithms- improve speed, accuracy, reliability
- Advanced sensors- better resolution, miniaturize
- Data processing- integrating with both aircraft and ground systems
- "Warning notice" to be actually placed on excavating equipment
- Cased crossings
    - Studies showed casings could be eliminated
    - DOTs nonetheless wanted them incorporated in design
    - Research needed to help eliminate the need for casings in most cases
- Database needed on all older non-metallic distribution pipe materials in the ground. Include name, manufacturer, test results and life expectancy and share with the industry.
- Plastic pipe risk model for high consequence areas (PIM)
    - Include SCC
- Camera to monitor subsidence in river banks or bridge crossings
- VUPS phase 3- add GPS to HDD equipment and trenchers
- DIM Risk Model to prioritize risk mitigation techniques
    - Risk based inspection intervals
- Remote and automated QA/QC- camera for inspections

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Track #1 – Threat Prevention

Additional Identified Gaps

- Integration of other monitoring technologies with one-call operations (satellite, geophone, acoustic, video, etc)
- Locate buried plastic, esp with no tracer wire
- Active monitoring of critical facilities during construction activities
- Satellite imagery, bring down the cost
- To ID various utilities by inducing frequencies on different utilities

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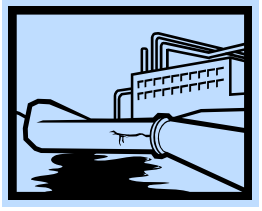
Track #2
Leak Detection

Mark Piazza / PRCI, Chair
Jim Merritt / PHMSA, Co-Chair
Andy McClymont / Cycla, Facilitator



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Track #2 – Leak Detection

Attendance Breakdown

Approximate total attendance	25 persons
Federal Government	2 persons
State Regulators	1 person
Pipeline Industry	7 persons
Researchers (GTI/PRCI/SWRI)	3 persons
Vendors/Others	12 persons

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Track #2 – Leak Detection

Presentations

- PRCI Research Program – Mark Piazza / PRCI
- DOT Perspectives on Leak Detection – Jim Merritt / PHMSA
- LDC/Utility Issues and R&D Needs – Kiran Kothari / GTI
- Gas Distribution Operator Viewpoint – Jeff Pugliese / Washington Gas
- Innovative Applications – Barton Bennett / Odyssian
- PRCI RAM Program – Gary Shane / BP
- NYSEARCH Leak Detection Programs – Angelo Fabiano / NYSEARCH
- ANGEL Program – Dwight Greenlee / ANGEL Services

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Track #2 – Leak Detection

Top Identified R&D Gaps

Gap #1 – Small Leak Detection (Technology)

Gap #2 – Leak Pinpointing (Technology)

Gap #3 – Aerial Reconnaissance (Technology)

Gap #4 – River Crossings (Technology)

Gap #5 – Odorant Issues (Technology / General Knowledge)

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Track #2 – Leak Detection

Associated Details (Gap #1)

Small Leak Detection (<5 cfh)

New or Improved Technology

a.What pipeline type(s) does the technology target?
All, but *Primary Gap is with Detecting Liquid Pipelines*

b. What operating environment(s) would the technology operate?
All

c. What are any functionality and or performance requirements?
Easy to Use
Portable
Sensitivity
Timely
POD / POFC

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Track #2 – Leak Detection

Associated Details (Gap #1, cont'd)

Small Leak Detection (<5 cfh)

New or Improved Technology

d. What road blocks or barriers prevent the technology deployment?
- *Instrument Sensitivity*
- *Scalable, cost effective solution for retrofit*
- *Remote detection*
- *Requires Line of Sight*

e. What are anticipated targets or timeframes to complete this research?
- *Estimated 3-5 years to Develop and Commercialize*

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Track #2 – Leak Detection

Associated Details (Gap #2)

Leak Pinpointing Tools

New or Improved Technology

a.What pipeline type(s) does the technology target?
All, but Distribution is where primary need is (Different technologies for liquid vs. gas)

b. What operating environment(s) would the technology operate?
- *All*

c. What are any functionality and or performance requirements?
- *Driven by the Need for a Technology fix for loss of workforce institutional knowledge*
- *High Accuracy (e.g., ± 1.5 ft.) in order to limit repair footprint*

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Track #2 – Leak Detection

Associated Details (Gap #2, cont'd)

Leak Pinpointing Tools

New or Improved Technology

d. What road blocks or barriers prevent the technology deployment?
Migration Patterns

e. What are anticipated targets or timeframes to complete this research?
3-5 years

Track #2 – Leak Detection

Associated Details: (Gap #3)

Aerial Reconnaissance

New or Improved Technology

a.What pipeline type(s) does the technology target?
All

b. What operating environment(s) would the technology operate?
Manned and Unmanned

c. What are any functionality and or performance requirements?
Response Time
Sensitivity
Multifunction Capability (Other Monitoring): "Pigs Can Fly"

Track #2 – Leak Detection

Associated Details: (Gap #3, cont'd)

Aerial Reconnaissance

New or Improved Technology

d. What road blocks or barriers prevent the technology deployment?
- *FAA regulations (Unmanned)*
- *Payload / Miniaturization*
- *Performance Capability (including Delayed Communication)*
- *Cost*

e. What are anticipated targets or timeframes to complete this research?
- *Short term (1-3): Manned, Liquid Transmission for Deployment / demonstration*
- *Long Term (3-5): Unmanned, LDC for Deployment / demonstration*

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Track #2 – Leak Detection

Associated Details: (Gap #4)

River Crossings

New or Improved Technology

a.What pipeline type(s) does the technology target?
- *All*

b. What operating environment(s) would the technology operate?
- *Underwater < 50 ft.*
- *Non-piggable crossings*
- *IM Requirements*

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Track #2 – Leak Detection

Associated Details: (Gap #4, cont'd)

River Crossings

New or Improved Technology

c. What are any functionality and or performance requirements?
- *Replace Human Divers*
- *Leak Location*
- *Additional Capabilities: Depth of Cover, pipe to soil potential*

d. What road blocks or barriers prevent the technology deployment?
- *Cost*
- *Adaptability of Existing Technology*

e. What are anticipated targets or timeframes to complete this research?
- *3 yrs. to Develop Cost Effective Leak and Integrity Monitoring Tool*

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Track #2 – Leak Detection

Associated Details: (Gap #5)

Odorant Effectiveness

New or Improved Technology

a.What pipeline type(s) does the technology target?
- *Class 2 &3 Gas Transmission, Gas Distribution*

b. What are any functionality and or performance requirements?
- *Comprehensive Literature Search*
- *Identification of Appropriate Odorant*
- *Determine impacts of Varying Environments/Conditions*
- *Must Meet Regulations*

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Track #2 – Leak Detection

Associated Details: (Gap #5)

Odorant Effectiveness

New or Improved Technology

c. What road blocks or barriers prevent the technology deployment?

Lack of Historical Data
Absorption by New Pipelines
Soil Scrubbing Effects

d. What are anticipated targets or timeframes to complete this research?

Information Obtained/ Disseminated within 1.5 Years

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Track #2 – Leak Detection

Additional Identified Gaps

•Inside-Structure Leaks

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Track #3
Anomaly Detection/Characterization

Track Chairs
Daphne D'Zurko, NYSEARCH
Craig Swiech, National Fuel

Facilitator
Julie Galante, Cycla

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Track 3 – Anomaly Detection/Characterization

Attendance Breakdown

Approximate total attendance	49 persons
Federal Regulators	2 persons
State Regulators	1 persons
International Regulators	1 persons
Pipeline Industry	17 persons
Standard Organizations	2 persons
Researchers/Vendors	24 persons
Academics	2 persons

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Track 3 – Anomaly Detection/Characterization

"Buckets" of Identified R&D Gaps

1. Unpiggable Pipeline Inspection Tools
2. Outside-the-Pipe Inspection Tools
3. Low Frequency ERW Pipeline Failures
4. Cased Crossing Assessment Methods
5. Inspection Data Evaluation & Risk Assessment/Qualification Testing
6. Advanced Development of ILI Technologies/Tools
7. Technology Transfer
8. Inspection of Plastic/Composites Pipes & Fittings
9. Data Collection, Sharing/Linking & Analysis (including samples)

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Track 3 – Anomaly Detection/Characterization

Top 4 Identified R&D Gaps

Gap #1 – Outside-the-Pipe Inspection Tools - Detection and Characterization of Anomalies from Outside the Pipe (Technology)

Gap #2 –Unpiggable Pipeline Inspection Tools - Platform Improvements for Operational Efficiency (Technology)

Gap #3 –Cased Crossing Assessment Methods - Correlation of Parameters for Assessing Middle of Casing (General Knowledge)

Gap #4 – (Low Frequency) ERW Pipeline Failures – Fracture (Damage) Mechanics (General Knowledge)

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Track 3 – Anomaly Detection/Characterization

Gap #1 Detection and Characterization of Anomalies from Outside the Pipe

Pre-amble: Metal loss, planar and distortional anomalies, and poor fusion joints all threaten the performance of energy pipelines. The ability to detect and characterize these to a higher performance level than inside or above ground pipeline inspections is paramount for pipelines. The closing of this gap would contributes to improved reliability. It requires linking all pipe inspections (outside, inside, and above) and material properties and integrating with Reliability Based Integrity Management.

New or Improved Technology

a. What pipeline type(s) does the technology target?
   Pipelines of all material types including carbon steel, cast iron, polymer and composite without limitation on wall thickness or diameter.
b. What operating environment(s) would the technology operate?
   Access to the outer surface of the pipeline is key to the technologies for responding to this gap.
c. What are any functionality and or performance requirements?
   These have a unique criteria;
      An order of magnitude more precise than technologies used from inside of the pipe, and
      Can provide information not currently attainable.
d. What road blocks or barriers prevent the technology deployment?
   Appropriate funding levels and resources to close these gaps.
e. What are anticipated targets or timeframes to complete this research?
   1-5 years can close these gaps.

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Track 3 – Anomaly Detection/Characterization

Additional Identified Gaps –

Detection and Characterization of Anomalies from Outside the Pipe

- Anomaly Detection Gaps:
  - Measurement of pipe grade,
  - Measurement of anomalies under supports,
  - Cast iron cracking and graphitic corrosion,
  - Guided wave range and access through key holes,
  - Polymer joint integrity, and
  - Improved crack detection.
- Anomaly Characterization Gaps:
  - Strain and load measurements,
  - Accuracy, Tolerance and Reliability capability (performance) for each anomaly type,
  - 3D imaging,
  - Differentiate mechanical damage from corrosion,
  - Criteria and limits for anomalies in composite materials and
  - Classification of anomalies and their characteristics for linking and integrating with other inspections.

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Track 3 – Anomaly Detection/Characterization

Gap #2 Unpiggable Pipeline Inspection Tools

Platform Improvements for Operational Efficiency
1. Locomotion Methods (wheels/tractor/floaters)
2. Extended Range and Power Issues
3. Communication and Controls

New or Improved Technology

a. What pipeline type(s) does the technology target? HL/Gas Trmn/Gas Dist
b. What operating environment(s) would the technology operate?
Unpiggable pipelines
c. What are any functionality and or performance requirements?
Locomotion, must be able to get in/out of the pipelines and around obstacles.
d. What road blocks or barriers prevent the technology deployment?
Technology Development
e. What are anticipated targets or timeframes to complete this research?
1-5 Years

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Track 3 – Anomaly Detection/Characterization

Additional Identified Gaps – Unpiggable Pipeline Inspection Tools

- Improved non-traditional sensors for defect detection. Unique opportunities to look for different types of defects due to technology (welds, material properties, mechanical damage, coating disbondment)

- Sensors for unpiggable features (mitered elbows, plug valves, tees, diameter changes)

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Track 3 – Anomaly Detection/Characterization

Gap #3 Cased Crossing Assessment Methods

Correlation of Parameters for Assessing Middle of Casing

Determine how data collected from the assessment of end sections of a casing can be correlated to accurately model and predict the condition of the middle section of the casing.

New or Improved Technology

a. What pipeline type(s) does the technology target? Gas Trmn/Gas Dist
b. What operating environment(s) would the technology operate? Cased Pipe
c. What are any functionality and or performance requirements? Identify and assess anomalies.
d. What road blocks or barriers prevent the technology deployment? Regulatory acceptance, availability of data, and time.
e. What are anticipated targets or timeframes to complete this research? 12-15 Months

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Track 3 – Anomaly Detection/Characterization

Additional Identified Gaps – Cased Crossing Assessment Methods

- Identify new indirect tools to assess casings.
- Demonstration and validation of tools in on-going R&D projects.
- Cleaning vent for inspection purposes
- Improving guided wave for limitations related to coatings and temperature
- Adapting Structural Liners to bring pipe below 20% SMYS
- Tools to Assess Full Wax Fill

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Track 3 – Anomaly Detection/Characterization

Gap #4 Low Frequency ERW Pipeline Failures

Fracture (Damage) Mechanics

Study to understand damage mechanisms in ERW pipe.
- **Must be statistical over representative sample size.**

Comprehensive program to include real world samples
- **Unflawed samples**
- **Notched samples**
- **Fatigue pre-cracked samples**

Possible use of ASME B31.8S

Creation and Dissemination of General Knowledge

a. What pipeline type(s) does the new knowledge target? HL/Gas Trmn/Gas Dist
b. What operating environment(s) does the new knowledge target? ERW Pipe
c. What technical details are necessary and recommended? Material characterization.
d. Can any targets or timeframes be identified to complete this research? 2-3 Years

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Track 3 – Anomaly Detection/Characterization

Additional Identified Gaps – Other

- Technology transfer – PHMSA to promote/host meeting and demonstrations to market promising technologies to venture capitalists, commercializers, operators (similar to Navy forum run by Dawnbreaker)
- Polymer/Plastic System Gaps
- Ability to monitor Cast Iron failure due to frost heave
- Strain measurement tools for bends, axial loading, dents and kinks
- Severity ranking and decision-making algorithms (risk assessment) enabling timely and proportionate responses when damage is discovered
- Reliability based Integrity Management
- Ability to predict future life of pipe materials
- Collection of benchmark defect samples for testing
- Sharing/publishing of known material property values
- Continuous feedback process from performance and uncertainty of the pipeline. Knowledge of materials properties (must deal with small defects), knowledge about dents, size of flaws.
- Integrating sensors of other tools
- Identifying cause of defect (corrosion, mechanical), does the cause of metal loss make a difference for the failure and thus the remediation/monitoring
- New Signal Calibration Methods Required
- New Signal Processing Methods Required to Compensate for Coatings

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Track 3 – Anomaly Detection/Characterization

Additional Identified Gaps – Other

- Advanced understanding of EMAT signals
- Ability to monitor Cast Iron failure due to frost heave
- Qualification process for new tools/procedures that is recognized by PHMSA
- Re-inspection intervals that based on run results, # of inspection runs and interim monitoring
- Modified B31G (and other remaining strength equations) for heavy wall pipe
- Transportation of pipe by truck or rail standards
- Address outside force threat with ILI data and how to monitor between runs
- Understanding tool accuracy, tolerance and reliability for the defect type of mechanism
- Current State-of-the-Art and confidence of ILI usage on longitudinal seams and girth
- Understanding of capabilities of computational ILI models; capabilities and limitations Improved tools for crack/crack detection

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Track 3 – Anomaly Detection/Characterization

Additional Identified Gaps – Other

- Development of multi-purpose ILI tools
- Quantitative understanding of the performance of existing ILI for discriminating between significant and benign anomalies
- Understanding of capabilities of computational ILI models; capabilities and limitations Improved tools for crack/crack detection
- Advanced understanding of EMAT signals
- Advantages/potential for combining MFL and Eddy Current sensors
  Improve on ILI tolerances of +/-10% or 15% with 80% confidence
  Improve methods for correlating in-the-ditch assessment to ILI signals
- Advantages/potential for combining MFL and Eddy Current sensors
- Improve on ILI tolerances of +/-10% or 15% with 80% confidence
- Improve methods for correlating in-the-ditch assessment to ILI signals
- Additional field experience to validate dual-field MFL and other emerging ILI technologies
- Assessing pipe in vault walls or other supports/bridge hangers
- Advanced MFL and non-MFL sensors for increased inspection capability
- Ability to interpret MFL signals for accurate characterization of defect features
- Alternatives for inspection of heavy walled pipe
- Increase availability of 'Other technology' for inspecting transmission lines in HCAs

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Track 4
Anomaly Remediation/Repair

Dave Johnson
Max Toch
Herb Wilhite

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Track 4 – Anomaly Remediation/Repair

Attendance Breakdown

Approximate total attendance	**21** persons
Federal Regulators	**1** persons
Pipeline Industry	**8** persons (all Transmission)
Researchers	**9** persons
Other	**3** persons

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Track 4 – Anomaly Remediation/Repair

Top 3 Identified R&D Gaps

Gap #1 – Girth weld repairs of high strength welds: methods to further eliminate cracked girth welds in field situations – type rod usage/welding process, pre-heat, NDE, MFL Tools – [Technology and Consensus Standard]

Gap #2 – Standardized evaluation, selection, installation, and testing of repair methods to improve confidence. [Technology and Consensus Standard]

Gap #3 – Allowable strain limits for dents [Technology]

- What initiates cracks in dents
- What increases SCC susceptibility and fatigue analysis
- Is 2% weld dent really a limit

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Track 4 – Anomaly Remediation/Repair

Associated Details
(Gap #1)

Girth weld repairs of high strength welds: methods to further eliminate cracked girth welds in field situations – type rod usage/welding process, pre-heat, NDE, MFL Tools

1. New or Improved Technology
a. What pipeline type(s) does the technology target? Steel transmission lines
b. What operating environment(s) would the technology operate? Any high strength weld
c. What are any functionality and or performance requirements? Performance to applicable standards
d. What road blocks or barriers prevent the technology deployment? None
e. What are anticipated targets or timeframes to complete this research? 2-3 years

2. New or Revised Consensus Standards (standards, guidelines or recommend practices)
a. Does the need address safety or specification related consensus standards? Yes
b. Which standard developing organization and which consensus standard name and number is affected? API 1104,
c. What pipeline type(s) does the consensus standard target? Steel transmission
d. What operating environment(s) does the consensus standard target?
e. What technical details are necessary and recommended? See Title
f. Can any targets or timeframes be identified to complete this research? 2-3 years

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Track 4 – Anomaly Remediation/Repair

Associated Details
(Gap #2)

Standardized evaluation and testing of repair methods to improve confidence.

1. New or Improved Technology
a. What pipeline type(s) does the technology target? All types
b. What operating environment(s) would the technology operate? All
c. What are any functionality and or performance requirements? Permanent restoration of serviceability
d. What road blocks or barriers prevent the technology deployment? Buy-in from vendors; engineering tests & analysis
e. What are anticipated targets or timeframes to complete this research? 1-3 years, depends on repair methods

2. New or Revised Consensus Standards (standards, guidelines or recommend practices)
a. Does the need address safety or specification related consensus standards? Yes
b. Which standard developing organization and which consensus standard name and number is affected? TBD
c. What pipeline type(s) does the consensus standard target? All
d. What operating environment(s) does the consensus standard target? All
e. What technical details are necessary and recommended? Part of development project; address common degradation scenarios
f. Can any targets or timeframes be identified to complete this research? 1-3 years, depends on repair methods

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Track # - Track Title

Associated Details
(Gap #3)

Allowable strain limits for dents [Technology]

1. New or Improved Technology
a. What pipeline type(s) does the technology target? Steel transmission
b. What operating environment(s) would the technology operate? All
c. What are any functionality and or performance requirements? Maintenance of pipeline integrity and serviceability
d. What road blocks or barriers prevent the technology deployment? User-friendliness; regulatory requirments
e. What are anticipated targets or timeframes to complete this research? 1-3 years

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Track 4 – Anomaly Remediation/Repair

Additional Identified Gaps

Repair of low toughness seams
- Are concerns for crack initiation in vintage ERW seams under steel sleeves legitimate? [Cat: Alt Rpr]
- Can selective corrosion of seams be repaired by welding? [Cat: Alt Rpr]

Repair of complex shapes [Cat: Alt Rpr, Std Proc]

Reliable methods to repair PE coating damage. [Cat: Alt Rpr]

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Additional Identified Gaps

Reliable methods to repair pipeline corrosion and other damage using nonconventional techniques (i.e., not welded sleeve or composite). [Cat: Alt Rpr]

Reliable methods to repair non-PE coating damage. [Cat: Std Proc]

Reinforced Thermoplastic Pipe (RTP) Utilization [Cat: Alt Rpr, Std Proc]
- Investigate: materials, connections, fittings, joining methods; shortcomings/failure points; testing, evaluation, standards, approvals for use

Pipeline Rehabilitation Techniques [Cat: Alt Rpr, Std Proc]
- new materials – both local and large sections
- procedures – pipe splitting, pipe bursting
- processes – low cost, environmentally friendly, hard to access

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Additional Identified Gaps

Hot tap fittings for large diameter NPS>20, large branch-to-run ratio, high pressure gas or liquid pipelines [Cat: Alt Rpr]

Improved confidence in composite repair methods. [Cat: Std Proc, Alt Rpr]

Develop Data for Composite Pipeline Repair System (CPRS) Testing for Fittings, Flanges, Bends, etc. [Cat: Alt Rpr]

Investigate application of CPRS patches to large diameter (>48") high pressure vessels, above and below ground [Cat: Alt Rpr]

Effects of bending, axial tension, and cyclic loading on composite performance [Cat: Alt Rpr, Std Proc]

- Moving towards a strain-based design as opposed to a traditional stress-based approach

Composite repair of offshore piping, pipelines, and risers [Cat: Alt Rpr]

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Additional Identified Gaps

Software solutions for consistent, user-friendly application of assessment technology.

Interpretation and Guidelines for Application of API 1104; ECD Sep 2009: API-1-2

Undertaking testing to compare and contrast all crack assessment methodologies

Effects of bending, axial tension, and cyclic loading on composite performance

- Moving towards a strain-based design as opposed to a traditional stress-based approach

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Track 4 – Anomaly Remediation/Repair

Additional Identified Gaps

Reliable methods to repair non-PE coating damage.

Hot tap welding guidelines for large diameter NPS>20, large branch-to-run ratio, high pressure gas or liquid pipelines

Reinforced Thermoplastic Pipe (RTP) Utilization
- Investigate: materials, connections, fittings, joining methods; shortcomings/failure points; testing, evaluation, standards, approvals for use

Pipeline Rehabilitation Techniques
- new materials – both local and large sections
- procedures – pipe splitting, pipe bursting
- processes – low cost, environmentally friendly, hard to access

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Additional Identified Gaps

Proper support and backfill procedures

Use of O-let fittings for hot taps

Need standards for approval, testing and long term NDE. Lead in to further language in B31.8, B31.4, B31.8S and maybe additional clauses in CFR §192.309(b) and §192.713 and § 192.485.

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Track 4 – Anomaly Remediation/Repair

Additional Identified Gaps

Coatings – effective maximum operating temperature for FBE coatings to operate long term at higher temperatures and type application methods to extend temperature ranges

Consider/develop fundamental understanding of mechanical damage
- Tribology of damage process, contact stresses, thermal effects
- Depth of damage zone and its effect
- Define “non-threatening” damage
- Damage tolerance of low-stress pipelines

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Track 4 – Anomaly Remediation/Repair

Additional Identified Gaps

Improve tools to address vintage construction methodologies and materials
- Tools are needed locate & remediate if remnant vintage threats, or to manage their continued service – for both blunt and crack-like defects – axial/circumferential orientation
- Need to bridge gaps between criteria used to make decisions for vintage versus modern line pipe

Standardize methods for determining corrosion rates

Reevaluate Seam Weld Fatigue [
- Appropriate crack growth rate constant
- Appropriate pressure sample rate for pressure signal analysis
- Understand vintage pipe initial quality
- Develop reliability approaches

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Track 4 – Anomaly Remediation/Repair

Additional Identified Gaps

Improve characterization of fitness for service input data for girth welds
- Describe fracture toughness and ductility properties of vintage in-service welds
- Applied stresses associated with loadings

Develop guidelines for investigation and repairs [Cat: Assess]
- Improve pre-excavation evaluation methods for >2% topside dents
- Develop quick ranking process for dent and gouge evaluation

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Track 5
Pipelining in Challenging Areas
(Arctic & Offshore)

Track Chair: Joe Zhou - Arctic

Track Chair: John O'Brien - Offshore

Facilitator: P Wood

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Track 5 - Pipelining in Challenging Areas

Attendance Breakdown

Approximate total attendance	22
Federal Regulators	4
State Regulators	0
International Regulators	1
Pipeline Industry - Offshore	3
Pipeline Industry - Arctic	5
Standard Organizations	0
Researchers	9
Academics	0
Other	0

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Track 5 - Pipelining in Challenging Areas

Top 4 Identified R&D Gaps - Arctic

Gap #1 – Strain-Based Design (SBD) (Consensus Standard and General Knowledge)

Representative R&D

Develop comprehensive guidelines for SBD - Needs to be supported by numerous technical projects

- Guidelines for strain demands from permafrost related hazards and other geo-hazards
- Guidelines for compressive strain capacity
- Guidelines for tensile strain capacity

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Track 5 - Pipelining in Challenging Areas

Top 4 Identified R&D Gaps - Arctic

Gap #2 – Reliability-Based Design & Assessment (RBDA) (Consensus Standard and General Knowledge)

Background
- Generic RBDA standard published by ISO 16708 in 2006
- CSA Z662 published a non-mandatory Annex O in 2007
- Review process in ASME B31.8 started in 2003 and continuing – need to be revitalized

Representative Developmental Activities - Require funding
- Complete the standard development with B31.8 and publish the RBDA standard as a supplement
- Extend the RBDA methodology to other type of pipelines
- Gain regulatory acceptance

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Track 5 - Pipelining in Challenging Areas

Top 4 Identified R&D Gaps - Arctic

Gap #3 – Quality Management System (QMS) (Consensus Standard and General Knowledge)

Background
- Various forms of QA/QC program widely implemented
  - Ranging from based on minimum standards to substantial supplemental company specific program
  - Varying performance
- TransCanada has piloted QMS approach as the basis for a number of pre-service hydrotest waivers
- QMS is an essential element of overall pre-commissioning of pipeline integrity, particularly in the arctic

Representative R&D - Quality Management Systems (QMS)
- Develop guidelines for a QMS for pipeline projects (from design to commissioning) to ensure consistent and acceptable quality that is
  - Comprehensive in scope
  - Flexible in process and procedure
  - Effective in achieving consistent and acceptable quality
  - Adequate and acceptable to demonstrate pipeline safety and integrity without pre-service hydrotest

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Track 5 - Pipelining in Challenging Areas

Top 4 Identified R&D Gaps - Arctic

Gap #4 – Metallurgy & Materials Performance (General Knowledge)

Representative R&D

Pipe Materials - Recommended Program
- Guideline for application and specification of SBD pipe
- Guideline for application and specification of X100 pipe (includes data collection requirement)

Coating Materials - Recommended Program
- Enhance/refine 3-layer coating systems for Arctic applications
- Guidelines for application and testing of girth weld coatings

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Track 5 - Pipelining in Challenging Areas

Top 4 Identified R&D Gaps - Arctic

Gap #4 – Metallurgy & Materials Performance (General Knowledge), continued

Representative R&D, continued

Welding - Recommended Program
- Develop high productivity welding "systems" to deliver quality and consistent welds
  - Continue current projects (PRCI MATH-1)
  - Extend to tie-in and repair welds as necessary
  - Implement into guidelines and standards
- Develop guidelines for avoidance of hydrogen induced cracking of high strength steels
  - Welding factors
  - Delay time before final inspection

NDT - Recommended Program

Develop industry guidelines and standards for:
- System design
  - How to design/specify system matched to needs
- System qualification
  - POD and Accuracy
- Operator qualification

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Track 5 - Pipelining in Challenging Areas

Top 3 Identified R&D Gaps - Offshore

Gap #1 - Construction Issues (Technology, Consensus Standard and General Knowledge)

- Welding and NDE solutions for heavy wall pipe up to 2”
- Substitutes for hydrotest (Alternate Integrity Verification - AIV) supporting commissioning
- Pipeline construction inspection of Corrosion Resistant Alloys (CRA)
- Subsea Quality Management System (QMS) - guidance development

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Track 5 - Pipelining in Challenging Areas

Top 3 Identified R&D Gaps - Offshore

Gap #2 – Damage Evaluation (Technology, Consensus Standard and General Knowledge)

- Need to develop a unified process for evaluating damage to subsea pipelines
- As with onshore pipelines, a grading tool is essential to support operator decisions on prioritizing their responses to damage
- Use testing to reduce uncertainty
- Standardized analysis methods for establishing tensile & strain loads

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Track 5 - Pipelining in Challenging Areas

Top 3 Identified R&D Gaps - Offshore

Gap #3 – Integrity Inspection (Technology, Consensus Standard and General Knowledge)

- SMART Pigs for ultra deepwater pipeline inspection
- Multi diameter pigging capability 8" ID variations
- Assessment of NDE technologies for outside the pipe inspection of internal corrosion on subsea flowlines
- Improving inspectability of gas pipelines & risers in the absence of liquids
- Subsea pipeline damage - inspection & protocol guidelines
- Evaluation of MTM technology (on & offshore applications) inspection

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Track 5 - Pipelining in Challenging Areas

Additional Identified Gaps - Offshore

- Non Piggable Pipelines - Access Issues, Inspectability, Cleaning, Base resource document for unpiggable pipelines (all sectors)
- Extreme Weather Loading, Landfall/near-shore seabed stability, allision issues
- Composite Repairs Techniques For Offshore Risers, Splash zone repair techniques - challenges
- Study on optimization of inhibitor use
- Pipe In Pipe Pipeline Inspection; Pipe in pipe CP criteria - isolation etc
- Coating performance on subsea pipelines
- Corporate knowledge/industry knowledge access (solves ageing process); authoritative reviews of R&D
- Integrity installed sensors
- Probabilistic approaches for life assessment
- Spiral welded pipe for subsea application

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Track 6
Alternate Fuels / Climate Change

Bob Wilson
Jake Haase
Mike Gallinaro

Attendance Breakdown

Approximate total attendance	25 persons
Federal Regulators	4 persons
State Regulators	0 persons
International Regulators	0 persons
Pipeline Industry	4 persons
Standard Organizations	4 persons
Researchers	6 persons
Academics	0 persons
Other (Biofuel Producer)	1 persons

Track 6 – Alternate Fuels / Climate Change

Top 3 Identified R&D Gaps

Gap #1 – Material Compatibility with Biodiesel and Cleaning effects of Biodiesel on Pipelines. (General Knowledge)

Gap #2 – Pipeline Safety and Integrity Issues Associated with Renewable Gas. (General Knowledge)

Gap #3 – Pipeline Integrity Impacts From Flowing Hydrogen Through Pipes. (General Knowledge)

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Track 6 – Alternate Fuels / Climate Change

Associated Details
(Gap #1)

Material Compatibility with Biodiesel and the Cleaning Effects of Biodiesel on Pipelines

This knowledge would target pipelines currently transporting refined liquid petroleum products, specifically diesel fuel. Pipelines would primarily be onshore and could be of any composition (steel, polymeric, etc).

The following technical focus areas are either necessary or recommended:
a. Identify what materials have not already been researched (in vehicle compatibility studies)
b. Determine the impact of biodiesel on elastomers and other polymeric materials (ID'd in step a)
c. Establish threshold levels of concern as related to pipeline integrity for various biodiesel constituents.
d. Investigate standardized monitoring methods and instrumentation for both biodiesel content and potential deleterious constituent levels
e. Investigate the potential cleaning effect of biodiesel

A proposed mandate calls for significant biodiesel use by 2012. Most of this work will need to be completed to meet this mandate.

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Track 6 – Alternate Fuels / Climate Change

Associated Details
(Gap #2)

Pipeline Safety and Integrity Issues Associated with Renewable Gas

This knowledge would target pipelines currently transporting natural gas. Pipelines affected include gas transmission and local distribution lines. Pipelines of steel and polymeric construction would be included.

The following technical focus areas are either necessary or recommended:
a. Identify trace constituents in gas that have an impact to pipeline integrity. Both existing natural gas sources as well as renewable gas sources (such as biogas) need to be investigated.
b. Conduct a materials science evaluation of existing pipeline components and their interaction with gas constituents.
c. Investigate the chemistry of odor fade concerns related to existence of trace constituents and its impact to public safety.
d. Investigate standardized monitoring methods and instrumentation for detecting the deleterious constituent identified above

This gap needs a short term solution because of both the changing nature of the country's gas supply and the influx of more renewable gas sources

***Government/Industry Pipeline R&D Forum – Crystal City, Virginia*, June 24-25, 2009**

Track 6 – Alternate Fuels / Climate Change

Associated Details
(Gap #3)

Pipeline Integrity Impacts From Flowing Hydrogen Through Pipes

This knowledge would target pipelines currently transporting natural gas or newly constructed pipelines dedicated to hydrogen gas transportation. Pipelines affected include gas transmission and local distribution lines. Pipelines of steel and polymeric construction would be included.

This gap concerns both co-mingling hydrogen gas with natural gas and transportation of pure hydrogen gas.

The following technical focus areas are either necessary or recommended:
a. Perform literature search or public "roadmapping session" to identify and prioritize issues.
b. Investigate impact of hydrogen on materials of construction.
c. Establish threshold limits for hydrogen gas in pipeline transportation scenarios.
d. Develop evaluation criteria for repurposing existing pipelines for hydrogen gas transportation.
e. Investigate trace constituents in hydrogen gas that results from hydrogen manufacture. Investigate the impact of any identified constituents on gas quality and pipeline integrity

Due to the large potential scope of these focus areas, this is a long term, multiyear project.

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Track 6 – Alternate Fuels / Climate Change

Additional Identified Gaps

- Enhanced in-situ leak detection and leak quantification for methane emissions
- Investigate regulatory barriers that impede methane recovery.
- Prioritize emission detection locations by specific asset (equipment) class. For example, should emission detection focus on valves instead of flange connections.
- Perform study on pipeline lifecycle emissions. Compare GHG emissions caused by pipelines from construction through de-commissioning to the GHG emissions caused by alternate transportation methods.

***Government/Industry Pipeline R&D Forum – Crystal City, Virginia*, June 24-25, 2009**

Appendix D

Forum Participants

Organization	Participant Name
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