

THE PRCI 2021 YEAR IN REVIEW

[View Our Accomplishments](#)

OF, BY, AND FOR THE ENERGY PIPELINE INDUSTRY

OUR MISSION

To collaboratively deliver relevant and innovative applied research to continually improve the global energy pipeline systems.

OUR VISION

OUR CORE VALUES

A LETTER FROM OUR LEADERSHIP

MARK GEBBIA, CHAIRMAN

"I am honored to work with the members, partners, and greater pipeline safety and integrity community to support dynamic solutions that address the energy pipeline industry's priorities. While I have been an active PRCI Board member for more than four years, it is even more meaningful to me to serve as chair in these unique times...."

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CLIFF JOHNSON, PRESIDENT

"One of the most gratifying parts of my job is working with our many wonderful volunteers and our amazing staff to develop the needed research to advance our members and the industry to towards our goal of zero leaks and zero failures...."

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CORE RESEARCH

Advancing PRCI's Core Research Program and enhancing the adoptability and usability of the findings is a key focal point in enhancing member and stakeholder engagement.

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TECHNOLOGY CENTERS

The Technology Development Center (TDC) in Houston, Texas and the Virtual Technology Development Center (VTDC) are the physical and digital opportunities for leading the industry to innovative solutions.

[Read more](#)



COMMITMENT TO THE ENVIRONMENT

As the world moves to the newer fuels, PRCI is identifying the gaps in our knowledge to innovate the solutions needed to transport and store the fuels.

[Learn More](#)

Thank you for another great year...

OF, BY, AND FOR THE ENERGY PIPELINE INDUSTRY

OF WORLDWIDE PIPELINE INDUSTRY ORGANIZATIONS:

Since 1952, PRCI has been recognized around the world as a unique forum within the energy pipeline industry delivering great value to its members and the industry – both quantitative and qualitative – through the development and deployment of research solutions to the operational, maintenance, and regulatory challenges that face it.

BY MEMBERS WORKING TOGETHER THROUGH PRCI:

The collaboration achieved through members' funding and resource/expertise contributions results in the development of pipeline industry research and technological advances that benefit member organizations and all energy users.

FOR THE GLOBAL PIPELINE INDUSTRY AND THOSE WHO HAVE AN INTEREST IN IT:

Members collaboratively drive and fund research most relevant to their organizations, so projects truly reflect the industry's priorities. The results provide intelligence and allow the industry to continue reducing risks from and to pipelines.

FROM OUR CHAIRMAN

MARK GEBBIA



In my first year as chair of Pipeline Research Council International (PRCI), I am honored to work with the members, partners, and greater pipeline safety and integrity community to support dynamic solutions that address the energy pipeline industry's priorities. While I have been an active PRCI Board member for more than four years, it is even more meaningful to me to serve as chair in these unique times. When prior chairs positioned PRCI to flourish, I am sure none of them expected that we would be faced with a global pandemic. Yet their leadership built a solid

foundation of collaboration devoted to the safety and integrity of the energy pipeline system that included the resilience required to weather these unprecedented times. From the earliest days when a simple committee gathered to solve a single problem to operators, solution providers, and organizations collaborating through research, each step of the way focused on innovation, allowing PRCI to continue to grow and respond to our members and the industry.

One of my first big lifts was to lead the PRCI Executive Board to the approval of the 2022 – 2024 strategic plan. In the plan, three initiatives were identified that will enable PRCI to enhance stakeholder engagement, influence, and outreach by delivering innovative solutions. The initiatives are

1. Core Research –enhancing the adoptability/usability of Core Research to grow PRCI membership by 15%;
2. Technology Centers – be the market leader for innovative solutions by leveraging real world samples to strength business operations; and
3. Environmental Commitment – be the primary research body for eliminating emissions and enabling emerging fuels transport and storage via the global pipeline network.

As the energy pipeline industry faces an inflection point, it is critical that PRCI provides the needed answers to enhance the safety and integrity of our current pipeline infrastructure globally and that we are able expand our portfolio to ensure that the energy pipeline industry can lead the transition to the next generation of fuels. It is a powerful time to be involved in PRCI, defining and answering these issues.

Under the leadership of my immediate predecessor, Walter Kresic, the Strategic Research Priorities (SRP) and the Emerging Fuels Institute (EFI) were established. Members need additional focus on key issues facing the energy pipeline industry. SRP allows members to collaborate across committees and address the needed research areas to aggressively advance the safety and integrity of the energy pipeline industry and to push attaining the goal of zero failures and zero emissions.

The creation of the EFI builds upon PRCI's legacy of environmental commitment to assist members and the industry in achieving a low carbon future and zero emissions. There are many technical challenges that need to be addressed to ensure the safe transportation and storage of the next generation of energy that will help meet the world's energy needs while reducing the impact to the environment. The EFI enables our members and the industry to make the transition to the next generation of energy a reality. The goal of the EFI is to provide an operations guide for our members and the industry to transport and store the generation of fuels either through current pipeline infrastructure or new construction. It is important that PRCI and our members are leaders in this conversation. The EFI will also enable PRCI to establish itself as the leading resource for technical challenges facing the global pipeline infrastructure.

During my term as chair, I look forward to the many great opportunities to advance PRCI down the path defined by the Executive Board. I invite you to expand or find your place within PRCI and make a difference in strengthening the global pipeline network through our research.

< [Emerging Fuels & Sustainability](#) | [Home](#) | [Letter from the President](#) >

FROM OUR PRESIDENT

CLIFF JOHNSON

One of the most gratifying parts of my job is working with our many wonderful volunteers and our amazing staff to develop the needed research to advance our members and the industry to towards our goal of zero leaks and zero failures. The process of putting together the Year in Review is a pleasurable journey of recounting the impact that PRCI is making. Let's take a look back are some of the actions that PRCI was able to accomplish in 2021:



The core of PRCI is research, and this year produced [over 75 research deliverables](#), and [11 compendium](#), were published.

Knowledge transfer is critical to PRCI. The Virtual Research Exchange (VREX2021) hosted over 1,300 attendees, and presentations were available for viewing for over a month. Throughout the year, five workshops were held: [Near Neutral pH](#), USM diagnostic, [Leak detection](#), [A Tool to Analyze CO2e Economics] [Hydrogen Storage](#), and [Midwall Cracking](#) [Management of Midwall Cracking in Operating Pipelines]

Two Strategic Research Priorities (SRP) were approved. Focusing on industry-wide issues, [Pathway to Achieving Efficient and Effective Crack Management](#) and [Greenhouse Gases Emissions Reduction](#) are the next collaborative opportunities to enhance pipeline safety and integrity.

Our partnership with the Pipeline Hazardous Safety Administration (PHMSA) was enhanced. PRCI was awarded PHMSA Project - [Advancement of Through-Tubing Casing Inspection for Underground Storage Wells](#).

Our collaborations were expanded with many key North American government agencies and several global associations in the pipeline sphere:

- **Research** collaborations included Australian Pipeline & Gas Association, European Pipeline Research Group, GERG, and Future Fuels CRC.
- **Trade Association** collaborations included American Petroleum Institute, Interstate Gas Association of America, American Gas Association, and Association of Oil Pipe Lines.
- **Government** collaborations included US Department of Energy PHMSA Canada Energy Regulator Natural Resources Canada

PRCI's Environmental Commitment was clearly defined. With the creation of the Emerging Fuels Institute, nine members raised almost \$2M and leverage up to \$20M. Additionally, the [CO2e Economic Analysis Tool](#) was released. We are honored to be featured in the [Interstate Natural Gas Association of America \(INGAA\) Climate Change and GHG Task Forces](#) inaugural climate report.

As I look over this list of last year's activities and remember that we continued to struggle with a global pandemic, it is remarkable to see how much we accomplished in our steadfast dedication to ensuring the safety and integrity of the global energy pipeline infrastructure. We look forward to an amazing 2022.

< [Letter from the Chairman](#) | [Home](#) | [Strategic Research Priorities](#) >

CORE RESEARCH

PRCI released its 2022-2024 Strategic Plan this year to deliver innovative solutions that improve the safety and integrity of the global energy pipeline systems and enhance member and stakeholder engagement. With three strategic initiatives to focus efforts in achieving the overarching goals, the first is to support members and the industry in this transfer of knowledge. The Core Research Program is at the heart of PRCI and this initiative.

When PRCI was established as a committee to solve a single industry-wide issue- long-running brittle fracture in natural gas transmission pipelines- the swift success of that collaboration led to asking what other issues could be identified and resolved. The committee’s solution of that initial problem within two years demonstrated the impact and benefits of industry collaboration. By sharing information and forming a research partnership, the results were not just suggestions from an ivory tower model: the results were clearly usable and adoptable. The results improved the pipeline industry’s understanding of a significant issue it was facing which ultimately led to a safer system.

Almost seventy years later, the committee has grown from a handful of representatives comprised of fifteen pipeline operators to a formal association of seventy industry operators, service providers, and related organizations. The single committee of representatives evolved into the Core Research Program guided by eight technical committees, each representing its unique technical perspective of the energy pipeline transportation and storage system. A collaborative research portfolio aligning with industry priorities is produced each year using the leverage generated by members’ resource contributions to produce solutions that assure the safe, reliable, environmentally sound, and cost-effective pipeline transportation of energy to consumers worldwide. This translates into thousands of issues having been identified and addressed.

Combined resources lead to more cost-effective and ultimately safer pipeline operations. Through formal benefit/cost studies of member participation, these resources have been demonstrated to yield consistently positive ratios, ranging from a conservative 4:1 to as high as 25:1. These benefits can create reduced costs of operations and maintenance, inspection, materials, design, construction, and testing. However, results are only as good as the ability to adopt and use them. At the heart of PRCI is the safety of the global pipeline system; thus, results must ultimately be able to be used to improve the industry’s understanding of and provide solutions to the issues and key challenges.

Knowledge transfer is a critical component of the results, and PRCI is committed to making it better and easier to do. Thus, advancing PRCI’s Core Research Program and enhancing the adoptability and usability of the findings is a key focal point in enhancing member and stakeholder engagement. With the commitment and technical expertise of its members, PRCI continues to develop dynamic research devoted to identifying, prioritizing, and implementing the industry’s core research objectives. As a result, PRCI continues to be a critical resource for all energy pipelines regardless of where they operate, how they operate, or the purpose of their operations.

VISIT THE PRCI WEBSITE

TECHNOLOGY CENTERS

The overarching goals of the PRCI 2022-2024 Strategic Plan are to deliver innovative solutions that improve the safety and integrity of the global energy pipeline systems and enhance member and stakeholder engagement. The second of the three strategic initiatives in achieving the goals is to enable members and the industry to utilize real world samples and learnings to inform business decisions for safe and efficient operations.

As the pipeline system is aging, growing, and changing, this generation is the steward of its current and future integrity. This responsibility includes knowledge transfer of processes, technologies, and materials so that the industry continues to be better and safer than the previous. The path that we are now on requires sharing of information, because safety is not a competitive advantage.

Whenever there is a failure at any level, it is felt deeply throughout the industry and the public's trust is damaged. When we share this pain, we must ask ourselves what could have been done better. The answer is to share information.

The Technology Development Center (TDC) in Houston, Texas and the Virtual Technology Development Center (VTDC) are the physical and digital opportunities for leading the industry to innovative solutions. Opened in 2015, the TDC is the physical location designed to develop new and increasingly effective technologies and collaborate with others. The pipe sample library has real world defects upon which to test and refine tools. It's an excellent training ground for engineers and technicians. It's a hands-on place to create the data and tools which ultimately inform the decisions made for safe operations.

A new initiative by the PRCI will develop the VTDC, a virtual center for industry members to develop technology-based solutions for operating problems in the energy pipeline industry through shared information, learnings, and data collected during previous physical testing. As part of the VTDC, PRCI is undertaking a project that will improve voluntary sharing by consolidating shared operator learnings. Recalling the successes from the collaboration of PRCI members to resolve issues, it is only natural that we lead the return to a sharing mindset.

We are responsible for the safety of those around the pipeline systems. Why wouldn't you share information with others?

COMMITMENT TO THE ENVIRONMENT

Delivering innovative solutions that improve the safety and integrity of the global energy pipeline systems and enhance member and stakeholder engagement is the focus of PRCI's 2022-2024 Strategic Plan. To accomplish these goals, the third strategic initiative builds upon PRCI's legacy of environmental commitment to assist members and the industry in achieving a low carbon future and zero emissions. As a leader in pipeline research, PRCI is positioned to be the primary research body for eliminating emissions and enabling emerging fuels transportation and storage via the global pipeline network.

The environmental mobius loop that symbolizes reduce, reuse, and recycle is everywhere. As an industry, we have added reduce to our mindset in the transition to reduce carbon and move towards greener fuels. As our climate is being disrupted at an alarming pace, each of us must take steps to reduce our carbon footprint. The energy industry is responding to that call by transitioning to emerging fuels and as they are being developed, the pipeline industry must be ready to safely transport and store them. The successful system that has been in place for decades wasn't designed for them, and to replace them would be costly and wasteful. We need to find ways to safely reuse what's already in place where feasible.

As the world moves to the newer fuels, PRCI is identifying the gaps in our knowledge to innovate the solutions needed to transport and store the fuels. The Emerging Fuels Institute (EFI) was founded in April to enable PRCI members and nonmembers to address the challenges facing energy pipelines in the transition to the next generation of fuels. This collaboration space will be an important component in determining how emerging fuels will play a role in the safe and reliable delivery of energy. In that effort, PRCI has published state of the art reports conducting gap analysis and future research roadmapping for the transportation and storage of [hydrogen](#) & [renewable natural gas](#).

Introducing new fuels such as hydrogen into existing pipeline infrastructure creates challenges that need to be addressed to deliver these new energies safely and reliably. Every aspect of operational components must be evaluated to ensure safety. The technology used today will need to be innovated to respond to the unique challenges that using hydrogen and other emerging fuels will present.

PRCI is leading the way by focusing on applied research to support the safe transportation and storage of these emerging fuels.

OUR MEMBERS

Pipeline Members

ATCO Pipelines

BHE GT&S

Boardwalk Pipeline

Buckeye Partners, L.P.

Cadent Gas Ltd.

Chevron Pipe Line Company

Colonial Pipeline Company

ConocoPhillips

DCP Midstream

Enbridge Pipelines Inc. and Enbridge Energy Partners LP

Energy Transfer

Enterprise Products

ExxonMobil Pipeline Company

Flint Hills Resources

Gassco A.S.

GRTgaz

Kinder Morgan

Marathon Pipe Line LLC

N.V. Nederlandse Gasunie

National Fuel Gas Supply Corporation

National Grid

Pacific Gas and Electric Company

Phillips 66 Pipeline LLC

PipeChina North Pipeline Company

Plains All American Pipeline, LP

Saudi Aramco

Shell Global

Southern California Gas Company

Storengy

TC Energy

Total S.A.

Trans Mountain Canada Inc.

TransGas Limited

Williams Companies, Inc.

Pipeline Industry Organizations

American Petroleum Institute

Association of Oil Pipe Lines

Operations Technology Development

Technical Program Associate Members

Aegion Corporation

ArcelorMittal

Australian Pipelines & Gas Association - Research & Standards Committee

Baoshan Iron & Steel Co., Ltd.

CBMM

CNPC Tubular Goods Research Institute

Cooper Machinery Services

Cybernetix

Emerson Process Management

Endress+Hauser

Enduro Pipeline Services, Inc.

Evrax North America

Innospection Ltd

JFE Steel Corporation

KROHNE, Inc.

Mears Group, Inc.

NDT Global

Quest Integrity

RMG Messtechnik GmbH

SICK

Siemens Energy Inc.

Solar Turbines, Inc.

T.D. Williamson

Welspun Tubular LLC

Worley Group

Associate Members

Baker Hughes

China Petroleum Pipeline Engineering Co., Ltd. (CPP)

DNV GL

The ROSEN Group

MEMBERSHIP SPANNING THE GLOBE:

Australia

Canada

China

France

Germany

India

Ireland

Japan

Netherlands

Norway

Saudi Arabia

United Kingdom

United States

ACCOMPLISHMENTS & FINDINGS

STRATEGIC RESEARCH PRIORITIES

Identifying and executing Strategic Research Priorities (SRP) allows for PRCI to address key strategic industry initiatives and issues in which there are near term opportunities to develop significant outcomes for the industry and for the interest of the public.

Focusing efforts and funding to address significant industry challenges demonstrates PRCI's recognition of the current state of the industry and the position that it has in providing the key solutions needed to enhance the safety and integrity of our global pipeline systems.

By collectively identifying and executing SRPs, PRCI will improve efficiency and engagement by being more strategic and intentional about breaking down silos and working cohesively as groups to solve problems that cross disciplines. This allows PRCI to lead industry research in a more significant way by making impactful advancements in technology and R&D to improve pipeline safety and performance.

[SRP-MD-01 Optimize the Detection and Mitigation of Mechanical Damage](#)

More reliable pipeline transportation systems with better guidance to operators as to when a repair/replace decision is needed.

[SRP-CM-01 Pathway to Achieving Efficient and Effective Crack Management](#)

Pathway to Achieving Efficient and Effective Crack Management is expected to benefit industry by: Reducing failures; Impacting on regulations and recommendations; Eliminating excavations that are not necessary; and, Ultimately changing the way operators manage their systems in a safer and more cost-effective manner.

[SRP-GHG-01 Greenhouse Gases Emissions Reduction](#)

Reduced environmental impact of gases contributing to greenhouse gas emissions.

ACCOMPLISHMENTS & FINDINGS

COMPRESSOR & PUMP STATION TECHNICAL COMMITTEE

ABOUT THE COMMITTEE

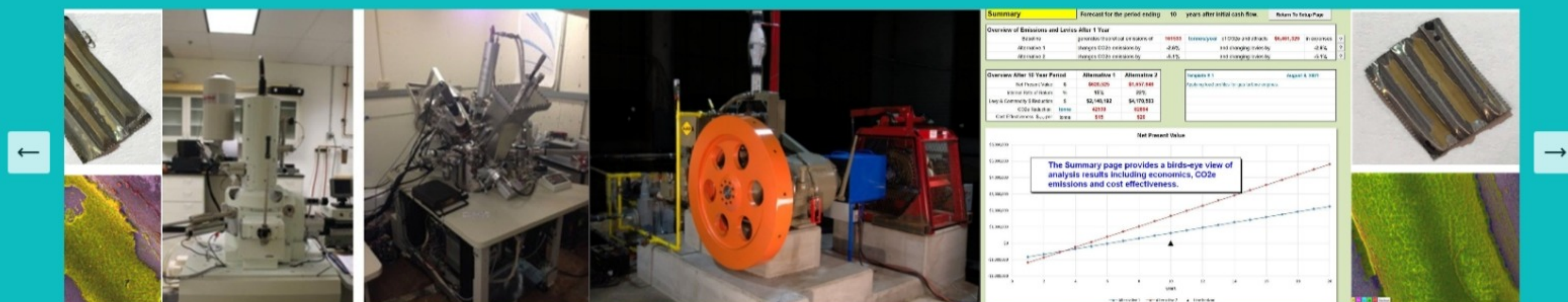
The [Compressor & Pump Station](#) is focusing on research efforts on minimizing the operating costs and capital requirements of compression and pump service while meeting market demands and all applicable environmental regulations. The current projects on the roadmap have a focus on:



- Reducing greenhouse gas emissions and improving compression efficiency
- Improved equipment reliability with a focus on dry gas seals and pump/motors
- Air emissions monitoring, measurement, and reductions
- Reducing the costs of operating gas turbines and liquid pumps
- Enhancing performance reliability

The committee has been working closely with other PRCI technical committees to continue the work associated with the Greenhouse Gas Emissions reduction SRP program. In 2021, eight projects were kicked off across four different committees. The work completed in 2021 has, and will continue to, guide future research efforts. Projects that support this cause include air emissions monitoring and measurement have also been recently initiated.

The committee continues to support and collaborate with other organizations to advance the focal areas above by providing both funding and providing technical resources to participate in ongoing research.



Texas A&M's Ajax E-565 engine testbed as used in PR-457-17201-R04, Residual Gas Fraction Estimation Based on Measured Engine Parameters -Phase IV (Photograph courtesy of Jacob Hedrick).

TECHNICAL COMMITTEE CHAIR:

Thomas Lumadue, *TC Energy*

VICE CHAIRS:

Howard Koop, *Enbridge*; Dan Rem, *Enbridge*

FEATURED REPORTS

[PR-663-20208-Z02 CO2e](#)

Economic Analysis Tool

The CO2e Economic Analysis Tool (CEAT) is a spreadsheet-based application for comparing project alternatives that are sensitive to GHG emission rates, emission levies, or other financial parameters. The tool is applicable to hydrocarbon transportation systems, with an emphasis on natural gas transmission. CEAT provides a comparative forecast of benefits and expenses (including levies) from initial cash flow to arrival at the forecast horizon.

Along with financial forecasting functions, the tool estimates the emissions associated with a wide range of hydrocarbon fluids (gas and liquid), electricity, thermal energy, and upstream transportation. The forecast model provides a flexible configuration of CAPEX and O&M expenses and a customizable levy structure. This updated version of the tool includes enhancements based on feedback from the first edition such as greater control of fuel use patterns. It also includes pre-designed, easily customizable analysis templates for situations that are likely to be repeated often in the field.

Key:

- Public Access
- Members Only
- Webinar Available
- Software Download

[PR-586-20205-Z01](#)

Pump Station Efficiency Improvement Evaluation

Pump station efficiency improvement is more complicated and specialized than simply following the latest industry trends. Liquids pipelines are different in many ways from comparable pumping environments. The pumps and electrical equipment are larger than in typical utilities, the stations on a pipeline are spaced out geographically over large parts of the country making maintenance and control more challenging. Much of what is researched and written is not applicable to the scale of liquid hydrocarbon pipelines, therefore, this report is unique in its examination of the factors that affect pump station efficiency and operating costs. Many practical and accessible means to improve pump station efficiency and reduce the cost of pumping liquid hydrocarbon are presented.

ADDITIONAL RESEARCH

[PO312-19200-E01](#)

Test Method Evaluation and VOC Exhaust Species for Natural Gas-Fired Reciprocating Engines

[PR-179-20200-R01](#)

Improved Catalyst Regeneration Process to Increase Poison Removal

[PR-312-18208-E02](#)

PRCI White Paper PVMRM Theoretical Issues and Recommended Solutions

[PR-312-18209-E03](#)

GHG Reporting Transmission Pipeline Blowdown Data Review and Emission Factor Trends

[PR-316-17200-R03](#)

A Study of the Effects of Liquid Contamination on Seal Performance

[PR-457-17201-R03](#)

Residual Gas Fraction Estimation Based on Measured In-Cylinder Pressure - Phase III

[PR-457-17201-R04](#)

Residual Gas Fraction Estimation Based on Measured Engine Parameters - Phase IV

[PR-457-17201-R04](#)

Residual Gas Fraction Estimation Based on Measured Engine Parameters - Phase IV

WEBINARS & WORKSHOPS

Improved Catalyst Regeneration Process to Increase Poison Removal and Performance Recovery

A Tool to Analyze CO2e Economics

[CO2e Economic Analysis Tool Workshop](#) [WORKSHOP]

Accomplishments & Findings

CORROSION TECHNICAL COMMITTEE

ABOUT THE COMMITTEE

The Corrosion Technical Committee focuses on industry challenges related to internal and external corrosion prevention and mitigation, as well as stress corrosion susceptibility evaluation and repair.



Prevention, mitigation, evaluation, and repair of corrosion damage.

Includes both conventional and stress corrosion cracking (SCC).



Experimental setup for a hydrogen permeation test.

TECHNICAL COMMITTEE CHAIR:

Trevor Place, Enbridge

VICE CHAIRS:

Jocelyn Nelson, ExxonMobil; Mohammad Al-Amin, TC Energy; David McQuilling, Pacific Gas and Electric Company; Benny Mumme, Flint Hills Resources; Didier JC. Caron, GRTgaz; Jeff Liang, Enbridge; Mohsen Achour, ConocoPhillips

FEATURED REPORTS

[PR186-203600-Z01](#)

Impact of Drag Reducing Agents on Corrosion Management

The purpose of this research was to understand the potential impact of drag reducing agents (DRA) on internal corrosion of liquid hydrocarbon pipelines.

The first task of this project included a comprehensive review of literature and knowledge, both in public domain and from industry experience, on the effect of DRA on water and solid transport in liquid hydrocarbons, and possible interactions with other performance chemicals typically used in the oil and gas industry. This was the basis for defining the final bench test methodology and test matrix to be performed in the second task.

A novel bench-top apparatus was designed based on a vertical Couette cell approach, and a test methodology was successfully implemented to evaluate the potential effect(s) of DRA on water accumulation and localized corrosion at the oil/water interface. A test matrix was conducted with two DRAs (a water based and an oil based) and two corrosion inhibitors (a water soluble and an oil soluble) at a given test condition (3.5% NaCl saturated with 97%CO₂/3%O₂, pH ~6 at 80 oF).

[PR261-193604-R01](#)

Optimizing Stress Corrosion Cracking Management - Field and Economic Study

This work aims to improve pipeline segment prioritization for stress corrosion cracking (SCC) excavations. Specifically, it is aimed at optimizing the technical accuracy and the cost of the Association for Materials Protection and Performance (AMPP, formerly NACE) Stress Corrosion Cracking Direct Assessment (SP0204-2015) process by:

evaluating the SCC susceptibility criteria of soil property parameters that were proposed in the first phase of the project (pH, resistivity, sulfide concentration, soil carbon dioxide (CO₂) concentration, carbonate concentration, soil oxygen (O₂) concentration, sulphate reducing bacteria (SRB) concentration, oxygen reduction potential (ORP), soil moisture content, soil effect on steel hydrogen permeation and electrochemical properties)

investigating the technical and economic feasibility of using commercially available field instruments for the measurement of these soil parameters to overcome limitations of laboratory testing (e.g., sample preservation and external costs)

Soil sampling and testing was conducted at twenty-two dig sites in three geographic regions in the USA and Canada. On-site soil sampling and testing activities were conducted by field service providers using commercially available portable instruments. Soil samples were sent to laboratories for chemical analysis and for electrochemical characterization. The data analysis consisted of: (i) comparison of soil properties obtained at sites with and without SCC against the proposed SCC susceptibility criteria (ii) comparison of soil property data obtained in the field to those obtained through laboratory analysis (iii) comparison of soil property data obtained using different field and lab measurement techniques (iv) comparison of costs associated with performing in-field measurements to those of laboratory analysis.

[PR378-173601-Z01](#)

Effect of Pressure Fluctuations on the Growth Rate of Near-Neutral pH SCC

This report summarizes the work completed in PRCI SCC-2-12A project: The Effect of Pressure Fluctuations on the Growth Rate of Near-Neutral pH SCC, which is Phase 3 of the work on the same subject of investigation. The following insights from the current phase of the PRCI SCC-2-12A project are thought to be the most important:

Near neutral pH crack initiation is pressure-fluctuation dependent. Severe pressure fluctuations accelerate the fracture and spallation of mill scale on the pipeline steel surfaces, making it harder to initiate SCC cracks from the bottom of pits that are developed at flawed mill scale sites. On the other hand, the presence of a primer layer before application of the protective coating preserves the mill scale on the pipe steel surface and promotes crack initiation.

The early-stage crack growth primarily features crack length extension on the pipe surface but limited crack growth in the depth direction. Three different mechanisms of crack length extension have been identified, including that determined by the geometry of coating disbondment, a chaotic process of crack coalescence, and the ability of existing cracks to induce further crack initiation and growth. This latter process is pressure-fluctuation sensitive.

A complete set of equations governing crack growth in Stage 2 has been established based on experimental specimens with surface cracks under mechanical loading conditions realistic to pressure fluctuations during the operation of oil and gas pipelines.

The contribution to crack growth by direct dissolution of the steel at the crack tip has been determined, which has been found to be crack depth-dependent and pressure-fluctuation-sensitive. Gas pipelines operated under high mean pressure show higher rates of dissolution.

The severity of crack growth and the accuracy of the predictive model can be significantly affected by crack tip morphology, either sharp or blunt, and this would yield different threshold values for Stage 2 crack growth and therefore different lengths of remaining life.

Full scale testing was performed and has validated the crack growth models contained herein.

The PipeOnline software has been revised to incorporate the new experimental results obtained from the current PRCI SCC 2-12A project. This PipeOnline software was previously developed from the two earlier phases of the PRCI project.

ADDITIONAL RESEARCH

[PR186-203600-Z01](#)

Impact of Drag Reducing Agents on Corrosion Management

[PR261-193604-R01](#)

Optimizing Stress Corrosion Cracking Management - Field and Economic Study

[PR378-173601-Z01](#)

Effect of Pressure Fluctuations on the Growth Rate of Near-Neutral pH SCC

WEBINARS & WORKSHOPS

Impact of Drag Reducing Agents on Corrosion Management

Optimizing Stress Corrosion Cracking Management - Field and Economic Study

Effect of Pressure Fluctuations on Growth Rate of Near-Neutral pH SCC - PipeOnline Software [WORKSHOP]

ACCOMPLISHMENTS & FINDINGS

DESIGN, MATERIALS & CONSTRUCTION TECHNICAL COMMITTEE

ABOUT THE COMMITTEE

The [Design, Materials & Construction](#) (DMC) Technical Committee focuses research efforts on the development of safe, environmentally responsible, cost-effective, and reliable solutions for the design, construction and operation of energy pipelines. DMC research enhances the performance of new pipelines through development and implementation of new design methods, materials, and construction technologies.



Unrepaired Sample in a pressure testing chamber for MATR-3-13 Project Evaluating Installation Techniques for Pipeline Repair Methods

TECHNICAL COMMITTEE CHAIR:

Stephen Rapp, *Enbridge*

VICE CHAIRS:

Smitha Koduru, *Enbridge*; Mery K Turner, *ExxonMobil*; Nick Khotenko, *ATCO Ltd*;
Jessica de Vries, *TC Energy*; Russell Scoles, *Enbridge*;
Jorge Penso, *Shell*; Junfang Lu, *Enbridge*

FEATURED REPORTS

[PR186-184507-R01](#)

Guidance for Application of Higher Strength E8010 Electrodes for Root Pass Welding

This Milestone Deliverable M02-T04 is draft guidance for the application of higher strength E8010 electrodes for root pass welding. The guidance discusses E8010 root pass weldability, operability, and productivity, and provides recommended applications and precautions for using E8010 electrodes for root pass welding.

Subsequent Milestone Deliverable M02-T05 will be final guidance, based upon project team feedback to this draft.

[PR652-184505-R01](#)

Evaluating Installation Techniques for Pipeline Repair Methods

A testing program was conducted to evaluate the effects of internal pressure during the installation of composite and steel sleeves repair systems on pipelines with plain dents. The testing program included cyclic pressure testing a group of 12.75-inch OD x 0.188-inch WT, Grade X42 pipe samples with plain dents having residual dent depths on the order of 3% to 4% of the pipe's outside diameter. The dent samples were repaired using four (4) different composite repair systems, type-A steel sleeves, and steel thermal compression sleeves. The composite repair systems included a carbon fiber wet-layup, an E-glass wet-layup, a system with precured plies, and a hybrid composite-steel repair system. To determine the effect internal pressure has on repair installation for dents, all repairs were installed with an internal pressure of 64% SMYS (793 psig) in the pipe sample. The dent samples were then pressure cycled between 8 – 80% SMSY ($\Delta P = 900$ psig) until failure or reaching the runout condition of 250,000 cycles. Only three (3) out of the fourteen (14) repaired dents reached the 250,000 pressure cycle runout condition and these samples were all repaired using steel sleeves. The maximum number of cycles reached by any composite repair was approximately 200,000 cycles while the least number of cycles reached was approximately 24,000 cycles.

In addition to the dent repairs, two (2) 12.75-inch OD x 0.375-inch WT, Grade X42 pipe samples with a 6-inch x 8-inch corrosion defect were repaired with an E-glass wet-layup. These two (2) samples were a continuation of a previous study that investigated the effects of a 50% SMYS (1,235 psig) installation pressure on the fatigue performance of corrosion repairs. Both samples reached the runout condition of 250,000 cycles.

The body of work is seminal in that it is the first time that industry was evaluated a wide range of repair technologies to determine the effects of pressure during installation in reinforcing plain dents. It has been speculated for some time that internal pressure present during installation of composite repair technologies has an impact on fatigue performance. Although corrosion features do not appear to be a concern, the reinforcement of dents with internal pressure requires careful consideration. Because gas transmission pipelines do not experience aggressive pressure cycling, the effects of pressure present during installation are not a major concern. However, liquid transmission pipeline operators should be cognizant of the pressure effects and respond accordingly. Namely, pressure should be reduced during installation as much as possible.

ADDITIONAL RESEARCH

[PR186-184507-R02](#)

Evaluate Higher Strength Consumables for Manual Root Beads in X70

[PR-218-174512-R01](#)

Full-Scale Surface Loading Testing of Buried Pipes

[PR-350-174507-R03](#)

Interim Recommendations for the Mitigation of Low-Strain Girth Weld Failures

[PR-350-174509-R01](#)

Enhancing Strain Capacity of Pipelines Subjected to Geohazards

[PR350-174515-R01](#)

Guidance on Excavation and Backfill in Areas of High Axial Strain and Stress

[PR-650-174516-R01](#)

Corrosion Resistant Weld Overlays for Pipeline Installations

WEBINARS

Composites - Systems for the Repair of Corrosion and Mechanical Damage Part 3

Improving the Assessment of Cracks Clusters with Intelligent Interaction Rules - Part I

Improving the Assessment of Cracks Clusters with Intelligent Interaction Rules - Part 2

Interim Recommendations for the Mitigation of Low-Strain Girth Weld - Part 1

Interim Recommendations for the Mitigation of Low-Strain Girth Weld - Part 2

Evaluate Higher Strength Consumables for Manual Root Beads in X70 Girth Welds

Guidance on the Excavation and Backfill Procedures in Areas of Geohazards and High Axial Stress and Strains

High Stresses Created by Integrity Digs and Construction

Key:

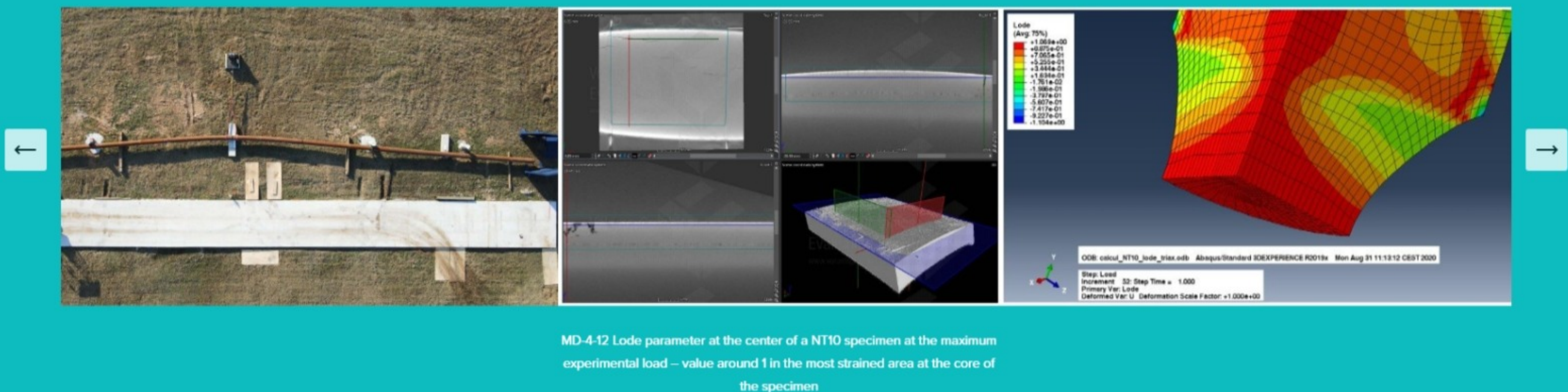
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ACCOMPLISHMENTS & FINDINGS

INTEGRITY & INSPECTION
TECHNICAL COMMITTEE

ABOUT THE COMMITTEE

The [Integrity & Inspection](#) (I&I) Technical Committee improves the reliability of the pipeline infrastructure and ensure the continuity of public service through the development and successful deployment of technologies associated with mechanical damage, pipeline integrity management, and associated inspection technologies.



VICE CHAIRS:

Joshua Bremner, Phillips 66: Inline Inspection; Richard Kania, TC Energy: Non-destructive Evaluation; Travis Sera, Southern California Gas Company: Difficult-to-inspect; Taylor Shie, Shell: Integrity Management; Dr. Mures F Zarea, Engle on behalf of GRTgaz: Mechanical Damage; Sean Keane, Enbridge: Crack Management

FEATURED REPORTS

[PR-306-143732-R02](#)

Lode Parameter Effect on Critical Strain in Mechanical Damage Defects

In this report, an advanced failure initiation criterion based on plastic deformation is presented and its use is discussed. The approach is based on the actual stress state and the plastic strain development within the defect region, as these two quantities have been demonstrated to drive the failure of ductile metallic materials. Two steel grades were selected to benchmark the suggested criterion and were fully characterized throughout a comprehensive laboratory testing campaign; where specific specimen geometries were designed so that a given stress state could be achieved in terms of stress triaxiality and Lode parameter. The latter has emerged in more recent studies as having a significant effect, in addition to stress triaxiality. Recent experiments showed that the Lode parameter, which distinguishes between axisymmetric and shear dominated stress states, has an effect on material ductility, especially at low stress triaxiality.

The effect of the Lode parameter on plastic strain to failure was experimentally observed in our case studies. It confirms the importance of accurately evaluating stress and strain fields in the pipe wall deformed by mechanical damage, but also the need of reliable material data base to enable engineers to conduct conservative engineering critical assessments as predictive as possible.

In addition, the introduced criterion has been numerically implemented in a FE code and tuned so that simulations are in good agreement with experiments. The criterion is so called “un-coupled model” since the plastic behavior is not affected by development of ductile damage during the calculation. It is used as a post-processing script which evaluates a damage indicator for each calculated increment, and failure initiation is expected when the criterion reaches unity.

Damage model was investigated on pipe specimens only, and its application has not been extended to actual defects on real pipelines in the scope of this study. It could be in a subsequent project.

[PR-335-203810-R01](#)

Review of Xray Computed Tomography Performance

X-Ray Computed Tomography (XRCT) has been utilized for decades in medical and industrial imaging applications. The technology uses penetrating X-ray radiation to image the internal structure of an object by measuring attenuation along multiple transmission paths through the object. XRCT is a promising technology for application in imaging and sizing of flaws in oil and gas transmission pipelines and has been used in such applications in the past. However, the performance of the technology in this specific application to flaw sizing in oil and gas pipelines has not been fully evaluated. The purpose of this report is to provide a complete statistical analysis of the flaw sizing error of XRCT by consolidating flaw sizing information from past projects where both XRCT data and cross-sectional micrographs were available for comparison. Sizing error data were evaluated as a whole and as segments in order to determine overall sizing performance and per-flaw-type/per-measurement-type sizing performance, respectively.

ADDITIONAL RESEARCH

[PR186-203813-R01](#)

Literature Review Pipeline Mid-wall Defect Detection and FFS Assessment

[PR-335-203810-R02](#)

Review of X-Ray Computed Tomography for Nondestructive Evaluation of Pipelines

[PR652-203801-R01](#)

Large Standoff Magnetometry (LSM) Technology Literature Review

[PR652-203801-R02](#)

Magnetic Object Model for Large Standoff Magnetometry Measurement

[PR-652-203801-R04](#)

Magnetometer Noise and Resolution

[PR-670-183826-R02](#)

Extended Evaluation of LSM - Magnetic Measurements of Corrosion Flaws

[PR-670-183826-R03](#)

Extended Evaluation of LSM-Magnetostrictive Pipe Models

WEBINARS

Best Practices for SCC

Software Specification to Support SCC Interacting Crack Length

Determination

Key:

- Public Access
- Members Only
- Webinar Available
- Software Download

ACCOMPLISHMENTS & FINDINGS

MEASUREMENT TECHNICAL COMMITTEE

ABOUT THE COMMITTEE

The [Measurement Technical Committee](#) focuses on measurement technology research related to improving the safety, performance (accuracy, uncertainty), environmental impact, and operating cost (operability, maintainability, reliability) of oil and gas transportation systems. The Measurement Technical Committee prioritizes research that supports industry standardization. The current projects on the roadmap have a focus on:



- Gas Metering
- Gas Measurement - Instrumentation & Laboratory
- Non-Traditional Gas Supplies / Emerging Fuels
- Liquid Metering
- Liquid Measurement - Instrumentation & Laboratory
- Instrumentation in Gas & Liquid Service

The committee continues to monitor and analyze the current conditions of the industry and adjusts its roadmap to provide the best support to members and operators. It also continues to support larger industry efforts such as the Greenhouse Gas Emissions reduction SRP program by providing leadership and technical resources, has members participating in the development of the leak detection candidate SRP program, and has ongoing complementary work to the emerging fuels institute. Core work also continues around ultrasonic flow meters specifically understanding flow conditions and their impact measurement, verifying clamp-on meter performance, and working to determine methods for in-situ flow verification. On the liquids side, members are working to better understand the formation of the rag layer so operators can better handle it and improve their measurement protocols.



PR-015-19606-R01 in-situ USM flow verification testing setup at the Southwest Research Institute Metering Research Facility.

TECHNICAL COMMITTEE CHAIR:

Chris Levy, *Chevron*

VICE CHAIRS:

Nathan Feldpausch, *Enbridge*; Jonatan A Mustafa, *Energy Transfer*

FEATURED PROJECTS

[PR-282-20601-R01](#)

High Pressure Calibration of Turbine and USMs with an Inert Gas

The response of gas flow meters to different gases and the accompanied potential uncertainty increase is an important subject in industry. Multiple measurement technologies exist and are expected to behave differently under the change of gas type and when operating under different pressure. The main interest of PRCI is the response of custody transfer gas flow meters to natural gas and air in the range of pressures between atmospheric and 100 bar (1500 psi). Understanding of the response of these flow meters may enable the calibration of these meters under conditions different from the actual field condition in expense of additional uncertainty.

[PR-015-19606-R01](#)

In-Situ Ultrasonic Gas Meter Flow Verification

This project provided proof of concept for an in-situ verification method for ultrasonic flow meters in natural gas service. The tested method consisted of simultaneously injecting helium in a minimum of two locations upstream from an ultrasonic flow meter at a known distance apart. The results from this project showed the flow verification method was successful in determining the gas velocity through an ultrasonic flow meter to within $\pm 5\%$. These results indicate that the tested in-situ verification method is not accurate enough to replace a laboratory flow calibration but could be used as a field diagnostic tool. The accuracy of the results and the scatter in the data were correlated to the distance between the injection points.

Key:
 Public Access
 Members Only
 Webinar Available
 Software Download

ADDITIONAL RESEARCH

[PR-000-21COMP-R03](#)

Flow Conditioning Compendium

[PR-004-20602-R01](#)

Technology Assessment of Applicable Methods for Dithiazine Analysis

[PR-015-20600-R01](#)

Flow Testing of FS500 Meters

[PR-179-19601-R02](#)

Evaluation of Online Analyzers for Measurement of Multiple Gas Contaminants

WEBINARS

Solvent Replacement Methods for Sediment and Water Content in Crude Samples

Impact of Composite Sample Mixing Methodology and Centrifugal Forces on Density Determination and S&W Results

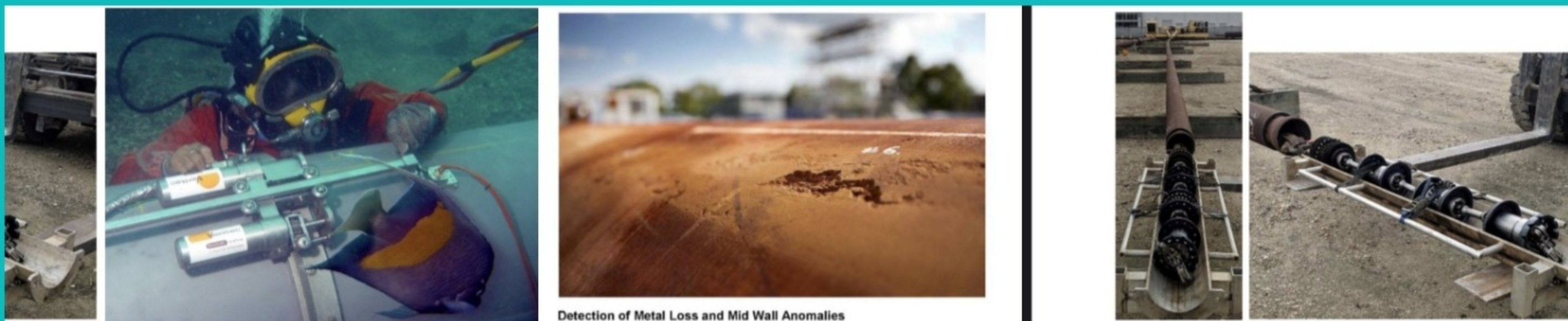
Practical Effects of Rough Walled Pipe in Gas Metering Applications

ACCOMPLISHMENTS & FINDINGS

SUBSEA TECHNICAL COMMITTEE

ABOUT THE COMMITTEE

The [Subsea](#) Technical Committee focuses on issues and challenges unique to the offshore pipeline environment through research focusing on Subsea Pipeline Integrity Management (SPIM) and Subsea Pipeline Direct Assessment (SPDA). The research deliverables target improvements to risers, on-bottom stability and pipe to enhance performance through development and implementation of new design methods, materials, and construction technologies



Detection of metal loss and mid wall anomalies

TECHNICAL COMMITTEE CHAIR:

Jamey Fenske, ExxonMobil

VICE CHAIRS:

Ludovic Assier, Total; Benjamin Damonville, Total S.A.; Farzan Parsinejad, Chevron

FEATURED RESEARCH

[PR164-205102-R01](#)

Application of Probabilistic Fracture Mechanics to Engineering Critical Assessment

This report summarizes the results of a series of deterministic and probabilistic fracture and fatigue calculations carried out in order to:

- Demonstrate that ProCW correctly implements probabilistic ECA, eg by comparing selected deterministic and probabilistic calculations,
- Show the effect of the choice of K-solution on the fatigue life and POF of pipes containing a circumferential flaw,
- Implement a two-stage probabilistic model of fatigue crack growth, in both air and marine environments,
- Consider the effects of modelling the fatigue crack growth threshold probabilistically,
- Demonstrate the use of ProCW for a representative riser geometry and a complex loading spectrum,
- For the same riser geometry/loading scenario, compare the POF implied by the use of design fatigue safety factors given in DNVGL-ST-F101 [2], DNVGL-RP-F204 [3] and DNVGL-RP-F201 [4] with the POF calculated directly from probabilistic calculations.

There is a related webinar.

[PR-652-195104-R02](#)

Development of Heavy Wall ILI Test Samples

Guidance is needed for the pipeline industry's in-line inspection (ILI) technologies as current industry practices address mainly thin-wall pipe specifications as well as spool and defect design. Heavy-wall pipe is mostly found in subsea applications where the predominant threats are internal; however, external defects cannot be discounted. Nondestructive evaluation (NDE) sensing technologies for heavy-wall pipe often have very different specifications for examining external versus internal defects.

The end uses for ILI technologies in the heavy-wall subsea applications often put a premium on low limits of detection for purposes of gauging time-dependent growth of internal wall loss rather than for fitness for service assessments. The test samples associated with the current study considers both. Post run ILI performance verification via external NDE, as is often employed for onshore applications, is prohibitively expensive for offshore applications. Thus, a high confidence in the ILI tool performance is required prior to run execution. This often drives project specific ILI performance testing and verification via an onshore pull testing as described herein. The seven categories from the Pipeline Operators Forum (POF), with an emphasis on external integrity condition performance, do not address the reasons pipeline operators may require project-specific, large-scale testing in advance of deployment. PRCI commissioned the SPIM-1-6 project to provide guidance on the design of ILI test samples for both training and blind validation purposes. It is envisioned that a standardized design process will lead to resource sharing between operators and ILI providers.

ADDITIONAL RESEARCH

[PR-393-205100-R01](#) ★

IRIS X-Ray CT Qualification for Flexible Pipe Inspection (Phase 1)

[PR-453-134504-R05](#) ★

On Bottom Stability Upgrade - MS III

WEBINARS

Application of Probabilistic Fracture Mechanics (PFM) to Engineering Critical Assessment (ECA) 📺

Design and Capabilities of the Magnetic Eddy Current (MEC) Pig 📺

Key:

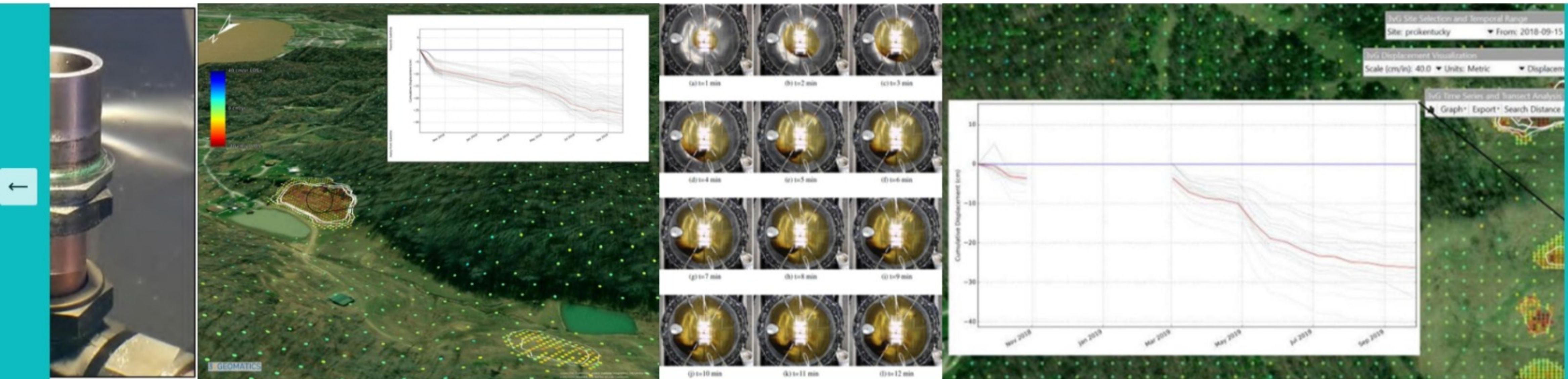
- 🔵 Public Access
- ★ Members Only
- 📺 Webinar Available
- 📄 Software Download

ACCOMPLISHMENTS & FINDINGS

SURVEILLANCE, OPERATIONS & MONITORING TECHNICAL COMMITTEE

ABOUT THE COMMITTEE

Products resulting from research activities conducted under the [Surveillance, Operations, & Monitoring](#) (SOM) Technical Committee improve the integrity of the pipeline infrastructure and the continuity of public service through the development and successful deployment of technologies identify Right-of-Way threats, leak detection, and damage prevention.



Time lapse images from On-Water Leak Detection Technology Evaluation

TECHNICAL COMMITTEE CHAIR:

Nikos Salmatanis, *Chevron Energy Technology Company*

VICE CHAIRS:

Mike McCutcheon, *TC Energy*; Chris O'Neill, *Enbridge*

FEATURED REPORTS

[PR-686-183908-R01](#)

InSAR Monitoring of Pipeline Geohazards in Vegetated and Very Large Non-Vegetated Areas

Using InSAR, 3vGeomatics has performed a proof of concept on the effectiveness, reliability, and precision of using L-band SAR satellites for InSAR monitoring of vegetated areas and C-band satellites for monitoring in non-vegetated areas. The InSAR displacement estimates are compared to ground truth data including differential light detection and ranging (LIDAR), in-line-inspection, and ground survey measurements. The goal of this project was to operationalize ongoing InSAR monitoring programs for pipeline networks in vegetated areas and very large non-vegetated areas for operating members.

[PR-244-193900-R01](#)

Oil-on-water Leak Detection Technology Evaluation Phase 2

Industry is directing efforts toward reducing the environmental impact of operation through improving pipeline performance and addressing evolving regulatory requirements. As a result, external leak detection technologies have been recently developed. However, testing these systems with real hydrocarbon products in-situ is challenging. This research project was developed to assess these external leak detection technologies' abilities to identify the presence of hydrocarbon products on the surface of water. In the first phase of the project, testing was limited to an idealized freshwater environment under ambient conditions. The second phase, described herein, was expanded to a freshwater environment under freezing conditions, where the surface of the water is frozen over. Testing was performed by releasing each test fluid (diesel, Synthetic Sweet Blend and Access Western Blend) into basins containing individual sensors. Releases were performed above the ice surface, below the ice surface, and onto the water surface after freeze/thaw cycles. Each sensor's response to contact with the test fluid was monitored and compared based on time to detection and estimated slick thickness at detection.

Key:

- Public Access
- Members Only
- Webinar Available
- Software Download

ADDITIONAL RESEARCH

[PR-670-183906-R0](#)

Literature Survey of Sensor Capability Embedded In Coating for Leak Detection

[PR667-183902-Z01](#)

Pipeline Assessment Tool for Human Factors (PATH) Users Guide

WEBINARS

[InSAR Monitoring of Pipeline Geohazards in Vegetated and Very Large Non-Vegetated Areas](#)

[On-water Leak Detection Technology Evaluation – Phase 1 & 2](#)

ACCOMPLISHMENTS & FINDINGS

UNDERGROUND STORAGE TECHNICAL COMMITTEE

ABOUT THE COMMITTEE

The [Underground Storage](#) Technical Committee is focused on developing and deploying technologies to ensure the safety, integrity, reliability, and productivity of new and existing storage facilities, including both reservoir and cavern storage.



US-3-J Testing at C-FER's Deep Well Simulator

TECHNICAL COMMITTEE CHAIR:

Anders Johnson, Kinder Morgan

VICE CHAIRS:

Dan Neville, Southern California Gas Company
Mark Thompson, Enterprise Products

FEATURED PROJECTS

[PR-244-18702-R01](#)

Evaluation of Casing Integrity for Underground Storage Wells

This work was funded in part, under the Department of Transportation, Pipeline and Hazardous Materials Safety Administration. The views and conclusions contained in this document are those of the authors and should not be interpreted as representing the official policies, either expressed or implied, of the Pipeline and Hazardous Materials Safety Administration, the Department of Transportation, or the U.S. Government.

C-FER Technologies (1999) Inc., ("C-FER") conducted a multi-phase study to further advance the ability to predict the remaining casing burst capacity for underground natural gas storage wells. This project is co-funded by the Pipeline Research Council International, Inc. (PRCI) and the US Department of Transportation (DOT), Pipeline and Hazardous Materials Safety Administration (PHMSA).

This project included a literature review of casing corrosion logging technologies and remaining burst capacity prediction models. Three casing corrosion logging tools, selected based on the outcome of a preceding PRCI casing logging tool test program, were tested to further evaluate their performance in detecting and sizing various metal loss features on casing specimens. Physical burst tests with capped ends were conducted on 20 specimens selected from the logged casing joints to benchmark the burst prediction models. Advanced finite element analysis (FEA) was also performed to evaluate the effect of in-situ downhole load conditions on the remaining burst capacity of corroded casing. A reliability-based framework was outlined to quantitatively address various uncertainties associated with the casing corrosion integrity management. This report summarizes the work completed, the key results and conclusions, as well as recommendations for future initiatives.

[PR-593-18700-R01](#)

Brine String Dynamics IV Deformation-Vibration in Solution Mined Caverns

The research described in this report is focused on the dynamics of the brine strings utilized in solution-mined caverns. In Configuration 3, fluid enters the system from the top of the brine string and exits via the annulus between the brine string and the casing. In Configuration 4 the flows are inverted. An improved analytical model for stability of the brine string in Configuration 3 has been generated, and considerably better modelling for Configuration 4 achieved. Experiments in a bench-top sized system and CFD work were pursued partly to further improve the analytical models, and partly to explain some unexpected observations from a full-scale cavern, reported by Reitze in 2019.

Note: Phase IV of this research was funded jointly by the Solution Mining Research Institute (SMRI) and Pipeline Research Council International (PRCI), and SMRI has published this same report with some formatting differences

[PR-591-20700-R01](#)

Wellhead Seals Best Practices

Wellhead seals are a key component of reservoir and salt-cavern storage wells that function to seal the well from the external environment and separate stored fluids contained within the well. Loss of integrity of these seals or seal failures are a common occurrence in the storage industry. Practical guidelines on how to choose the proper sealing components and prevent seals from failing are generally lacking.

In this study, data related to wellhead sealing were compiled through a literature review, discussions with wellhead experts, and a survey distributed to Pipeline Research Council International (PRCI) members and others involved in the industry. Through the evaluation of this data, meaningful parameters involved in successful and failed seals were identified and best practice recommendations were provided on seal selection and wellhead design.

There is a related webinar.

ADDITIONAL RESEARCH

[PR-317-10701-R01](#)

Temperature Logging as a Mechanical Integrity Test (MIT) for Gas-Filled Caverns

[PR-681-18701-R01](#)

Evaluating the Use of Optical Gas Imaging Cameras for Above Ground Facilities

[PR-427-12701-R01](#)

Review of Mechanisms That Lead to Well Cement Deterioration

[PR-244-16704-R01](#)

Casing Corrosion Logging Tool Test

[PR-317-17700-WEB](#)

Accuracy of Temperature Logging for Calculating Gas Inventory in Storage Caverns

WEBINARS & WORKSHOPS

Wellhead Seals Best Practices

Accuracy of Temperature Logging for Calculating Gas Inventory in Storage Caverns

Hydrogen Storage Workshop Agenda:

- [Day 1: DOE Shasta and SoCalGas](#)
- [Day 1: Sandia National Laboratories and Baker Hughes](#)
- [Day 1: WSP, BEG, C-FER, Sandia National Laboratories, PG&E](#)

KNOWLEDGE TRANSFER

Translating research from scientific methods and laboratory results into practical applications has been a key focus at PRCI in recent years. PRCI webinars provide the industry* with the opportunity to learn firsthand from the research partners and project teams who executed the research on how an operator can benefit from using the research and how best to implement it.

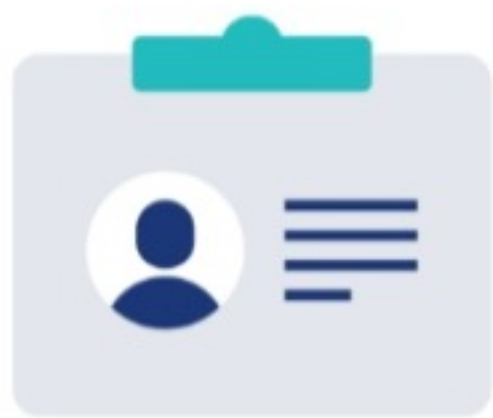
2021 BY THE NUMBERS:



24 WEBINARS



1.1K RECORDING VIEWS



11.9K REGISTRANTS



2.7K ATTENDEES



58% ATTENDANCE RATE

TOP 3 PRCI WEBINARS



1. [Best Practices for SCC](#)
2. [High Stresses Created by Integrity Digs and Construction](#)
3. [Guidance on the Excavation and Backfill Procedures in Areas of Geohazards and High Axial Stress and Strains](#)

PRCI WEBINAR LIBRARY

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Members must login to view member-only content.
**excludes member-only research*

2021 AWARDS

CONGRATULATIONS TO OUR AWARD WINNERS!

Presented at VREX 2021, four members were honored for their work with Distinguished Service Awards. These individuals were nominated by their peers for their service to the energy pipeline industry through a sustained commitment to PRCI and noteworthy contributions to the achievement of its mission, goals, and programs

One member was honored with the Distinguished Researcher Award for dedicated and distinguished service and scientific achievements that have enhanced the integrity, reliability, and environmental performance of energy pipelines around the world

11

DISTINGUISHED SERVICE AWARDS 2021

For distinguished service to the energy pipeline industry through a sustained commitment to PRCI and noteworthy contributions to the achievement of its mission, goals, and programs



Michael Cook

After nearly 39 years working for ExxonMobil in advancing pipeline and riser technology, both offshore and onshore, Mike recently retired as Senior Engineering Manager at the end of January of this year.

Mike has been an active member of PRCI's Design, Materials, and Construction Technical Committee since 2010, with a focus on broadening industry acceptance of strain-based design and advancing geohazard management technology, most recently serving as the Vice Chair in those areas. Mike led PRCI research efforts to develop an SBD state-of-the-art report and multiple follow-up efforts to further advance SBD technology, including providing feedback to PHMSA on their initial SBD special permit; outlining the steps that should be considered if there is a significant ground movement event on a pipeline right-of-way; and a joint PHMSA-PRCI effort to advance technology to manage pipelines that cross waterways. He has always been a strong advocate for industry to robustly design pipelines in geohazard terrain or anywhere that ground movement can occur. Mike is also a positive mentor for new engineers and has always been willing to share perspective and strives to bring the best results.



Steve Koetting

Steve joined Mobil Pipe Line Company in 1982 and has enjoyed working in the pipeline business continuously for the last 39 years.

He's worked in a variety of fields including Pipeline Design & Construction, Control Center & Field Operations, Project Development, Recruiting and Training, and Major Project Execution but spent the majority of his career in Pipeline Integrity Management. When he transitioned into Integrity Management in 2001, and he saw the value of participating in PRCI as a means of helping him write ExxonMobil's IMP processes and procedures using the latest research and the most up to date technical knowledge to support decision making. We are proud to have this year mark Steve's entry into the PRCI 20-year club!

He would like to share that his dear colleagues and mentors helped him understand that the value of PRCI is in the relationships built with fellow Technical Experts and in using science to build bullet-proof Research Reports to support appropriate integrity and operations decision making. To that end he has worked on and voted on hundreds on PRCI Projects and Technical Reports and doesn't ever plan to stop!

And while Steve doesn't plan to stop, he also advocates for developing the next generation of pipeliners, as one of the founding senior advisors in the formation of the Houston Branch of YPP in 2015, and has mentored 30 young engineers in getting their PE Licenses.



Walter Kresic

Currently the Vice President of Pipeline Integrity & Innovation for Enbridge, Walter is accountable for the pipeline integrity management standards and programs applied to mainline pipelines and facilities. He also oversees the Innovation, Research, and Development program for the Liquids Pipelines division. Walter has over 30 years of experience within the pipeline industry and has been involved in PRCI for about 20 years in a variety of roles from committee member, Executive Assembly member, and now as Chair of the Board.

Walter truly embraces PRCI's model of collaboration and would tell you that his roles in PRCI have all been in support of others that were far greater experts than him on matters, and to ensure to align his company's participation accordingly. In short, he would express that his passion has been to have his member company be an organized, committed, and contributing participant to PRCI and to the industry. All in all, Walter would state his greatest accomplishment at PRCI has to be meeting and getting to know industry people that became some of his best friends and comrades.



Donald Drake

PRCI and the industry were devastated to hear of Don's passing five years ago. Don was a long standing member of and valued contributor to the PRCI Corrosion Committee and was also actively engaged in many other industry associations. With 45 years of industry experience, he was an extremely talented corrosion engineer who always made time to mentor and support his colleagues in the industry. He was constantly touted as one of the smartest people in the room, and that shouldn't come as a surprise after receiving three Masters of Science degrees. Don also enjoyed international travel and spent a lot of time in Saudi Arabia, Nigeria, Ecuador, and Indonesia in the middle of his career.

Don was well known for his signature look and commitment to professionalism and professional conduct. While few shared his belief that an engineer should always wear a white shirt and jacket, as he did at every PRCI meeting, Don did not in any way force that belief onto others. He was the embodiment of professionalism.

His wife Tan Than Drake and daughter Tiffany Drake are joining us in the ceremony today and will pass it on to their family. They have expressed their sincere gratitude on behalf of Don and their family for his colleagues' recognition of his dedication to the industry. They would tell you that Don was a man of dedication, modesty, and sincerity. He often shared with them how much he enjoyed serving the industry and working with his peers whom he regarded as his friends.

DISTINGUISHED RESEARCHER AWARD 2021

For dedicated and distinguished service and scientific achievements that have enhanced the integrity, reliability, and environmental performance of energy pipelines around the world.



Mark Stephens

As a Senior Engineering Consultant and the Chief Engineer at C-FER Technologies, Mark has been a leading researcher for PRCI for more than 25 years. He has applied his combined analytical and experimental expertise to lead research in the areas of advanced structural analysis, large-scale testing, and engineering system risk and reliability.

Mark has played a leading role in analytical research that has led to the development of methods and models for quantitative risk and reliability-based design and assessment, which is being applied widely in the industry for design, construction, and supporting maintenance decisions through engineering assessment projects. Mark's depth of knowledge and expertise have been applied to PRCI research that has advanced the state-of-the-art in the area of strain based design and assessment, and experimental research that has evaluated the performance capabilities of new and emerging leak detection technologies. He is actively involved in the development of North American pipeline codes and standards in the areas of limit state design, integrity management, and risk assessment.

Through PRCI funded work, Mark challenged standard, prescriptive approaches to the operation and maintenance of pipelines. His work has been instrumental in developing tools that allowed operators to develop pipeline safety programs based on an understanding of risk, reliability, and performance-based management systems. And pulled all of that off while wearing his signature bowtie!

TECHNOLOGY DEVELOPMENT CENTER

A CATALYST AND HUB FOR INDUSTRY-WIDE PIPELINE RESEARCH AND ACTIVITIES

The TDC adjusted to the “new normal” throughout the year to maintain and grow operations with a continued focus on our safety standards. Expanding upon the previous year’s 40+ events during the early stages of the COVID pandemic, the TDC safely hosted pull tests, sample scanning, and conferences as the world learned to exist with the virus:

- The research labs were used 125 times within the year.
- Pull testing occurred on 29 different occasions.
- The flow loop was utilized an incredible 17 times throughout 2021.
- Conference rooms were booked for 49 different occasions.
- Requests for tours more than doubled, totaling 24 in all.

Additionally, to maximize the value of the extensive pipe and coupon inventory housed at the TDC, a major campaign to better organize, label, and store our physical samples was initiated. A searchable, publicly available database was completed in 2021 to be widely available soon.

The TDC is located on over eight acres in Houston, Texas and includes a five acre state-of-the-art pull test facility, and over 20,000 sq. ft. workshop and test facility with an additional 9,000 sq. ft. of office and meeting space. It provides the industry with an independent third party site to test and fully understand the capabilities of current tools and to guide the development of the new technologies needed to push towards the goal of ensuring the safety of the global pipeline systems.



The flow loop.

ACKNOWLEDGEMENTS

PRCI would like to acknowledge the TDC Advisory Committee for their dedication and support, as well as member companies that have and continue to contribute samples and whose financial support helps to supplement the TDC’s operations.

If you are interested in the available services at the TDC or would like to schedule a tour, please contact us at TDC@prci.org.