



Pipeline and Hazardous Materials Safety Administration Office of Pipeline Safety

**2023 FECM/NETL Carbon Management Research Project Review Meeting
PHMSA Carbon Dioxide Pipeline Safety**

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*US DOT - PHMSA – Office of Pipeline Safety, Engineering and Research Division
August 31, 2023*



PHMSA's Mission

To protect people and the environment by **advancing the safe transportation of energy and other hazardous materials** that are essential to our daily lives. To do this, the agency establishes national policy, sets and enforces standards, educates, and conducts research to prevent incidents. We also prepare the public and first responders to reduce consequences if an incident does occur.

PHMSA By the Numbers

3.4 Million

Miles of Regulated
Pipelines

1.2 Million

Daily Shipments of
Hazardous Materials

16,700

Underground Natural Gas
Storage
Wells

1.6 Billion

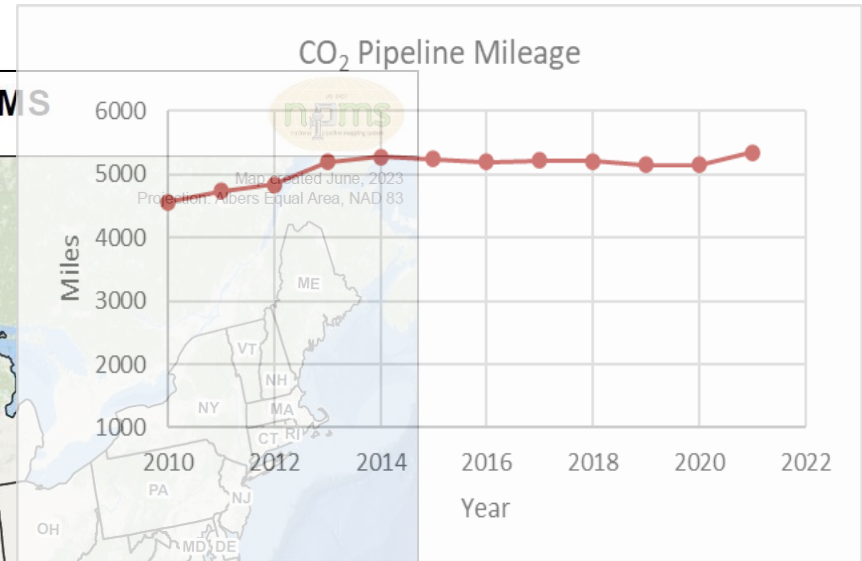
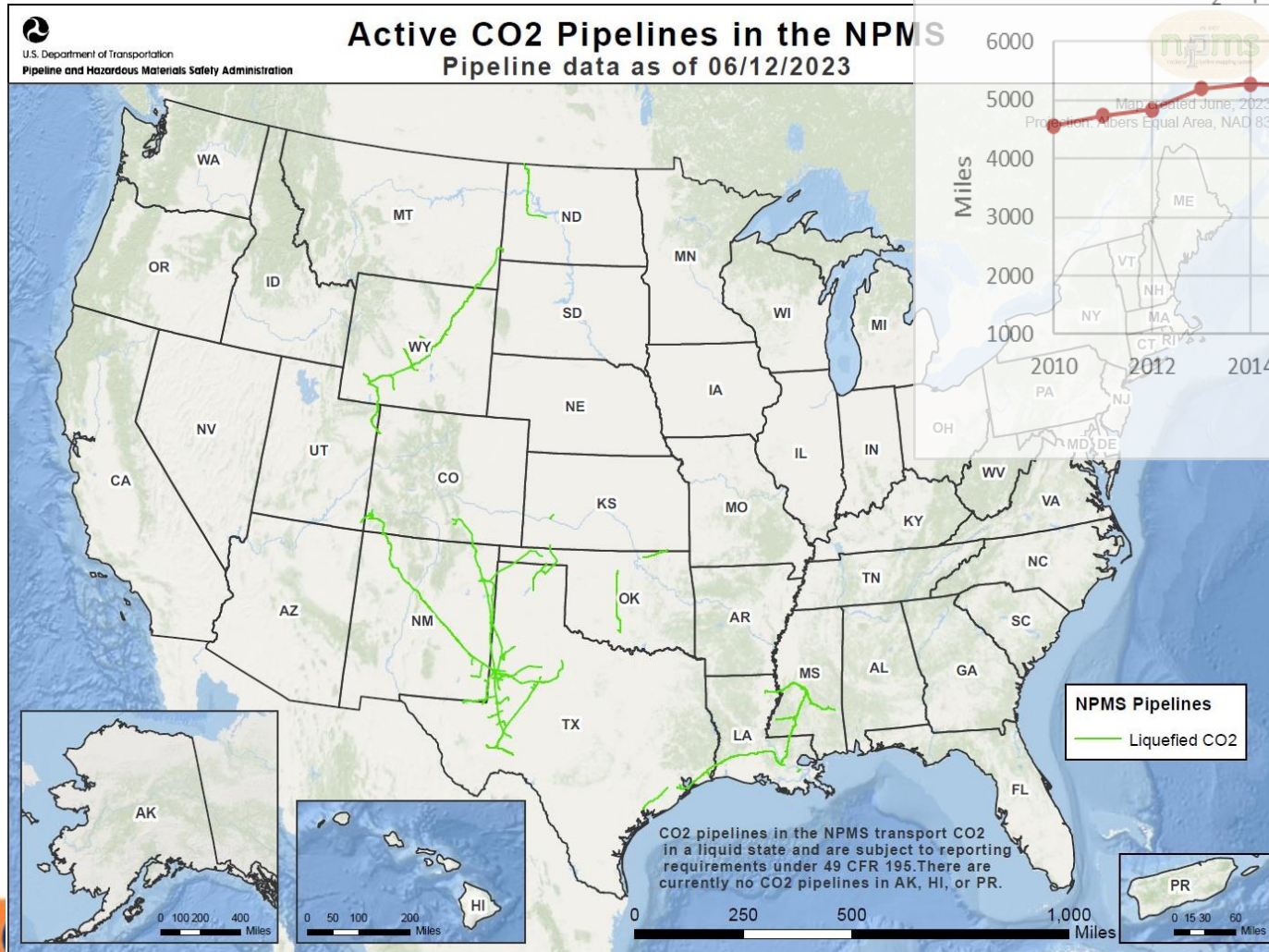
Tons of Hazardous
Materials Shipped
Annually by All Modes

64%

Of U.S. Energy
Commodities
Transported by Pipeline



CO₂ Pipeline Network



5,515 Miles

**All Pipelines:
PHMSA
Regulates 3.4 M
Miles Total**



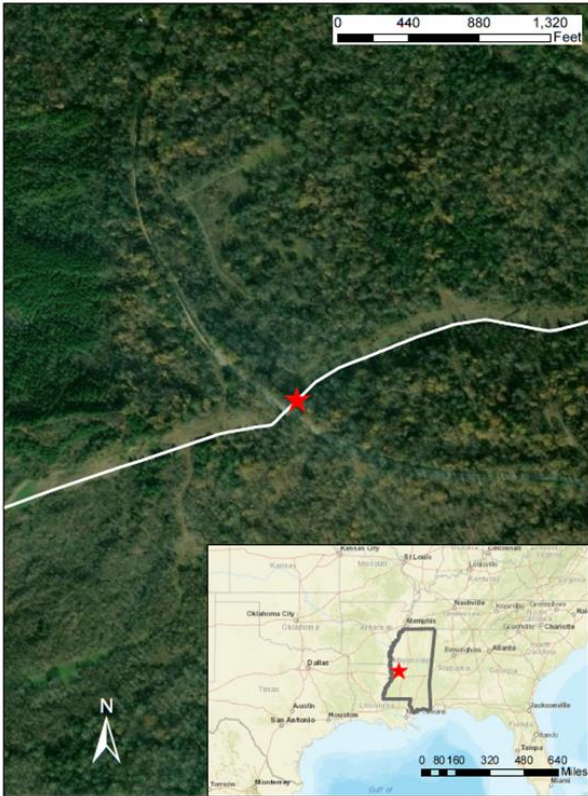
Regulatory Background

- August 1986 a catastrophic release of CO₂ in Lake Nyos, Cameroon, Africa killed 1,700 people
- Lake Nyos did not involve a pipeline but showed the potential consequence
- Pipeline Safety Reauthorization of 1988, Section 211, required DOT to develop regulations for the transportation of CO₂ by pipeline
- DOT added CO₂ into Part 195 effective July 1992
- Pipeline Safety Act of 2011, Section 15 mandated DOT “prescribe minimum safety standards for the transportation of carbon dioxide by pipelines in a gaseous state.”
 - PHMSA found that there were few gaseous CO₂ pipelines and that no foreseeable needs justified addition to Part 192 at that time



Carbon Dioxide - What Has Changed

OPID 32545 - Denbury Gulf Coast Pipelines, LLC - Satartia, MS. 2/22/2020



- February 22, 2020
- Occurred 1 mile southeast of Satartia, Mississippi
- 200 people were evacuated
- 45 individuals sought medical attention
- Over 30,000-barrels released



Carbon Dioxide – Rulemaking

RIN: 2137-AF60

Under Development

- Initiated after the 2020 rupture in Satartia, MS
- Will address emergency preparedness and response, among other topics
- NPRM scheduled for publication 1st quarter 2024
- Updates on the rulemaking found at: <https://www.phmsa.dot.gov/legislative-mandates/pipes-act-web-chart>



CO2 Safety Public Meeting 2023

Event Purpose: The purpose of the two-day CO2 Public Meeting is to inform rulemaking decisions, by discussing key topics such as public awareness, emergency response and effective communication with emergency responders and the public, dispersion modeling, safety measures to address other constituents besides CO2 in CO2 Pipelines, leak detection and reporting, and Geohazards. The CO2 meeting will be webcast for those who cannot attend in person.

- Help inform rulemaking
- Better inform stakeholders
- Share Data/Technology/Ongoing Efforts
- Address comments/concerns



Event Summary:

- May 31st - June 1st, 2023
- Over 1000 in-person & virtual attendees
- Meeting and Comments Docket Information:

<https://primis.phmsa.dot.gov/meetings/MtgHome.mtg?mtg=165>



CO2 Safety Public Meeting 2023

- **Major Topics Discussed**

- Safety expectations for pipeline operators.
- General state of CO2 pipeline infrastructure – current mileage and forecasts.
- Federal and state jurisdictions and authorities.
- Public awareness, engagement, and emergency notification.
- Emergency equipment, training, and response.
- Dispersion modeling.
- Safety measures to address other constituents besides CO2 in CO2 pipelines.
- Leak detection and reporting.
- Geohazards.
- Conversion to service.



What's Next



Next Actions:

- Review comments submitted to PHMSA-2023-0013 as rulemaking development continues
- Publish NPRM



SAVE THE DATE!

PHMSA R&D | 2023 RESEARCH FORUM

OCTOBER 31 TO NOVEMBER 1, 2023 | 8:00 am to 4:30 pm EST.
WESTIN CRYSTAL CITY | 1800 Richmond Highway, Arlington, VA



Topics:

- CO2
- Anomaly Detection, Repair & Rehabilitation

- Hydrogen
- Leak Detection
- Threat Prevention

More info here: <https://primis.phmsa.dot.gov/meetings/MtgHome.mtg?mtg=166>



Developing Design and Welding Requirements Including Material Testing and Qualification of New and Existing Pipelines for Transporting CO₂

Researcher: BMT Commercial USA

Project Cost: \$1,500,000 (\$1,200,000 PHMSA + \$300,000 cost sharing)

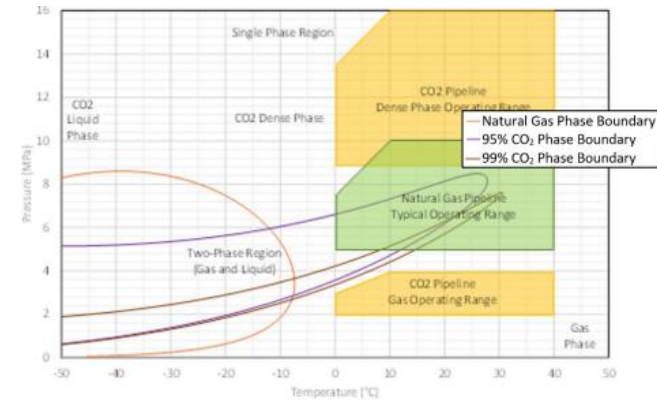
Public Page: <https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=996>

Project Objective:

- Identify unique aspects of CO₂ pipeline design, integrity, and operational considerations currently not well supported by existing knowledge.
- Define processes and procedures to fill these safety gaps.
- Identify performance-based safety targets for CO₂ pipelines.

Project End Date: 9/29/2024

Potential Impact on Safety: Will advance the safe transportation of impure CO₂ at both low pressure (gas phase) and high pressure (supercritical and dense phase), by defining the state of knowledge and how it can be applied in CO₂ pipeline design, operation, and maintenance.



Pictures courtesy BMT



Determination of Potential Impact Radius (PIR) for CO₂ Pipelines Using Machine Learning Approach

Researcher: Texas A&M Engineering Experiment Station

Project Cost: \$359,560 (\$279,754 PHMSA + \$79,806 cost sharing)

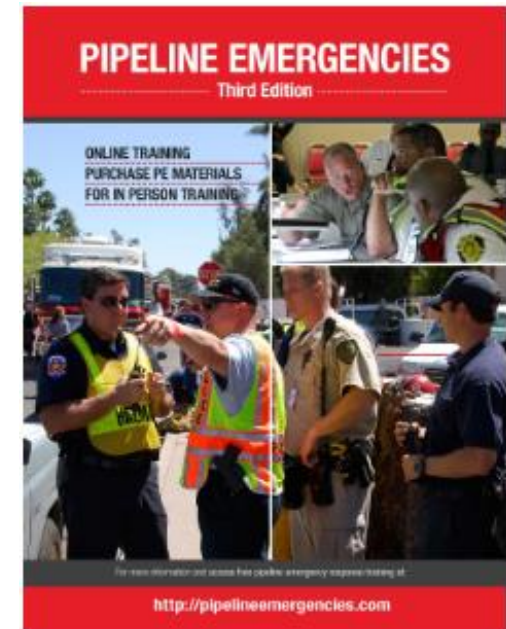
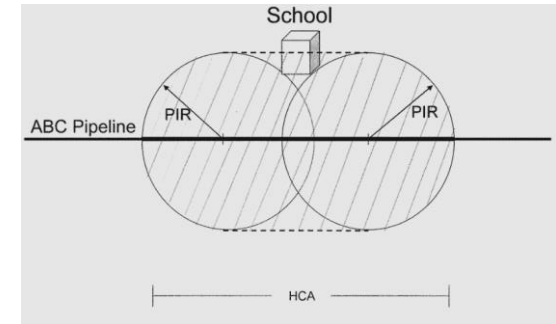
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Project Objective:

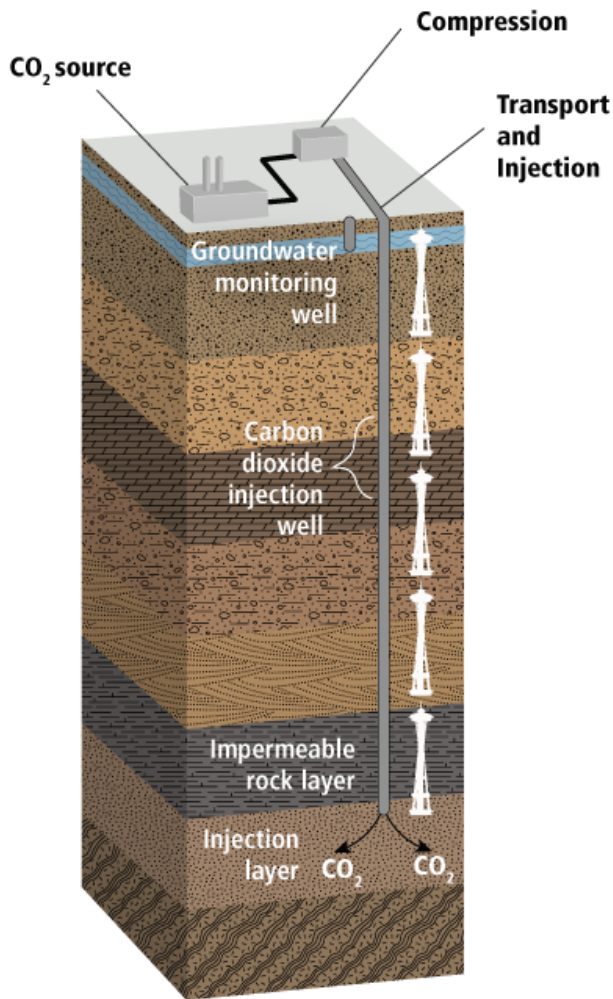
- Establish a computational fluid dynamics model to simulate the release and dispersion of supercritical CO₂ from full pipeline ruptures.
- Use the simulation results to construct a database comprising CO₂ dispersion data under different scenarios.
- Use the resulting scenario data in a machine learning analysis for predicting dispersion ranges and health consequences.
- Develop a rapid, universally applicable tool to assess the consequences of accidental CO₂ dispersion from high-pressure pipelines.

Project End Date: 9/29/2025

Potential Impact on Safety: A tool to measure the impact radius will aid in the development of effective response planning.



IAA: Establishing the Technical Basis for Enabling Safe and Reliable Underground CO₂ Storage Operations – PENDING*



Researcher: US Department of Energy, Office of Fossil Energy and Carbon Management Carbon Transport and Storage Office – Inter-Agency Agreement
Project Cost Estimate: \$2,000,000

Specific Project Objectives:

- To assess storage potential and likely use cases for CO₂ storage in existing natural gas storage fields.
- To leverage existing technical learnings from related natural gas and CO₂ storage activities that can be directly applied to conversion of UNGS fields to CO₂.
- To identify significant modifications to standard UNGS practices that may be required, particularly for leakage mitigation and safety practices.
- To highlight significant technical or regulatory gaps that require further study.
- Tasks:
 1. Geologic Suitability and Demand Scenarios
 2. Well and Infrastructure Suitability
 3. Monitoring Considerations
 4. Regulatory Considerations
 5. Phase 2 Scope Development

Estimated Project End Date: Fall of 2025

*Currently developing Phase 1 Statement of Work with FECM, will be awarded before FY2023 year end.



R&D Links

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About Pipeline Research & Development

The mission of PHMSA's Pipeline Safety Research & Development Program is to sponsor projects focused on providing technical solutions that will improve pipeline safety, reduce the environmental impact of failures, and enhance the reliability of the Nation's pipeline transportation system.

The research program has the following objectives:

- Employ a coordinated and collaborative approach to address mutual pipeline challenges with a wide set of pipeline stakeholders
- Help remove technical and sometimes regulatory barriers on a given challenge
- Tell the research story by measuring our research results, outputs, and impacts
- Promote transparency by posting online R&D program/project actions and products.

R&D Program Website: <https://www.phmsa.dot.gov/research-and-development/pipeline/about-pipeline-research-development>

R&D program awards and sortable features: <https://primis.phmsa.dot.gov/matrix/>

Submit a research gap suggestion: <https://primis.phmsa.dot.gov/rd/gapsuggestions.htm>

Join the R&D Program Alerts Distribution List: <https://service.govdelivery.com/accounts/USDOTPHMSA/subscriber/new>

R&D Program Email: R&Dteam@dot.gov



Thank You

Questions?

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