

FY 2023 R&D Forum Working Groups

1) Carbon Dioxide (CO₂) Pipelines

To advance the safe transportation of CO₂, this working group will take into consideration all public interest, including what was learned during the Pipeline and Hazardous Materials Safety Administration's (PHMSA's) May 2023 public meeting held in Des Moines, Iowa. This working group will seek solutions to address the following research topics:

- Criteria for engineering assessments on existing infrastructure to be converted to CO₂ service;
- Leak detection;
- Odorization for both gaseous and supercritical CO₂ pipelines;
- Dispersion modeling, including validation of existing models;
- Fracture propagation of CO₂, including potential for crack arrestors; and
- Compatibility of gaseous and supercritical CO₂ with, and the effects of impurities on, pipeline systems, including inspection tools.

This working group also will consider incorporation of machine learning and artificial intelligence (AI) into these research areas. PHMSA envisions that the workgroup will develop four or five research topics that focus on advancing knowledge and technology related to CO₂ transportation and storage.

2) Hydrogen Pipelines

Safe transport of hydrogen in pure or blended form by pipeline continues to be a PHMSA priority as decarbonization efforts expand and industry interest increases. This working group will seek solutions to address the following research topics:

- Failure modes for steel, including pre-1970 vintage and non-metallic pipeline materials;
- Compatibility of hydrogen and hydrogen blends with non-metallic pipe materials, such as polymers;
- Leak detection of pure hydrogen and hydrogen blends.
- Impacts of hydrogen and hydrogen blends on previously installed valves, meters, and pressure regulators to clarify short- and long-term functionality over a wider range of conditions;
- Transmission and distribution system assessment methodologies, including engineering assessment protocols, establishment of various incremental operation and maintenance activities, and modified safety protocols, at various blend levels;
- Dispersion modelling of hydrogen and hydrogen blends in the case of a release and determination of potential impact radius to be used for integrity management and class location categorization for hydrogen and hydrogen blends;
- Novel hydrogen carriers (liquid organic, anhydrous ammonia, methanol, etc.); and

- Modelling of hydrogen blending economics and impact of overall hydrogen compatibility on the pipeline network compared to natural gas pipelines, including need for modification, lowering of maximum allowable operating pressure, compressor station toleration, inspection costs, pipeline life, opportunity cost of reduced energy transmission capacity, etc.

This working group also will consider incorporation of machine learning and AI into these research areas. PHMSA envisions that the workgroup will develop four or five research topics that focus on advancing knowledge and technology related to the transportation and storage of hydrogen and hydrogen blends.

3) Leak Detection for Pipeline and Liquefied Natural Gas (LNG) Facilities

Leak identification remains one of PHMSA's top priorities for ensuring pipeline safety, and it supports the Administration's climate goals of reducing greenhouse gas emissions. This working group will explore various leak detection systems for natural gas, hazardous liquids, and LNG facilities, including the use of drones, satellites, and light detection and ranging (LiDAR), controlled acoustics, technologies to improve the detection of small and persistent leaks—including in LNG tanks and other LNG facilities—and segmentation methods to improve leak detection. Opportunities for the use of machine learning and integration of AI to improve leak detection methodologies and sensor data analysis also will be explored.

PHMSA envisions that the workgroup will develop four or five research topics that focus on advancing knowledge and technology of leak detection.

4) Threat Prevention

Due to the importance of identifying and preventing pipeline threats, this working group seeks to improve methods and technologies used to prevent damage to pipelines from threats, including—but not limited to—corrosion, third-party damage, material defects, and natural forces. This working group will explore the following topics:

- Earth movement and seismic damage to pipelines, tanks, and other pipeline equipment;
- Safe levels of bending strain;
- Right-of-way monitoring from such sources as satellites or autonomous drones;
- Changes to geological threats caused by climate change such as flooding, earth movement, and changes to permafrost; and
- Methods to better understand and model problematic corrosion mechanisms.

This working group will also evaluate how machine learning and AI can help improve threat prevention. PHMSA envisions that the workgroup will develop four or five research topics that focus on advancing knowledge and technology of threat prevention.

5) Anomaly Detection, Repair, and Rehabilitation

Enhancing detection of defects and anomalies remains critical to the prevention of pipeline leaks and incidents. As the pipeline infrastructure in the United States continues to age, repair and rehabilitation increase in importance. This working group will explore research topics related to early and safe detection of anomalies in natural gas, hydrogen, hazardous liquid pipelines—including CO₂—tanks, underground gas storage systems, and other pipeline equipment. Specific topics include hard spot detection and characterization, detection technologies for small diameter and distribution piping, satellite monitoring for subsurface geohazards, and detection of anomalies on in-service LNG tanks. This working group also seeks to develop technologies and methods to repair pipelines and tanks more safely and reliably and improve rehabilitation methods of aging pipelines. Specific topics include in-service repair methods of LNG tanks, in-ditch and in-line anomaly repair methods, and rehabilitation of aging pipe.

This working group also will evaluate how machine learning and AI can help improve anomaly detection, repair, and rehabilitation. PHMSA envisions that the workgroup will develop four or five research topics that focus on advancing knowledge and technology of anomaly detection.