

Pipeline Research Council International, Inc.

PHMSA R&D Forum
Working Group #4

Underground Gas Storage Facilities

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Presentation Overview

- **PRCI Overview**
- **Recent Completed Work**
- **Ongoing Work**
- **Areas of Interest**

Our Mission

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

Our Members

4

- **33 Energy Pipeline Operating Companies**

- 15 Natural Gas Transmission; 10 Liquid
- 8 Liquid/Natural Gas

- **4 Pipeline Industry Organization (PIO) Members**

- American Petroleum Institute (API)
- Association of Oil Pipelines (AOPL)
- Canadian Energy Pipeline Association (CEPA)
- Operations Technology Development (OTD)

- **34 Associate Members & Technical Program Associate Members**

- Australia, Canada, China, Europe, Japan, U.S.

- **Worldwide Research Organization**

- 45 North American Companies (U.S. & Canada)
- 25 Non-NA (Australia, Brazil, China, Europe, India & Japan)



AUSTRALIA
AUSTRIA
BRAZIL
CANADA
CHINA
FRANCE
GERMANY
INDIA
IRELAND
JAPAN
NETHERLANDS
NORWAY
UNITED KINGDOM
URUGUAY
USA

Current Pipeline Operator Members

- **Natural Gas**

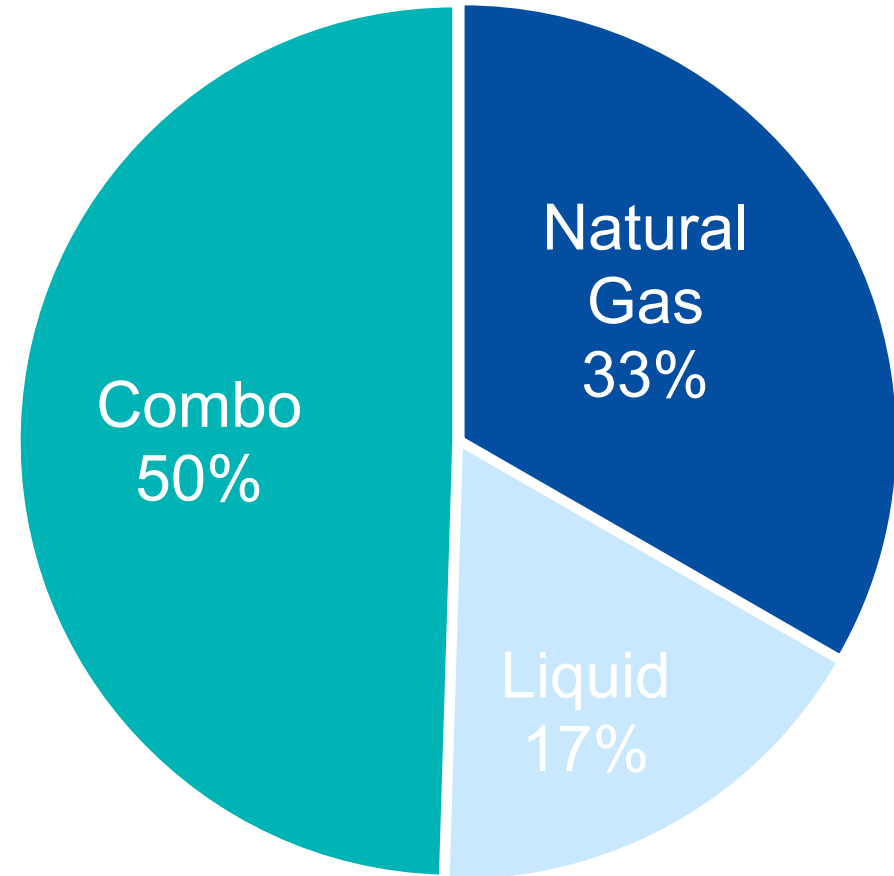
- ATCO
- Boardwalk
- Cadent
- Dominion
- Energy Transfer
- Gassco
- Gasunie
- GRTgaz
- National Fuel
- National Grid
- PG&E
- SoCalGas
- Total
- TransGas
- Williams

- **Liquid**

- Buckeye
- Chevron
- Colonial
- ExxonMobil
- FHR
- Marathon
- Phillips 66
- Plains
- Saudi Aramco
- Trans Mountain

- **Combo**

- ConocoPhillips
- Enbridge
- Enterprise
- Kinder Morgan
- Petrobras
- PetroChina
- Shell
- TC Energy





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LEADING PIPELINE RESEARCH

TECHNOLOGY DEVELOPMENT CENTER

PRCI Technology Development Center (TDC)

7



- **ILI pull test rig**
- **Thousands of pipe samples**
 - Corrosion
 - Mechanical damage
 - Cracks
 - Long seam
 - Other
- **NDE evaluation and training**
- **Conference rooms**





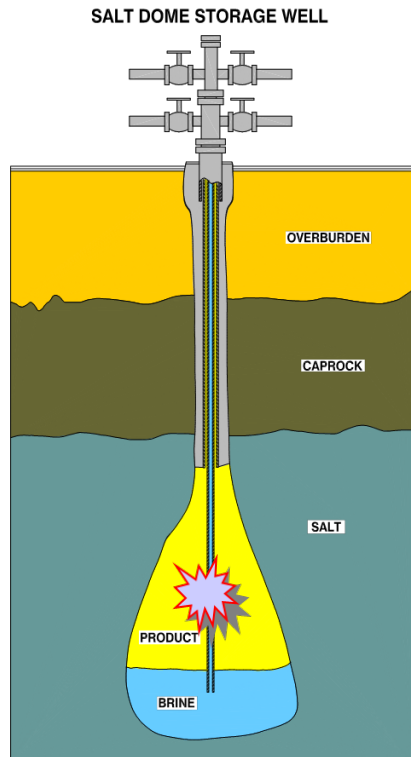
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LEADING PIPELINE RESEARCH

**ONGOING
WORK**

Current Research Portfolio

▪ Laboratory Bench Scale and Analytical Model - Flow Induced Vibration of Brine Strings

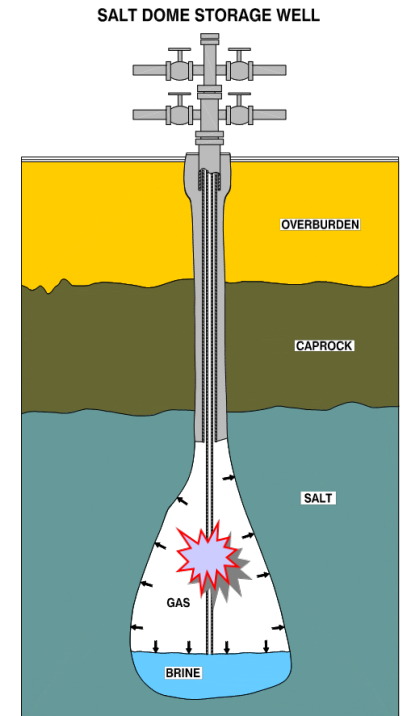


» Objective is to determine the range of parameters to ensure maximum safe brine injections

» Identify the sequence of dynamical states succeeding instability

» Ultimately, develop an operating guideline

» Expected: June 2020



Current Research Portfolio

10

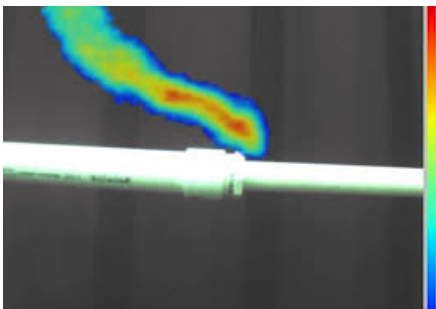
- **Assessment of Methane Emission Quantification Techniques for Storage Facilities**

- » *Stanford University led project of optical gas imaging quantification*



- » *Field trials to test minimum detection limits in multiple weather conditions and at multiple imaging distances as well as tests to quantify accuracy for equipment with a built-in quantification*

- » *Simulate optical gas imaging equipment performance to propagate the leaks forward in time which may assist in risk analysis/repair prioritization*



- » *Expected: December 2020*

Current Research Portfolio

11

■ In-line Inspection Technology Comparative Testing

» *Co-funded by PHMSA*

» *In-depth evaluation of various casing corrosion logging tools' detection capability and accuracy*

» *Quantitative evaluation of various casing corrosion logging tools conducted by full-scale physical testing in a controlled lab environment*

» *Expected: September 2020*





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LEADING PIPELINE RESEARCH

RECENTLY
COMPLETED
WORK

Recent Publications

- **Accuracy of Temperature Logging for Calculating Gas Inventory in Storage Caverns (2019)**
 - This study presents an initial computational fluid dynamics investigation into the appropriateness of wireline temperature logging for gas inventory calculations.

- **Characterization of 4.5 Inch Casing Corrosion Features (2018)**
 - Casing samples removed from natural gas storage wells were provided for corrosion feature characterization and comparison.

- **Effects of Stress on Casing Magnetic Flux Leakage (MFL) Measurements (2018)**
 - Tubing joints with localized defect features were subjected to increments in axial tension to maximum stress levels beyond yield. At various load steps, measurements were made using Baker Hughes' High Resolution Vertilog Tool to assess the variation in the defect measurements with load.

- **Methane Leak Detection and Quantification Systems for Underground Storage Facilities (2017)**
 - The project conveys results of a field study of a stationary leak detection system and other technologies that are currently available or being developed.



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LEADING PIPELINE RESEARCH

RESEARCH GAPS

Research Gaps (and current 2020 Ideas)

15

- **Wellhead Seals Best Practices**
- **Modelling Hanging String Dynamics**
 - Vibration filed test cavern dewatering
- **Cavern Abandonment**
- **Thru-tubing Casing Inspection Accuracy**
- **Casing Inspection Logging Validation**
- **Additional Topics Developed in Response to February 12, 2020 Final Rule**