



### **THE 2022 PRCI YEAR IN REVIEW**

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



### MARK GEBBIA, CHAIRMAN

The cornerstone of PRCI is the solid foundation of collaboration devoted to the safety and integrity of the energy pipeline system that includes the resilience of the network. As we move boldly into energy transition, PRCI is well positioned to be the technical resource for our members and the industry.

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### **CLIFF JOHNSON, PRESIDENT**

One of the things that I enjoy most about my job is taking the opportunity to reflect on our successes and opportunities. I have often wondered what our founders would think of the PRCI of today and the growth that we have seen in the last 70 years.

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# LETTER FROM THE CHAIRMAN

The cornerstone of PRCI is the solid foundation of collaboration devoted to the safety and integrity of the energy pipeline system that includes the resilience of the network. As we move boldly into energy transition, PRCI is well positioned to be the technical resource for our members and the industry.



In 2020, we developed the Strategic Research Priority (SRP) effort with the goal of identifying and finding solutions to the key issues facing the energy pipeline industry as we advance into the energy transition. The SRPs take a holistic approach by bringing together subject matter experts (SME) from varied areas to address a problem. Currently, we have four SRPs:

**Optimize the Detection and** Mitigation of Mechanical Damage

2. Pathway to **Achieving Efficient** and Effective Crack Management

3. **Green House Gas Emissions** Reductions

4. **Advanced Leak Detection** 

The first three SRPs will be completed in 2024, and Leak Detection is the newest, having been approved in 2022. The safety and integrity of the pipeline infrastructure is a key part of our global economy.

Two of the SRPs are components of PRCI's environmental commitment: Green House Gas Emissions Reduction and Advanced Leak Detection. In conjunction with the PRCI Emerging Fuels Institute (EFI) and the CO2 Task Force, PRCI is providing the solutions needed to ensure the safe and efficient transport and storage of these products. Over the past year, the EFI grew from 4 members to 20. The CO2 Task Force was formed in 2022 to define the research needed for transport and storage of CO2. For me, these efforts are very rewarding as they demonstrate the leadership in this area by PRCI and our members.

As I begin my final year as Chair of Pipeline Research Council International, I am proud of our successes in 2022 and look forward to 2023. I am proud of what PRCI has accomplished in our first 70 years and I am excited to lead us into the next 70 years. Through our collaborations with industry partners around the globe and growing partnerships with key government agencies in North America, PRCI's value and importance for providing technical solutions that ensure the safety and integrity of the global pipeline infrastructure continues to grow as well.

MARK GEBBIA, CHAIRMAN



# LETTER FROM THE PRESIDENT

One of the things that I enjoy most about my job is taking the opportunity to reflect on our successes and opportunities. I have often wondered what our founders would think of the PRCI of today and the growth that we have seen in the last 70 years.



From expanded global collaborations to our growing partnership with government agencies to ensuring the safety and integrity of the global pipeline infrastructure, the importance of the work that PRCI does has never been greater.

In 2022, we received three Pipeline and Hazardous Materials Safety Administration (PHMSA) research awards in addition to six projects that we have currently. Winning these awards takes a team effort, starting with members and includes staff to shepherd ideas through the process. Thank you to all who participated in submissions. Our partnership with PHMSA is key for ensuring that the research we perform impacts the regulations guiding our industry.

In October, PRCI's largest ever in-person SRP & TC Meeting was held in Phoenix, AZ with over 200 attendees. The week began with a Technical Committee – Research Steering Committee joint leadership meeting to drive strategic alignment of the research portfolio. The roadmaps are the cornerstone of the PRCI research program, and the Technical Committees are the lead on developing and implementing the roadmaps. The Technical Committees are the backbone of PRCI, and we appreciate the leadership and dedication of the TC Chairs and Vice Chairs in moving this important work forward. We dedicated a day for discussion around the currently funded Strategic Research Priorities (SRP) and potential SRPs. A few potential SRPs currently being advanced are in the following topical areas:

Geohazards

Leak Detection

Risk Management

Hard Spots

Pipeline of Things



Home Activities Environmental Commitment Technology Centers Core Research

The exchanges during the discussion was very lively, demonstrating how we can begin to move research into application and develop the next generation of SRPs.

The Technology Development Center (TDC) has exceeded prior years' usage. Activities include executing third-party projects with over 50 activities and hosting training events. Additionally, over 200 registrants attended the TDC Open House in the spring. The NDE Summit held in October had over 175 registrants. Facilities Manager Lance Abney's strong leadership is a key reason for the success of the TDC.

PRCI Emerging Fuels Institute (EFI) had tremendous growth, ending the year with 20 members represented in this global forum for the research needed to ensure the safety and efficient delivery of the next generation of fuels. The goal of the EFI is twofold. The first is to maintain an online research clearinghouse for the global research being done to support the energy transition. From there, the second goal is the development of a guidance document for pipeline operators to transport and support hydrogen blends, pure hydrogen, and renewable natural gas. PRCI established the CO2 Task Force to progress the research and technology needed to meet the challenge of net zero via CO2 transport and storage. The first effort is to complete the State-of-the-Art Report (SOTA) to determine the research needed to ensure safety and integrity. The SOTA will be complete by the end of the summer 2023.

There are many initiatives and committees dedicated to finding solutions to the industry's current issues. If you are interested in learning more about them or to participate, I encourage you to reach out to me, leadership, or staff.

As we look back on 2022, I want to thank everyone that made this a great year. From the Executive Board, Executive Assembly, Research Steering Committee, Technical Committee Leadership, Audit & Finance Committee, Technical Committee Members, to staff, it truly takes a team to make PRCI successful. We are blessed with a great team!

CLIFF JOHNSON, PRESIDENT





# HISTORY OF PRCI AT 70

Pipeline Research Council International (PRCI) was established in 1952 as the Pipeline Research Committee (PRC) of the American Gas Association when a small group of engineers came together seeking solutions for one key issue facing the industry that they were not able to solve individually.

By working together, sharing experiences, and collaboratively researching the issues, a solution to the ongoing issue was found sooner than they ever expected. They also realized the need for the establishment of permanent opportunities for sharing operational challenges and developing research needed for more solutions. The resulting solution within two years to a decades old issue demonstrated the impact and benefits of industry collaboration and the leveraging effect of voluntary funding.

In the first two decades after the founding of PRC, collaboration continued to be successful. In the 1970s and 1980s, PRC produced some of the earliest research for the transport and storage of hydrogen. These results form many of the building blocks used in the current research to enable the inclusion of other fuels into our current pipeline assets.

During these decades, PRC released industry defining research focused on the theoretical model for crack propagation and arrest in pressurized pipelines (NG-18) and Residual Strength Assessment and Residual Life Prediction of Corroded Pipelines (RSTRENG). These documents are key reports for ensuring the remaining life and fitness for service of the global pipeline infrastructure. RSTENG is required by the Pipeline & Hazardous Materials Safety Administration (PHMSA) to evaluate the remaining strength of corroded pipe.

### **OUR CORE VALUES**

**Enabling Creativity** to Innovate

Our Team is a resource of new ideas, fueling better processes, and finding unconventional solutions for getting things done. We will continuously create better ways of doing what we do.

Collaborating **Beyond Compare** 

We pool a diverse set of perspectives and experiences by assembling cross-functional teams to collaborate.

**Committing to Excellence** 

We will endeavor to exceed expectations in everything we do - whether for things or people, we will always strive to do more than the expected and certainly

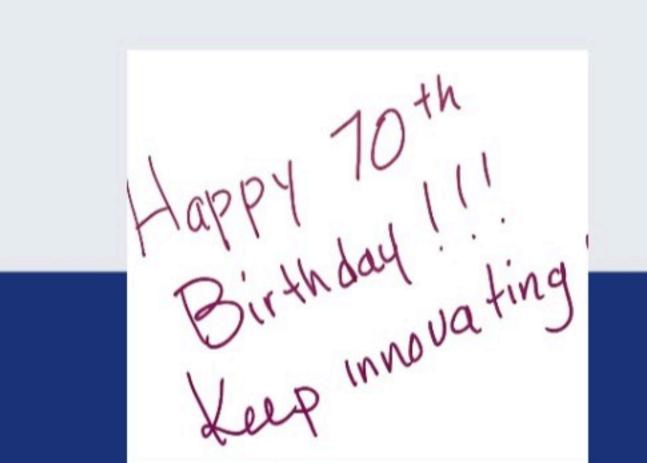
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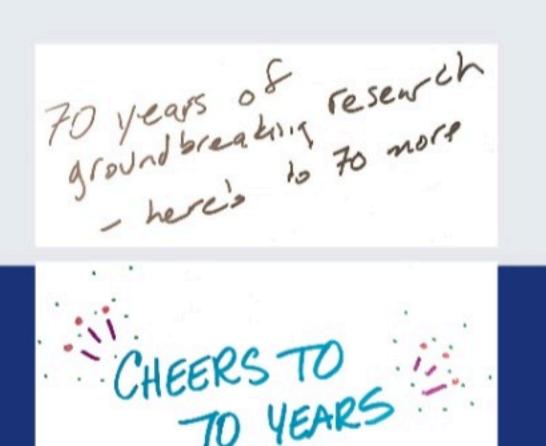
**Caring for Each** Other

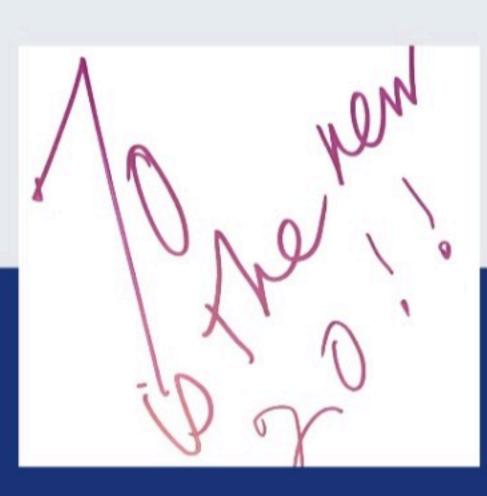
The qualities we cultivate among us are reflected in what we deliver.

As the value of PRC became increasingly apparent to the industry, membership in the 1980's grew to include non-North American operators, the first of which was Gasunie, a Dutch pipeline operator. Knowing the challenges facing pipelines are universal and to leverage the pathways to solutions globally, PRC established a partnership with the European Pipeline Research Group (EPRG) to share knowledge on a regular basis to advance the safety and integrity of the pipeline infrastructure. The Pipeline Research Committee had become an international organization.

Throughout this time, research was advanced by the creation of technical subcommittees whose expertise ranged from corrosion to subsea. It should come as no surprise that the committees changed and were modified over time to address the key challenges that the natural gas pipeline industry faced. Even today, the commitment and technical expertise of its members continues to develop dynamic, PRCI research programs devoted to identifying, prioritizing, and implementing the industry's core research.







## **SEVENTY YEARS LATER**

Seventy years later, the mission to collaboratively deliver relevant and innovative applied research to continually improve the global energy pipeline systems has never been more important. While the initial charter was to confront long-running brittle fracture in natural gas transmission pipelines, PRCI has evolved to become a critical resource for all energy pipelines regardless of where they operate, how they operate, or the purpose of their operation. With the commitment and technical expertise of its members, PRCI continues to develop dynamic research programs devoted to identifying, prioritizing, and implementing the industry's core research objectives. As a result, PRCI brings together leading pipeline companies from around the world to engage in a collaborative process that is truly "of, by and for" the industry.

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American Petroleum Institute	
Australian Pipelines & Gas Association - Research & Standards Committee	
Liquid Energy Pipelines Association	

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# **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.

#### **2022 BY THE NUMBERS**







52% Attendance Rate



1430 Registrants



270 Additional Views



744 Attendees

- Numerical Modeling and Full-scale Testing to Evaluate the Performance of Large Standoff Magnetometry
- Flow Sensors for Continuous Monitoring and Diagnostics for Equipment Efficiency Monitoring
- CT Fundamentals with Calibration and Reference Standards for Pipeline Anomaly Detection
- Full Scale Testing of Interactive Dent Features for Improved Models
- Why Cracks Fail
- Evaluation of Online Analyzers for Multiple Gas Contaminants Field Test: PRCI (Member Only)
- Vapor Corrosion Inhibitors Effectiveness for Tank Bottom Plate Corrosion Control Phase 2
- Post-Heating as an Alternative to Delayed Nondestructive Examination (NDE)
- Update of PRCI Pipeline Repair Manual 2021 Edition
- Comparative Analysis of Slope Monitoring Methods Utilizing Remote Sensing Techniques and In-Situ Instrumentation

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

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# **OUR 2022 AWARD WINNERS**

Every achievement the energy pipeline industry earns is shared by every member, and PRCI is honored to be a key participant in that endeavor. We proudly acknowledge members who have gone above and beyond in service to the energy pipeline industry's success through a sustained commitment to PRCI.

### CONGRATULATIONS TO OUR 2022 DISTINGUISHED SERVICE AWARDEES

Recipients of the Distinguished Service Award have dedicated their time and effort to help advance PRCI's initiatives through noteworthy contributions to the achievement of its mission, goals, and programs. These awards are a token of our appreciation and gratitude for their continued dedication.



### **Lori Curtis**

Lori routinely offers her experience and wisdom to newer committee members so they feel welcome, included, and engaged. She shared that being a member of PRCI has been very beneficial, allowing her to meet peers and build relationships, work on developing new technologies and diagnostic techniques, and expanding measurement and gas quality knowledge to others in Kinder Morgan and the industry.



### **Richard Kania**

Richard's PRCI colleagues have remarked that his leadership in providing expertise in the development of ILI tools is critical to their success. He speaks to the practical application of ILI tools to manage pipeline risks which helps in drawing a roadmap in the development and testing of NDE technology.



### **Russell Scoles**

His colleagues have noted that Russell has been an active champion and leader in advancing the industry charge and collaborates and shares with other operators and industry groups to ensure industry-wide uptake of research.

### CONGRATULATIONS TO OUR 2022 IN-KIND SUPPORT AWARDEE

Recipients of the In-Kind Support Award are companies which have provided significant contributions and support in furthering PRCI research programs to enhance the integrity, reliability, and environmental performance of energy pipelines around the world.



SHELL

Since joining PRCI in 2000, Shell has consistently been a significant contributor to PRCI's programs and a leader in pipeline industry research. Shell enables its staff to serve in leadership positions across all roles in PRCI including the Board, Technical Committees, Strategic Research Priorities, and projects. Shell SMEs, specifically Tim Burns and Taylor Shie, are actively leading Technical Committees and serve as Champions for two Strategic Research Priorities, our pilot Mechanical Damage & Crack Management, and have proven the success of our new research model.

# CONGRATULATIONS TO OUR 2022 DISTINGUISHED RESEARCHER AWARDEE

Recipients of the Distinguished Researcher Award have enhanced the integrity, reliability, and environmental performance of energy pipelines around the world through the dedication of their time and effort. These awards are a token of our appreciation and gratitude for their continued dedication.



# **Adam Hawley**

Adam is a great collaborator when developing research ideas and finalizing scope details at initiation and continually delivers high quality, easily understood research updates that resonate with PRCI members and greatly help ensure project success. He is an excellent listener whose care to get it right is always evident, which makes all the difference in research value realization. Adam is a deserving award recipient based on his high quality body of PRCI work and his longstanding dedication to get it right rather than get it done.

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# RESEARCH PROJECTS AWARDED

PRCI was awarded three contracts for research projects from the U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration (PHMSA) that were co-funded by PRCI. These projects contribute to enhancing the safety of our nation's critical pipeline infrastructure. PRCI is again honored by the opportunity to work collaboratively with PHMSA to further improve pipeline safety and integrity.

#### THE RESEARCH PROJECTS THAT PRCI WAS AWARDED

#### Developing Corrosion Control Monitoring Technology for Hazardous Liquid Breakout Tanks, Research Idea 3386

The objective of this project is to research and identify technologies that can detect and quantify the interaction between Vapor Corrosion Inhibitor (VCI) and Cathodic Protection (CP) associated components. This project will thoroughly investigate several aspects of the VCI technology such as delivery methods, dosages, migration and dispersion from the injection points, reinjection intervals, and VCI and CP compatibility. The major project outcome will be an in-depth understanding of the VCI technology's operating parameters such as delivery methods, coverage, dosages, monitoring, reinjection, and its interaction with the CP and associated components such as the anodes.

#### Monitoring the Long-Term Compatibility of Vapor Corrosion Inhibitor (VCI) and Cathodic Protection (CP) Associated Components, Research Idea 3387

The objective is to research and identify validated technologies to monitor the corrosion conditions under the bottoms of the breakout tanks then develop successful monitoring programs and processes. This research will be comprised of field testing utilizing in- service aboveground storage tanks (ASTs), plus laboratory testing and evaluations. Various corrosion control monitoring methods will be developed and evaluated as part of the field testing. Major project outcomes will include development of process and evaluation of the monitoring tools and methodology, including frequency and extent of monitoring, needed to make informed decisions about the effectiveness of the active corrosion control measures, and any need for implementation of supplementary corrosion controls.

### Innovative Leak Detection Methods for Gas and Liquid Pipelines, Research Idea 3406

The limitations of CPM systems have been studied by PRCI and others, as the ability of a CPM system is only as good as the corresponding hydraulic models and the associated data. Current supervisory control and data acquisition systems (SCADA) are reliable and robust but have limitations on how data gathered from many different locations is meshed at a system level.

This project is expected to (1) develop improved algorithms to better estimate pipeline inventories short of full pipeline transient modeling applications, (2) develop a new algorithm for enhanced zone balancing calculations, (3) develop pattern identification methods to identify how corrected zone balances shift based on changes in system flow; this is used to identify meter(s) that are most likely attributing to measurement flow errors, and (4) develop recommended practices to troubleshoot facilities with high error probabilities.

This project is proposed to be developed and implemented on a natural gas pipeline.

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# REX

Fueling the Future through Innovation Today

### THE PIPELINE SECTOR OF THE ENERGY INDUSTRY IS SEEING MANY TRANSFORMATIONAL CHANGES.

Whether it is in the changing workplace, changes in the generations leading the industry, or the fuels we consider moving through the assets we manage and operate, today's pipeline system is different from even just a few years earlier. While we all have varying perspectives on changes in the industry, we all rally behind safety and integrity.

> How each company performs and manages those functions is different, but we came together through the PRCI Research Exchange to share innovative solutions, learn from one another and continue to work to eliminate accidents, incidents, and impact to our environment.

More critical than ever, we recognize the value of research for the industry to continue to improve our past performance and will continue collaboration to find solutions for a better tomorrow.







The 2022 Research Exchange was held in Orlando Florida to provide PRCI member companies, our key research partners, and external stakeholders with a report on important research results and provide a forum for an exchange of ideas and to learn how to move the results into practice.

< Research Projects Awarded | Home | TDC Open House >





# TDC OPEN HOUSE

The Technology Development Center Open House showcased the value of the TDC and demonstrated opportunities for using the facility.

#### **SHOWCASING THE TDC**

PRCI welcomed 300 attendees who expanded their networks by meeting other attendees and 25 exhibitors as well as through four technical presentations that highlighted how PRCI members advance safety and integrity within the industry through the TDC.

Participants viewed pull test demonstrations and toured the flow loop. Food trucks served breakfast sandwiches and coffee for early risers; afternoon attendees were treated to burgers and tacos. To celebrate PRCI's 70th anniversary, cake was served throughout the day.







< REX | Home | NDE Summit >



**Technology Development Center** 



# NDE SUMMIT

PRCI hosted a Non-Destructive Evaluation (NDE) Summit on October 11-12, 2022 at the Technology Development Center (TDC) in Houston, TX to improve the state of practice of pipeline non-destructive evaluation by providing an opportunity for the three pillars of the NDE triangle equipment manufacturers, in-ditch service providers, and pipeline operator customers - to come together to discuss their successes, obstacles, and most importantly the opportunities for improvement.

### IMPROVING THE STATE OF PRACTICE OF PIPELINE NDE

This two day event built upon the 2019 PRCI NDE Day, which allowed PRCI to perform benchmarking with different technologies and their applications for different threats.

Competencies were further increased in:

how we procure NDE services,

how NDT devices are manufactured to serve pipeline-specific needs,

how NDT equipment is calibrated to the pipe & anomalies of interest,

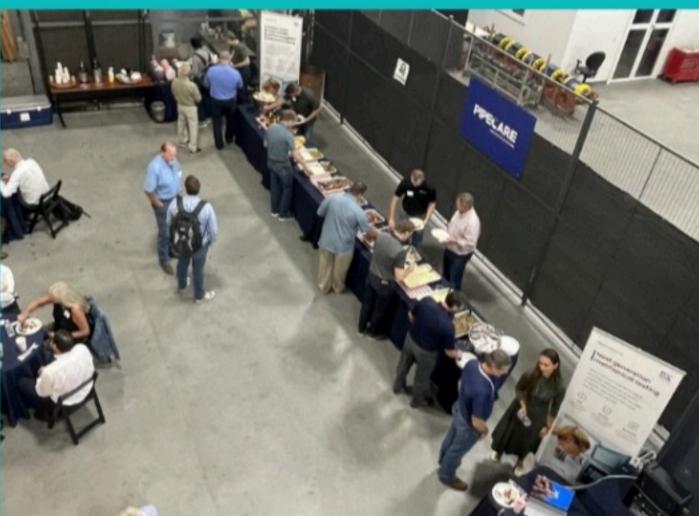
how we communicate between ILI vendors and NDE service providers,

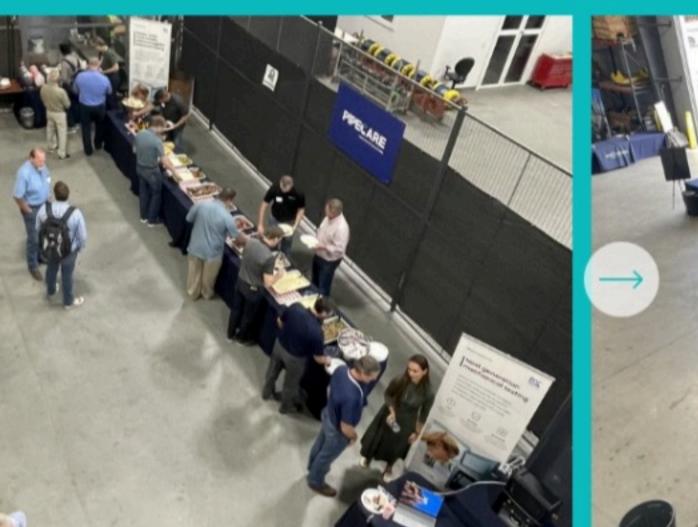
how we record and communicate NDE data from the ditch to the desk, and

how we go about training and qualification of our service providers.









This continued collaboration leads to increasingly relevant and innovative solutions for continuous improvement to the safety and integrity of pipelines.

### SHARED EXPERTISE

Representatives from equipment manufacturers, in-ditch service providers, and operators shared their expertise as exhibitors.

Members of the American Society for Non-Destructive Testing and the American Petroleum Institute as well as knowledge transfer experts performed assessments of knowledge transfer within the industry.

Topics included:

- Keys for successful NDE of hook cracks: PRCI Project NDE-4-12 project review
- Operator/Original Equipment Manufacturer collaboration for field success eddy current
- Operator/Original Equipment Manufacturer collaboration for field success phased array ultrasonics
- Updates on X-ray computed tomography development
- Human factors component to NDE Teaching, training, and certification
- Demonstrations of current technology

< TDC Open House | Home | JTM >



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# JTM

PRCI co-hosted the Joint Technical Meeting (JTM) in Edinburgh, Scotland together with our partners in Europe through the European Pipeline Research Group (EPRG) and Australia through Australian Pipeline & Gas Associations (APGA).

#### **GLOBAL COLLABORATION**

PRCI shared 12 of the 36 papers that covered a wide range of topics and presented throughout the week. PRCI also led two working groups that focused on Sour Service and Mechanical Damage. EPRG led two groups on Hydrogen and CO2. Output from the sessions is alignment of research and identification of possible joint research.

There were considerable conversations around the issues to address the opportunities to transport and store hydrogen. The APGA, in conjunction with Future Fuels CRC, received funding from the Australian Government in 2018 to perform research to enable a safe and efficient hydrogen infrastructure. They shared a number of key projects that have been completed and that will be undertaken soon, including the transition of a natural gas pipeline to 100% hydrogen service in 2023.

Our partners in Europe have accelerated their timeline from 2030 to 2027 to begin transporting hydrogen. They performed the first research that will be used to enhance ASME B31.12 to consider the challenges that will be faced in moving large volumes of hydrogen at higher pressures for longer distances than is currently considered in the standard. EPRG is working to host the first large scale test in the fall of 2022. PRCI and APGA are in discussions with them on how we can partner with the test.

Another area of discussion was the transport and storage of CO2. With the potential for developing large amounts of CO2 depending on the source of hydrogen, there is a need to revisit the current knowledge around CO2.

The world of pipelines finds itself in challenging circumstances, with hydrocarbon market volatility and energy transition aspects such as H2 and CO2 transmission weighing heavily alongside the usual challenges of maintaining safe operation and growth of both onshore and offshore networks.

Building on the dual push for our industry of needing to advance the next generation of fuels, there is still considerable opportunities to enhance our current operations and practices.

These three streams of discussion highlight the unique position our industry is in today and the need to collaboratively advance research to achieve our goals in a timely fashion.

This biennial event enables the global industry to share solutions to our common challenges. Being a part of the JTM embodies of one of the key elements of our industry – the willingness to share to ensure the safest and most efficient global pipeline network. The next JTM will be held in 2025 in North America.

The tripartite collaboration of the European Pipe Research Group (EPRG), the Pipeline Research Council International (PRCI), and the Australian Pipelines and Gas Association (APGA) gathers to discuss current topics on safe pipeline manufacture, construction, and operation. The Joint Technical Meeting (JTM) aims to provide an ideal platform to listen to the latest thinking across a wide range of pipelines issues, as well as a forum for detailed discussion on the challenges facing the industry.

< NDE Summit | Home | Environmental Commitment >



# ENVIRONMENTAL COMMITMENT

Building upon on PRCI's legacy of environmental commitment assists 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 & storage via the global pipeline network.

We must take steps to reduce our carbon footprint as our climate is being disrupted. As an industry, our environmental commitment is forward thinking with the transition to reduce carbon and move towards greener fuels. As these new fuels are being developed, the pipeline industry must be ready to safely transport and store them. We need to safely reuse the system that's already in place, knowing that what has been in place for decades wasn't designed for them, and replacing them would be costly and wasteful.



### **EMERGING FUELS INSTITUTE**

The Emerging Fuels Institute (EFI) grew to 20 members in 2022 working to resolve the technical gaps that exist as the industry transitions to low carbon energy solutions using the existing pipeline asset infrastructure. As many governments are planning or have begun mandating transitions to renewable energy sources to achieve their stated goals of stabilizing the climate, low carbon footprint fuels are a foundational component for a sustainable energy society.

The scope of the EFI addresses ammonia, biofuels, carbon capture and sequestration (CCS), hydrogen, and renewable natural gas (RNG). The EFI's current priorities are following market focus in the storage and transportation of hydrogen and RNG.

Project emphasis areas include:

- Integrity of pipeline system steel and non-steel components
- Compressor stations and facilities
- Pressure control and over-pressure safety devices
- Design requirements for electrical classification and fire safety
- · Downhole reservoir and cavern storage

An important output of the EFI will be to develop a guide to safely convert and operate pipeline systems to allow for the transport and storage of the next generation of fuels.

Collaboration with industry stakeholders is critical to ensure the optimization of the overall transition effort. To ensure a comprehensive and continued awareness of ongoing work within the industry, a key task of the EFI is partnering with peer research associations to share respective roadmaps so that work is efficiently and comprehensively incorporated into EFI deliverables. These peer research associations currently include the Australian Pipeline and Gas Association (APGA), the European Pipeline Research Group (EPRG), the European Gas Research Group (GERG), the Future Fuels Collaborative Research Center (FFCRC), and the Gas Technology Institute (GTI).

The EFI also coordinates it efforts with governmental agencies such as the Canada Energy Regulator (CER), the U.S. Department of Energy (DOE), and the U.S. Pipeline and Hazardous Materials Safety Administration (PHMSA).

Industry associations that the EFI coordinates with include the Association of Oil Pipe Lines (AOPL), the American Petroleum Institute (API), and the Interstate Natural Gas Association of America (INGAA).

Similarly, the EFI coordinates with technical societies such as Canadian Standards Association (CSA) and the **American Society of Mechanical** Engineers (ASME).

# **WANT TO LEARN MORE?**

**PRCI Hosts Emerging Fuels Forum** 

PRCI Emerging Fuels Institute White Papers



# **CO2 TASK FORCE**

As we explore the next generation of fuels and attempt to reduce carbon emissions, PRCI established the CO2 Taskforce with Shell, Williams, and ExxonMobil in April 2022 to identify, drive, and ensure a timely execution of the key research needed to transport and store CO2.

CO2 Task Force expertise is drawn from PRCI members and industry leaders. This leverages PRCI as an integral organization in progressing the research and technology necessary to meet the challenge of transitioning to net zero.

The CO2 Taskforce, in conjunction with the Greenhouse Gas Emissions Reduction SRP, is critical to the research program to lower emissions.

The ultimate effort of the CO2 Task Force is to produce guidance to the industry on how to safely transport and store CO2.

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The CO2 Taskforce, in conjunction with the Greenhouse Gas Emissions Reduction SRP, is critical to the research program to lower emissions. The ultimate effort of the CO2 Task Force is to produce guidance to the industry on how to safely transport and store CO2.

< JTM | Home | Technology Centers >





# **TECHNOLOGY CENTERS**

Enhancing the Technology Centers enables members and the industry to build upon real world samples and learnings to inform business decisions. The Technology Development Center in Houston, TX and the Virtual Technology Development Center are the physical and digital opportunities for leading the industry to innovative solutions. As the pipeline system is aging, growing, and changing, the stewardship of its current and future integrity must include knowledge transfer of processes, technologies, and materials. The path that we are now on requires sharing of information, because safety is not a competitive advantage. The solutions we need will now be found by shared information.

# TECHNOLOGY DEVELOPMENT CENTER



Collection and management of pipeline defect samples from around the world and performing technology testing services to advance the integrity of the pipeline industry.

The TDC continues to host many of the industry's next steps to a safer and more efficient pipelines through member driven research and third-party projects. Knowledge is transferred through meetings between operators, service providers, and other related parties.

The research labs were used 92 times within the year.

Pull testing occurred on 31 different occasions.

The flow loop was utilized 10 times.

Conference rooms were booked for 37 different occasions.

Requests for tours continued to increase, totaling 38 visits.

The Technology Development Center (TDC) is a major commitment by the energy pipeline industry to address the key issues that it faces to ensure the safety of the national and international pipeline system.

Having a single location able to accumulate former in-service pipe materials with real-world pipeline features/flaws is invaluable to PRCI's R&D Program and the industry, and provides a central point for hosting industry-sponsored training and workshops.

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.

# VIRTUAL TECHNOLOGY DEVELOPMENT CENTER

PRCI launched the first stage of the Virtual Technology Development Center (VTDC), a virtual center for industry members to develop technology-based solutions for operating problems in the energy pipeline industry through data collected and shared information/learnings. The safety and integrity of the global energy pipeline system relies upon detailed analysis of relevant data leading to informed decision making. Shared learning significantly improves the ability to perform this critical analysis.

The first stage of the platform hosts databases which allow users to utilize anonymized data and information from multiple projects that have been standardized across projects and sources. The inaugural databases were Pipe Material Properties Database and Ultrasonic Test Results Database, with additional ones planned for the future.

The Pipe Material Properties Database includes reports that have the material properties of yield strength and Charpy energies for pipes of different vintages, diameters, wall thicknesses, chemical compositions, and manufacturers.

Data from the Ultrasonic Test Results Database can be used for inter-comparison of test results, what-if analysis of different test conditions, and the discovery of additional insights through standard collection, storage, and analysis of PRCI's extensive investment in ultrasonic meter installation effect testing test results.

The VTDC leverages collaboration to create opportunities to have greater impact in the pipeline industry by using data and information not previously consolidated in one convenient location. The next stage will provide a platform to share information and learning; the first project in this area will enhance the knowledge of river crossings by bringing together knowledge from over a dozen operators around the world to understand the impact of the environment around the pipelines.

Shared learnings from other industry issues will be included in the third stage of release.

contribute data and learnings outside of PRCI projects to expand the database and leverage machine learning to strengthen integrity and safety.

Operators will be able to

< Environmental Commitment | Home | Core Research >



Main Office

# CORE RESEARCH

Advancing PRCI's Core Research Program and enhancing the adoptability/usability of the findings. The heart of PRCI is pipeline safety. The Core Research Program delivers results that are then able to be used to improve the industry's understanding of issues and implement needed solutions.

Over the past seventy years, a single committee of operator representatives evolved into the Core Research Program, now guided by eight technical committees representing the unique technical perspective of the energy pipeline transportation and storage system. Strategic Research Priorities (SRP) represent a diversity of subject matter experts for addressing strategic issues in the industry. The result is a collaborative research portfolio aligned with industry priorities to produce solutions that assure the safe, reliable, environmentally sound, and cost-effective pipeline transportation of energy to consumers worldwide.

### STRATEGIC RESEARCH PRIORITIES

Identifying and executing SRPs allows 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.











### COMPENDIUMS

PRCI generates research compendiums that assemble PRCI-funded projects and related research by key areas of interest.

### **TECHNICAL COMMITTEES**

















< Technology Centers | Home | SRP: Mechanical Damage >









This Strategic Research Priority consolidates mechanical damage research to effectively manage deformations identified through condition assessments to ensure repairs are made where truly needed.

### **OUTCOMES AND VALUE TO INDUSTRY**

Improving operator management systems to advance safety, protection of the environment, reliability, and cost-efficiency.

Eliminating unnecessary excavations and failures.

Impacting industry recommended practices and standards, including standards for ILI reporting criteria for mechanical damage.

### **INDUSTRY IMPROVEMENT**

#### DAMAGE PREVENTION

Performance assessment for damage prevention and mitigation measures.

Establishment of key performance indicators for tools, techniques, and approaches.

New technologies for sensing and responding to unauthorized encroachment on ROW corridors.

#### **INSPECTION TECHNOLOGIES**

Detecting, discriminating, and sizing MD using ILI tools and in ditch technologies and methods, including the effects of coincident features.

Establishing consistent and uniform inspection reporting requirements for deformations on pipelines and for deformations with coincident features.

#### **ASSESSMENT**

Improving engineering assessment approaches including indentation straininduced cracking, risk, failure pressure, pressure-cycling fatigue failure for plain dents and those interacting with other threats/features.

#### REPAIR

Connects related PRCI work on composite materials for repair of mechanical damage, and NDE studies on the inspection of composites after being installed to address features.

Provides technically credible justification for updates to PRCI Pipeline Repair Manual with regard to mechanical damage.

### **CURRENT RESULTS**

Performed ILI test trials at the PRCI TDC including seven ILI technology providers with 70+ mechanical damage samples and multiple ILI systems in both air and liquid coupled environments.

Led industry-changing feedback sessions with ILI service providers to establish uniform dent shape and coincident features reporting criteria.

Expanded the ILI test string at the PRCI TDC with 140+ mechanical damage samples with associated features (metal loss, crack, gouge, weld); testing continuing in 2022 on a minimum of four technology providers participating to improve industry standards on mechanical damage inspection and assessment.

Reviewed multiple presently-applied methods for performing dent/strain/fatigue assessments, evaluating the accuracy of the assessment methods, and making suggestions to improve them.

Completing a capstone report systematizing 20 years of mechanical damage research.

Collected pipeline operator data to assess real-world experience and support engineering assessment model validation.

< Core Research | Home | SRP: Greenhouse Gas Reduction >







This Strategic Research Priority will provide greenhouse gas reduction technology in the combustion process for both fugitive and vented natural gas.

### **OUTCOMES AND VALUE TO INDUSTRY**

Understanding the carbon footprint of an operating company for the purposes of permitting new facilities.

Improving standards for assessing performance, technological advancement and tools to mitigate emissions, and providing a standardized approach for assessing alternatives.

Technology advancement and standards development to encourage agencies to implement more efficient and lower cost GHG regulations or permit requirements.

Evolving regulations at the state, federal, and international levels, including carbon trading/carbon tax approaches.

### **INDUSTRY IMPROVEMENT**

Developing an economic prioritization model/tool to identify the GHG reduction efforts that provide the largest net reduction in GHG emissions per net present value of spend.

Increasing the efficiency of both compression driver and driven equipment.

Enhancing leak mitigation programs to efficiently implement alternatives to conventional regulatory leak detection and repair programs.

Reducing fugitive leaks through compressor rod packing, gas seals, and isolation/blowdown/dump valves.

Developing alternatives to natural gas pneumatic control and actuation devices, and assessing the feasibility and optimization of current alternatives.

Reducing natural gas blowdowns associated with pipeline repair and equipment shutdowns.

Developing enhanced natural gas leak detection/ quantification methods.

Working to change regulations that inhibit economically viable methods to reduce greenhouse gas emissions.

### CURRENT RESULTS

Developed economic analysis tool that identifies largest net reduction in emissions for different technologies and operating conditions.

Technologies such as steam methane reforming, non-catalytic partial oxidation, autothermal reforming, plasma reformers, and dry reformers are being studied for use as an alternative to compressor fuel. Viable technologies could lead to additional research.

Literature review completed that depicts current techniques for minimizing blowdowns by pipelines during repairs and replacements. Best practices and recommendations for future work are included.

Literature review ongoing that will assess retrofittable, low-cost flow sensors for compressor stations that will facilitate continuous monitoring and diagnostics of equipment. Survey has been completed of members to determine technologies of most interest.

< SRP: Mechanical Damage | Home | SRP: Crack Management >



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This strategic research priority focuses on the prevention of failures due to crack-like defects by making improvements in the integrity management life cycle of susceptibility, Inspection, Assessment and Remediation, and Management for the threat.

#### **OUTCOMES AND VALUE TO INDUSTRY**

Closing identified gaps in performance demonstration for crack ILI, NDE, and material properties' performance data.

Providing the next generation of susceptibility models by cracking threat/morphology.

Broadly communicating outcomes to advance crack management within industry fabric.

Further operationalizing the TDC and VTDC for crack management.

#### **INDUSTRY IMPROVEMENT**

#### SUSCEPTIBILITY

Susceptibility assessments by cracking threat/ morphology lead to selection of the appropriate integrity assessment method.

#### **INSPECTION**

Known strengths and limitations of the inspection technique(s) provide confidence in assessment and remediation programs, ultimately improving threat management.

#### **ASSESSMENT &** REMEDIATION

Effective and efficient response to inspections including improved remaining strength equation variables, dig criteria, repair criteria, and reassessment intervals.

#### **MANAGEMENT**

Management of known crack-related threats to reduce failure rates and minimize likelihood of releases before reassessment.

### **CURRENT RESULTS**

Developed a flow loop of relevant defects to challenge the current crack detection ILI tools and allow for ILI service providers to test their tools and learn for improved performance.

Performed a root cause analysis of over 100 failures to ensure subsequent years research are strategic and highest priority.

Analyzed failure pressure ratios of features repaired to verify a sufficient safety factor is maintained through current industry guidance.

Populated a database of critical material properties.

Established pathways of communication to the six key stakeholder groups.

< SRP: Greenhouse Gas Reduction | Home | SRP: Leak Detection >





This Strategic Research Priority closes the primary gaps in standardizing the way that technologies and methods for leak detection are validated and qualified for energy pipelines (gathering, transmission, and distribution), and their associated facilities.

#### **OUTCOMES AND VALUE TO INDUSTRY**

Identifying, developing, and confirming effective leak detection monitoring technology options for the industry.

Significantly reducing liquid and gas leak impacts and improve confidence in pipeline safety.

Impacting industry recommended practices and standards.

#### **INDUSTRY IMPROVEMENT**

#### LIQUID HYDROCARBON SYSTEMS

Improved detection technology.

Comprehensive leak detection strategy for gas and liquids operators (internal/external).

**External detection and quantification** guidance.

### **NATURAL GAS PIPELINE**

Accelerated event identification through remote sensing.

**Application of continuous pipeline** monitoring for natural gas transmission operations.

Validation of technology capabilities and limitations.

#### **GREENHOUSE GAS EMISSIONS IDENTIFICATION & QUANTIFICATION** FOR NATURAL GAS PIPELINES

Industry guidance for continuous monitoring of facilities.

Clarify capabilities and limitations of large area remote monitoring.

Identify advanced leak detection technologies capably of accurate quantification of rates and leak location.

Improving characterization of release and emissions intermittency for detection and quantification.

### **IN PROGRESS**

Develop and demonstrate a proof-of-concept cable system that inductively provides power and communications to distributed sensor nodes incorporating PAS hydrocarbon leak detectors.

Use machine learning to evaluate possible improvements in CPM leak detection technology.

Evaluate options and feasibility of detecting leaking valves, quantifying leak rates, and in situ repairs.

Data mining of subpart W data to find most effective areas to devote methane emission mitigation measures.

Provide options for low-cost methods to identify/quantify leaks at compressor stations.

< SRP: Crack Management | Home | Compendiums >



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PRCI generates research compendiums that assemble PRCI-funded projects and related research by key areas of interest.

#### **2022 COMPENDIUMS**

These compendiums are a resource and aid to find completed research on a given topic area, avoiding unnecessary replication or research efforts, and aiding the implementation of this research.

- PR-000-22COMP-R04 Cathodic Protection Shielding Compendium 

   P
- PR-000-22COMP-R01 EMAT Pipeline Inspection Compendium (P)
- PR-000-22COMP-R02 Pipe Hard Spot Management Compendium (D)
- PR-000-22COMP-R03 Potential Impact Radius Compendium (D)
- PR-000-21COMP-R01 Pipe Burst Pressure Compendium (D)
- PR-000-21COMP-R13 AC Interference and Corrosion Compendium (P)
- PR-000-21COMP-R05 Carbon Dioxide Pipelines Compendium

Key

Public Access

Members Only

Webinar Available

Software Download

< SRP: Leak Detection | Home | Compressor & Pump Station >



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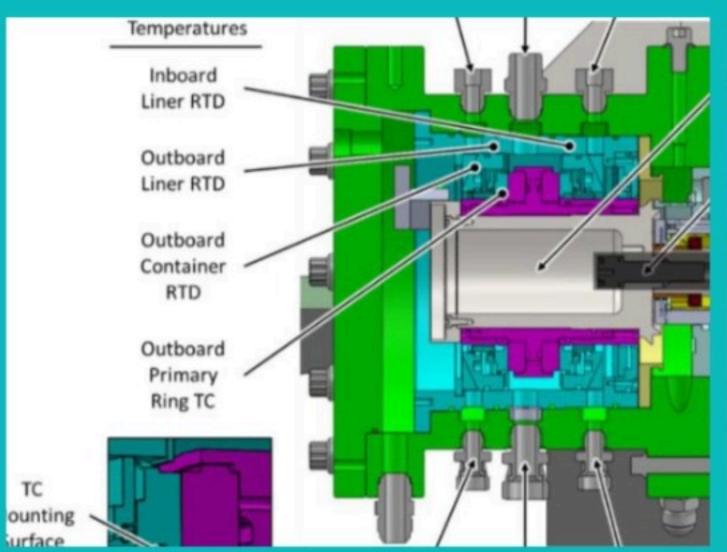


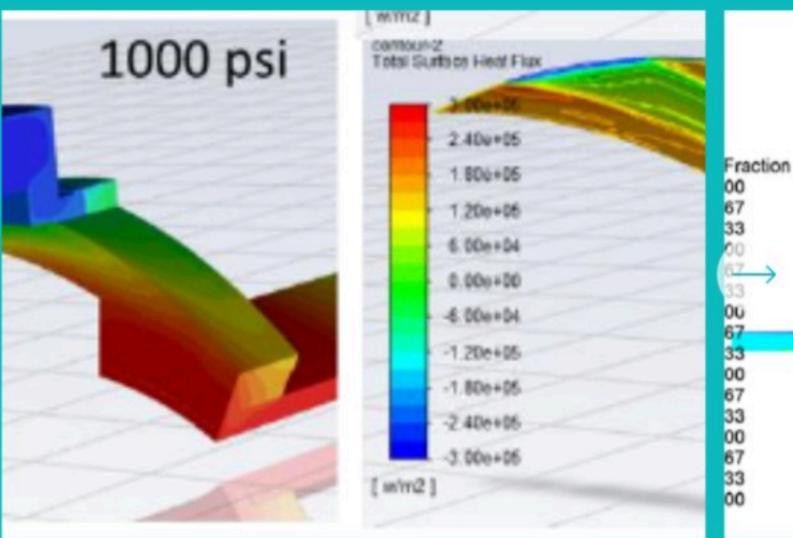
The Compressor & Pump Station (CPS) Technical Committee focuses on research efforts on minimizing the operating costs and capital requirements of compression and pump service while meeting market demands and all applicable environmental regulations.

Chair: Thomas Lumadue, TC Energy

Vice Chair(s): Daniel Rem, Enbridge Pipelines Inc. and Enbridge Energy Partners LP Howard Koop, Enbridge Pipelines Inc. and Enbridge Energy Partners LP







### **PUBLISHED REPORTS IN 2022**

- PR-316-21201-R01 A Study of the Effects of Liquid Contamination on Seal Performance @
- PR-283-20207-R01 Field Trial of Solar Turbines Methane Emissions Reduction Solution for Gas Compressors (P)
- PR-312-18208-R03 AERMOD Performance Assessments, Implementation Issues and Recommended Improvements ®
- PR-703-21202-R01 Fuel Reforming as an Alternative Fuel for Large Bore Reciprocating Engines (D)
- PR-015-21208-R01 Improvements in Compressor and Pump Station Facility Efficiency ®

Key

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Members Only Webinar Available

Software Download

< Compendiums | Home | Corrosion >



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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).

Chair: Trevor Place, Enbridge Pipelines Inc. and Enbridge Energy Partners LP

Vice Chair(s): Jocelyn Nelson, ExxonMobil Pipeline Company

Mohammad Al-Amin, TC Energy

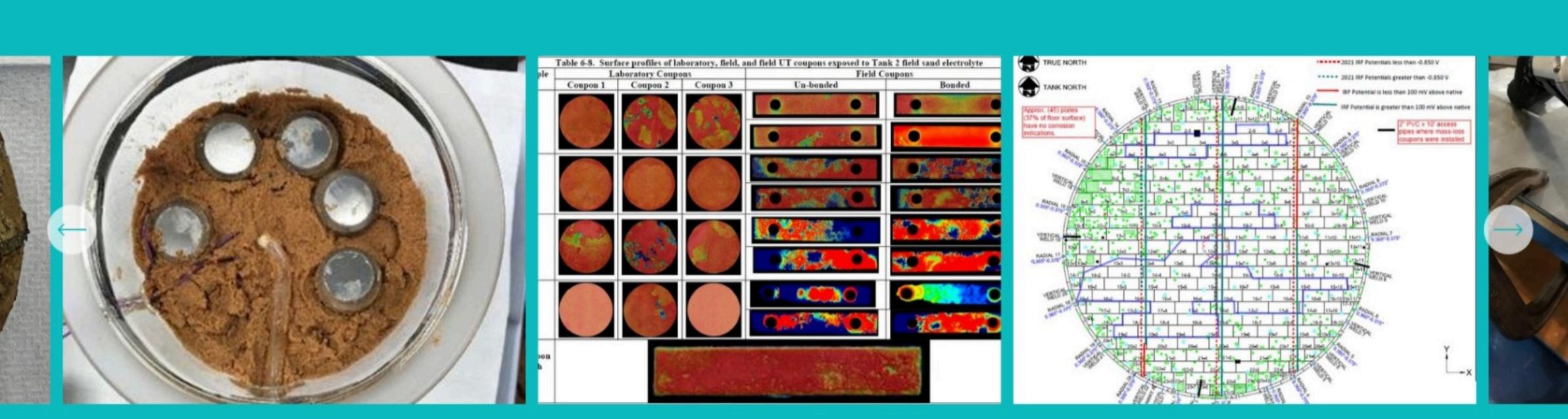
David McQuilling, Pacific Gas and Electric Company

Benny Mumme, Flint Hills Resources

Didier JC Caron, GRTgaz

Jeff Liang, Enbridge Pipelines Inc. and Enbridge Energy Partners LP

Mohsen Achour, ConocoPhillips





- PR675-203601-R01 Minimum Separation Between Underground Pipelines and Electric Supply Line Structures @
- PR644-183611-R01 Vapor Corrosion Inhibitors Effectiveness for Tank Bottom Plate Corrosion Control Phase 2 @ @
- PR-000-22COMP-R04 Cathodic Protection Shielding Compendium
- PR-000-21COMP-R13 AC Interference and Corrosion Compendium PR-000-21COMP-R01 Pipe Burst Pressure Compendium

< Compressor & Pump Station | Home | Design Materials & Construction >



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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.

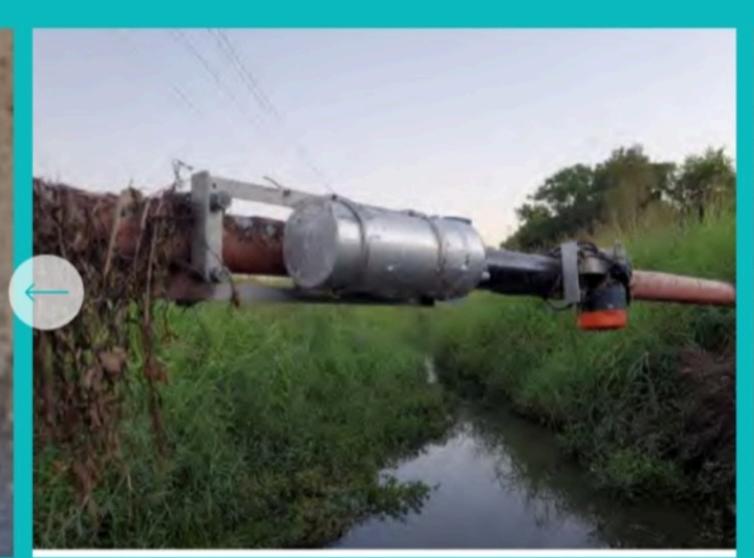
Chair: Stephen Rapp, Enbridge Pipelines Inc. and Enbridge Energy Partners LP

Vice Chair(s): Michael Gragg, ExxonMobil Pipeline Company Smitha Koduru, Enbridge Pipelines Inc. and Enbridge Energy Partners LP Jim Kyfiuk, TC Energy

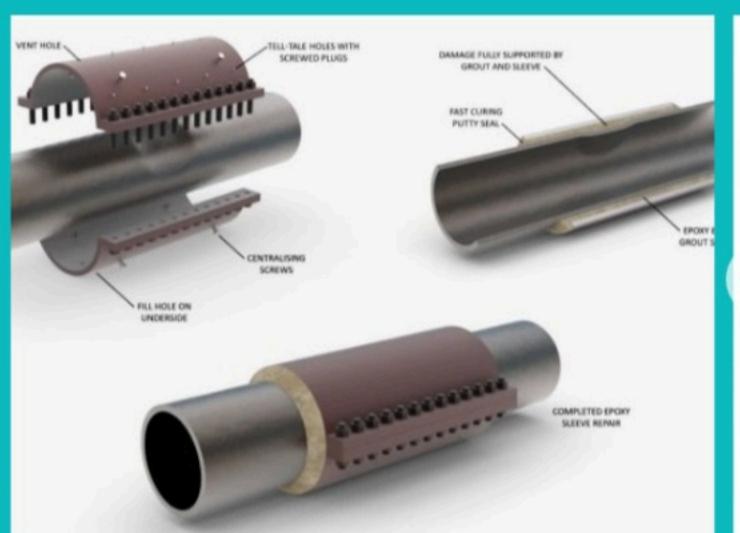
Daniel Castro, Williams Companies, Inc.

Russell Scoles, Enbridge Pipelines Inc. and Enbridge Energy Partners LP Jorge Penso, Shell Global

Junfang Lu, Enbridge Pipelines Inc. and Enbridge Energy Partners LP







### **PUBLISHED REPORTS IN 2022**

- PR328-214501-R01 Methods to Reduce Pipeline Blowdowns for Repair and Inspections ®
- PR-685-184506-R07 Scour Equations and Field Verification Methods ®
- PR-685-184506-R08 Field Validation of VIV Initiation Within Waterways ® PR-214-214504-R01 Identification of Hydrogen Susceptible Line Pipe ®
- PR-214-204505-R01 HAZ Softening Susceptibility Test Development ®
- PR-716-204500-R01 Integration of 3D NDE Systems to FEA Evaluation of Flaws ®
- PR-186-204504-R01 PRCI Pipeline Repair Manual 2021 Edition → D
- PR350-164500-R03 Semi-Automatic FCAW-S Welding Process and Implications to Pipeline Girth Weld Integrity ®
- PR-350-174507-Z01 Guidance on the Use, Specification, and Anomaly Assessment of Modern Linepipes (D)

< Corrosion | Home | Inspection & Integrity >

### Key

Public Access

Members Only Webinar Available

Software Download



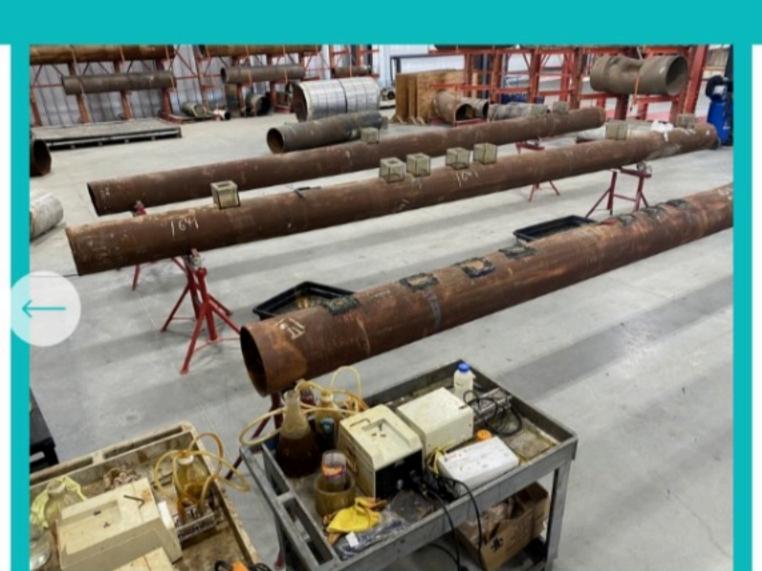


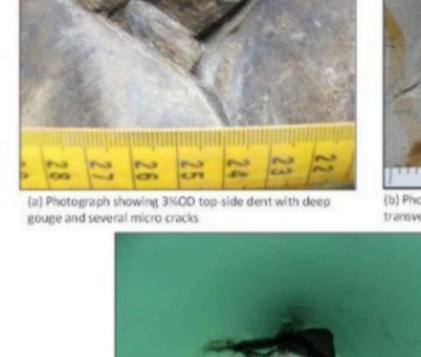


The Integrity & Inspection Technical Committee improves the reliability of the pipeline infrastructure and ensure the continuity of public service through the development and successful deployment of technologies associated with mechanical damage, pipeline integrity management, and associated inspection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

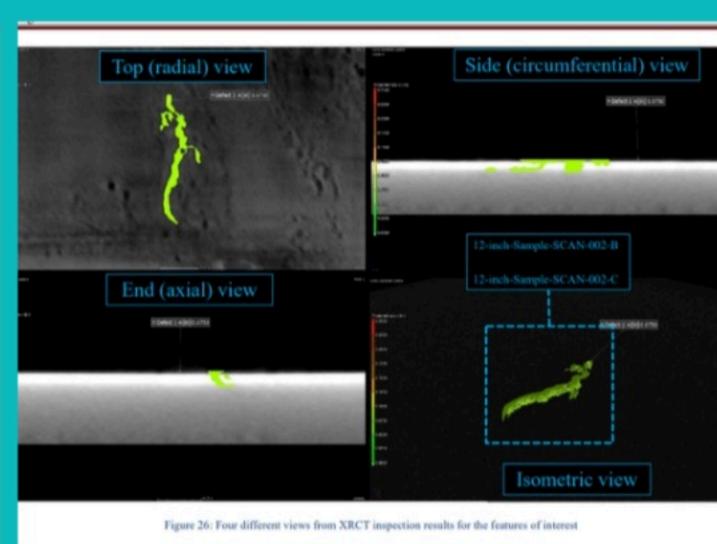
Chair: Sean Moran, Williams Companies, Inc.

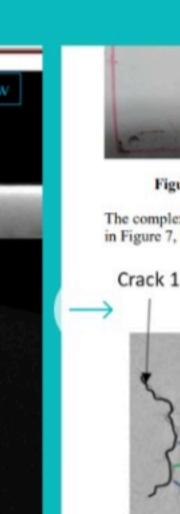
Vice Chair(s): Joshua Bremner, Phillips 66 Pipeline LLC David Xu, Pacific Gas and Electric Company Shenwei Zhang, TC Energy Paul Monsour, Southern California Gas Company Chris Newton, Phillips 66 Pipeline LLC











### **PUBLISHED REPORTS IN 2022**

- PR-652-213801-R01 Technology Assessment for Detection of Fatigue Cracks on Heavy Wall Gas Risers ®
- PR-335-183837-R03 NDE Technician Performance Evaluation Through Practical Application Blind Trials @

- 693JK31810003 Non-Destructive Tools for Surface to Bulk Correlations of Yield Strength Toughness and Chemistry @
- PR-000-22COMP-R01 EMAT Pipeline Inspection Compendium
- PR727-213904-R01 Considerations for Crack ILI Response in Hazardous Liquids Pipelines ®
- PR-306-123732-R02 Realistic Dent and Cracked Gouge Defects for Characterizing Inspection Tools Performance @ • PR-335-203810-R03 CT Fundamentals with Calibration and Reference Standards for Pipeline Anomaly Detection 🕲 📵
- PR214-203804-R01 Systematize 20 Years of Mechanical Damage Research ®
- PR-214-203806-R01 Improve Dent-Cracking Assessment Methods ®
- PR-186-203813-R02 Pipeline Mid-wall Defect Detection and Fitness for Service Assessment ®
- PO164-173840-R02 Laser Surface Hardening of X60 Sour Grade Steel @ PO164-173840-R01 TWI Laser Surface Hardening Report - Calibration Plates @
- PR-000-22COMP-R02 Pipe Hard Spot Management Compendium ®
- PR-000-22COMP-R03 Potential Impact Radius Compendium (D) • PR-652-203802-R01 Computed Tomography for the Development of Standards for Anomaly Detection-Characterization (Development of Standards for Anomaly Development (Development of Standards for Anomaly Development of Standards f
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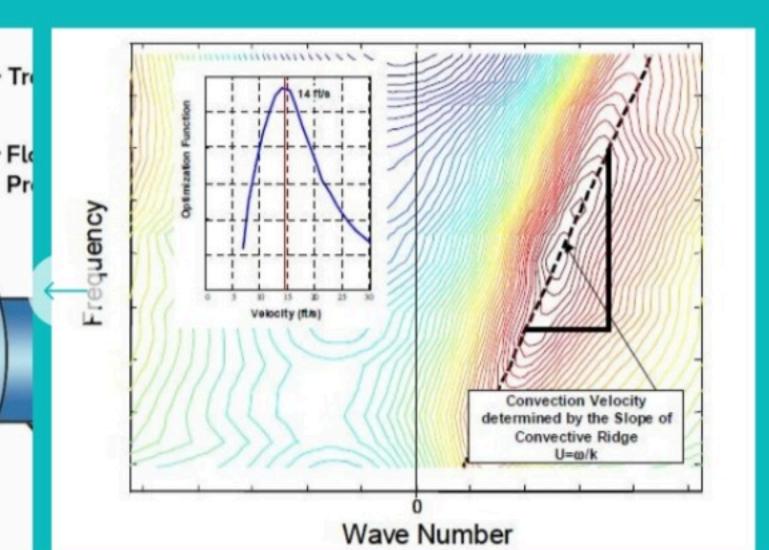
The Measurement Technical Committee focuses on measurement technology research related to improving the safety, performance (accuracy, uncertainty), environmental impact, and operating cost (operability, maintainability, reliability) of oil and gas transportation systems. The Measurement Technical Committee prioritizes research that supports industry standardization.

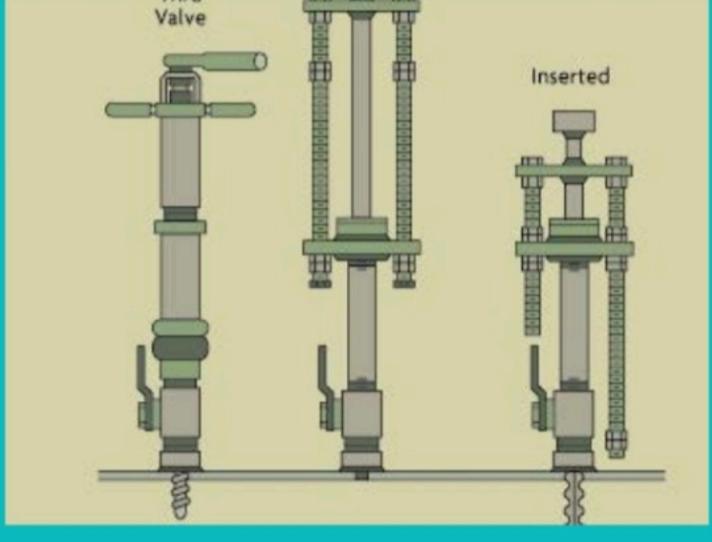
#### The current projects on the roadmap have a focus on:

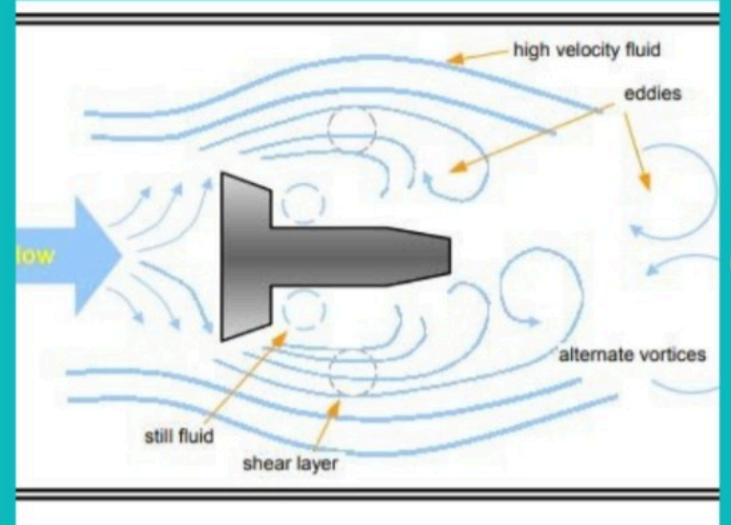
Gas Metering • Gas Measurement - Instrumentation & Laboratory • Non-Traditional Gas Supplies / Emerging Fuels • Liquid Metering • Liquid Measurement - Instrumentation & Laboratory • Instrumentation in Gas & Liquid Service

Chair: Chris Levy, Chevron Pipe Line Company

Vice Chair(s): Nathan Feldpausch, Enbridge Pipelines Inc. and Enbridge Energy Partners LP Jonatan A Mustafa, Energy Transfer









- PR-469-19604-Z01 Auto Diagnostic Method Development for Ultrasonic Flow Meter ®
- PR-015-20605-R01 Clamp-On Ultrasonic Meters for Oil and Gas Flow Meter Verification @
- PR-015-18600-R01 OIML Test Data Summary for Ultrasonic Meters
- PO-015-21607-R01 In-Situ USM Flow Verification Data Analysis @
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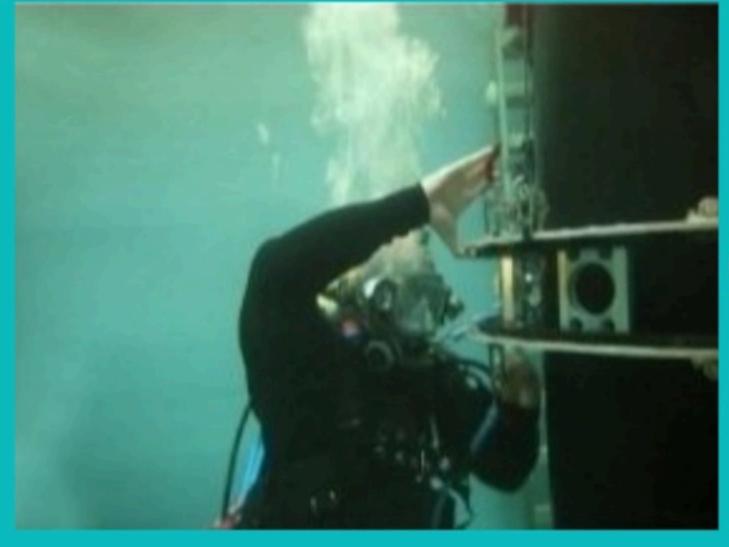
The Subsea Technical Committee focuses on issues and challenges unique to the offshore pipeline environment through research focusing on Subsea Pipeline Integrity Management (SPIM) and Subsea Pipeline Direct Assessment (SPDA). The research deliverables target improvements to risers, on-bottom stability and pipe to enhance performance through development and implementation of new design methods, materials, and construction technologies.

Chair: Farzan Parsinejad, Chevron Pipe Line Company

Vice Chair(s): Wilson Zeng, ExxonMobil Pipeline Company Benjamin Damonneville, Total S.A.









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- PR393-215101-R01 IRIS X-ray CT for Flexible Pipes
- PR453-205101-R01 Prediction of On-bottom Wave Kinematics in Shallow Water ®
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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.

Chair: Nikos Salmatanis, Chevron Pipe Line Company

Vice Chair(s): Zach Locks, TC Energy Chris O'Neill, Enbridge Pipelines Inc. and Enbridge Energy Partners LP









- PR635-203904-R01 In-situ Instrumentation and Remote Sensing Methods for Slope Monitoring for Pipelines ❷ ❷
- PR-015-203900-R01 Reliability Detection and Accuracy of CPM Detection Systems Using Machine Learning ®
- PR015-203900-M01 Machine Learning Framework Guidance Documentation for Pipeline Leak Detection (9)
- PR-420-183903-R01 Pipeline Right-of-Way River Crossing Monitoring With Satellites ®

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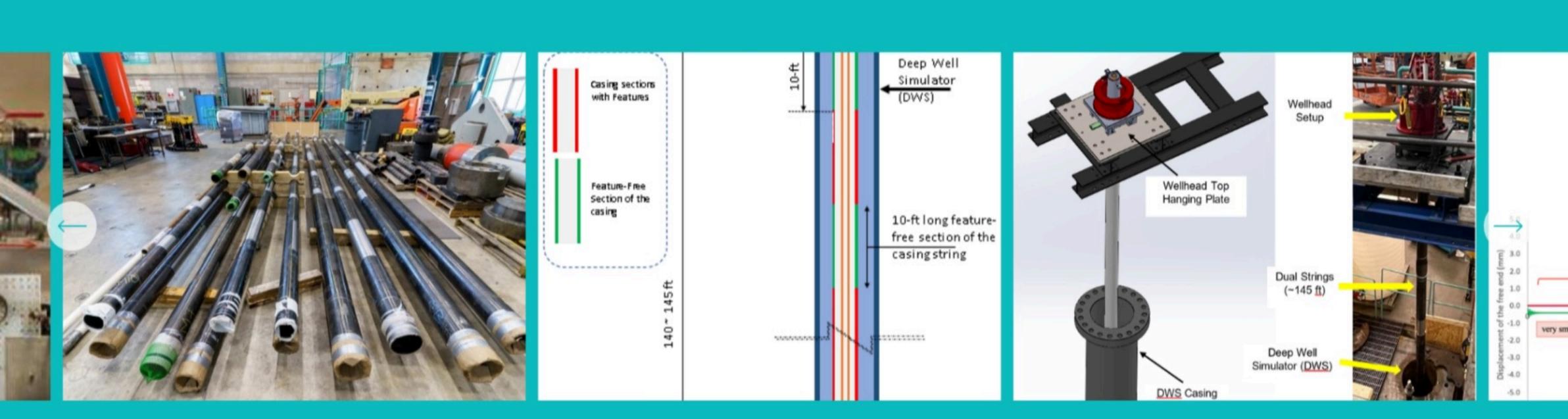




The Underground Storage Technical Committee is focused on developing and deploying technologies to ensure the safety, integrity, reliability, and productivity of new and existing storage facilities, including both reservoir and cavern storage.

Chair: Anders Johnson, Kinder Morgan

Vice Chair(s): Dan Neville, Southern California Gas Company Stephanie Sexton, ExxonMobil Pipeline Company



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