U.S Department of Transportation
Pipeline and Hazardous Materials Safety Administration
Office of Pipeline Safety

Introductory Remarks and Review of Satartia Incident

Atmospheric Dispersion Modelling Liaison Committee Webinar

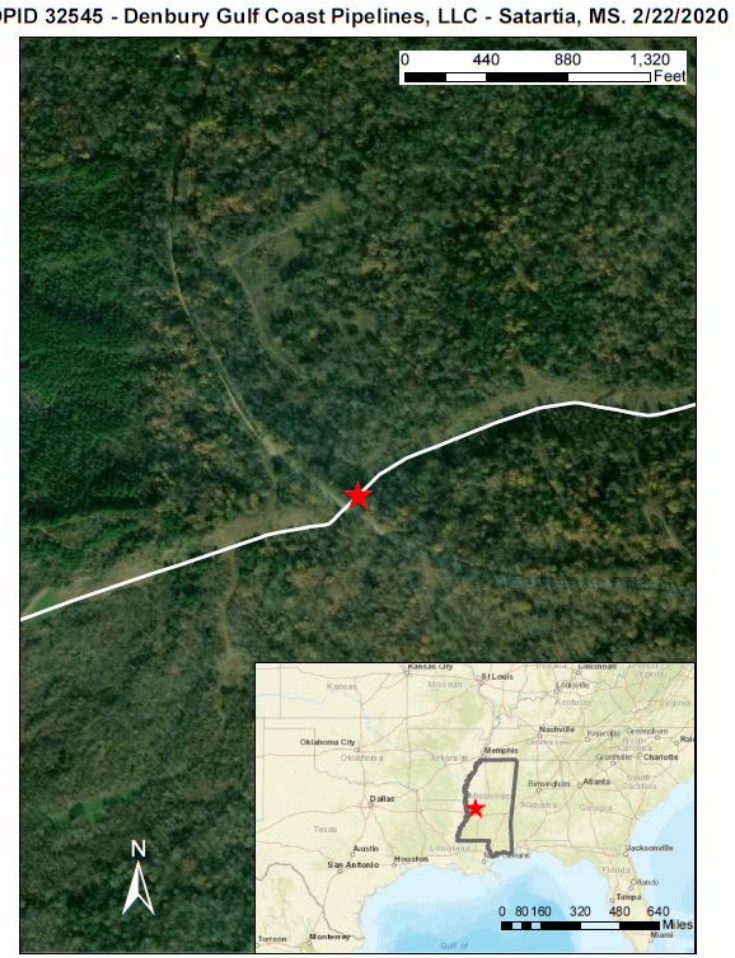
Dense gas dispersion modelling in complex terrain (CO_2 Pipelines)

Max Kieba, Director, Program Development

7 March 2023

Pipeline Information

- 24-inch CO_2
- Installed in 2009
- 77 miles (Jackson Dome, MS to Delhi, LA)
- Primary use is for Enhanced Oil Recovery (EOR)



Incident Details

- Release occurred at night approximately one mile southeast of Satartia, Mississippi
- 45 individuals sought medical attention
- 200 Satartia, MS residents and those in the area evacuated
- Estimated total of 31,405-barrels released
- Atmospheric inversion

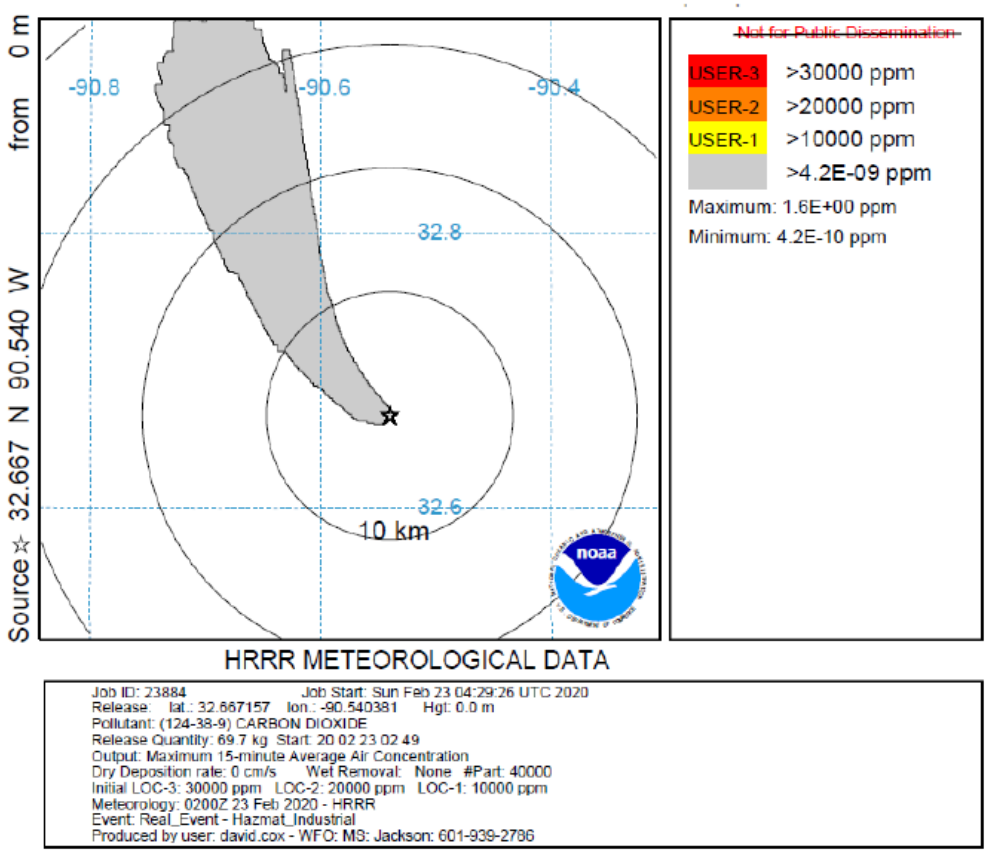
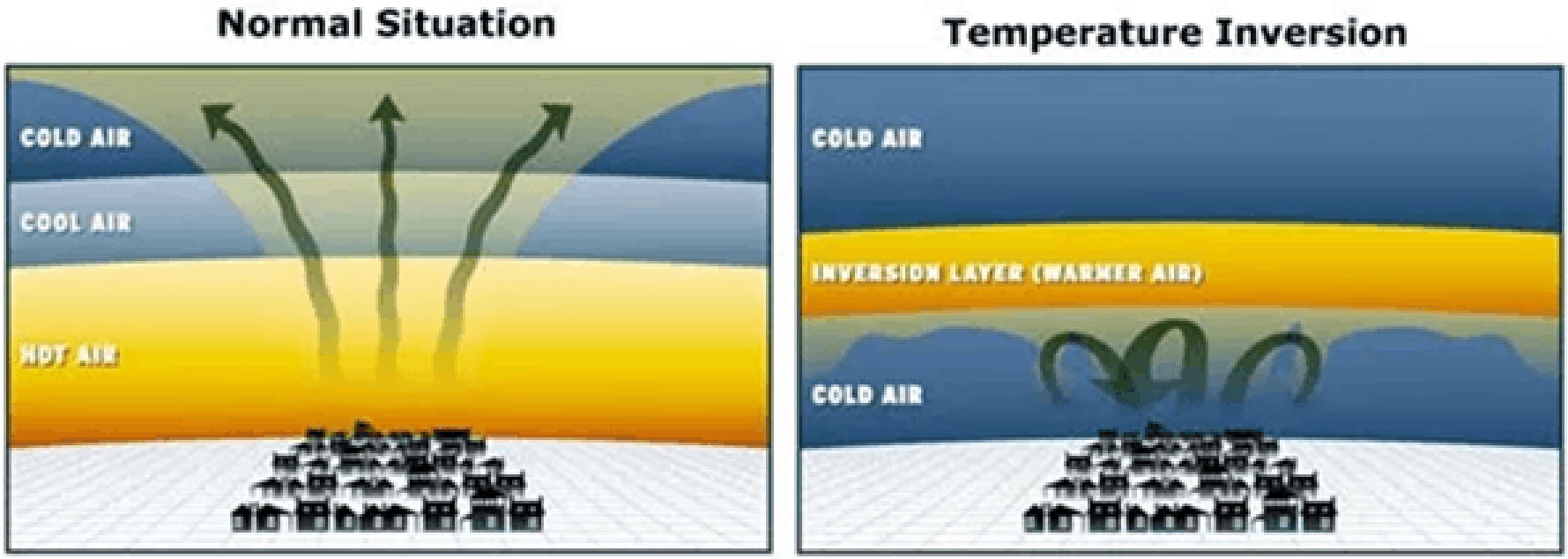


Figure 5: This Chart Shows the Plume Model Data Generated by the National Weather Service/NOAA - The Model Indicates the Direction a Plume or Cloud of CO_2 Would Have Followed from Ground Level While Dissipating, According to Atmospheric Data at the Time of the Release - Each Ring is 10 Kilometers (Satartia is Less Than Two Kilometers Northwest of Release Site, Indicated by the Star)[8]

Temperature Inversion

In certain unique environmental conditions (cold/no breeze), a large release of CO_2 can be dangerous – such as the situation that occurred in February 2020 in near Satartia, Mississippi.



Findings

The failure was a result of soil movement which caused excessive axial loading leading to failure at the girth weld.

Area topography, soil type and large amounts of rain over the preceding months saturated and vertically eroded the loess soil on the side of the hill above the pipeline.

Contributing Factors

- Geohazard
  - Procedures
  - IMP
  - Aerial patrols

Figure 6: Topographical Map Showing the Delhi Pipeline (Green) and Denbury's Buffer Zone (Red) on Either Side of the Pipeline and the Proximity to Satartia (Blue Star Indicates the Rupture Site)

- Emergency response and preparedness
  - CO_2 dispersion model underestimated the potential affected area
    - Operator did not notify local responders advising them of a potential failure

PHMSA May 2022 Press Release

- Initiating rulemaking
- Issued notice of probable violation
- Failure investigation report
- Issued an updated advisory related to land movements and geohazards
- Conducting research solicitations

PHMSA Announces New Safety Measures to Protect Americans From Carbon Dioxide Pipeline Failures After Satartia, MS Leak

Thursday, May 26, 2022

PHMSA 05-22
Contact: PHMSAPublicAffairs@dot.gov

WASHINGTON - The U.S. Department of Transportation's Pipeline and Hazardous Materials Safety Administration (PHMSA) today announced it is taking steps to implement new measures to strengthen its safety oversight of carbon dioxide (CO_2) pipelines around the country and protect communities from dangerous pipeline failures. The new measures, as well as an enforcement action taken today are a result of PHMSA's investigation into a CO_2 pipeline failure in Satartia, Mississippi in 2020 that resulted in local evacuations and caused almost 50 people to seek medical attention.

"I recently visited with the first responders in Satartia to hear firsthand of the pipeline failure so that we can improve safety and environmental protections for CO_2 pipelines and work to protect communities from experiences like this," said PHMSA Deputy Administrator Tristan Brown. "The safety of the American people is paramount and we're taking action to strengthen CO_2 pipeline safety standards to better protect communities, our first responders, and our environment."

Actions since PHMSA May Press Release

- Initiated rulemaking. Limited on providing additional details due to ex-parte. Summary of meetings required.

117. Pipeline Safety – Safety of Carbon Dioxide Pipelines

Popular Title: Carbon Dioxide Pipelines
RIN 2137-AF60
Stage: NPRM

Abstract: This Proposed rulemaking would amend PHMSA's Pipeline Safety Regulations (49 CFR parts 190-199) to adopt revisions that would enhance the safe transportation of carbon dioxide by pipelines to accommodate an anticipated increase in the number of carbon dioxide pipelines and volume of carbon dioxide transported. Also, this proposed rulemaking would include requirements related to emergency preparedness and response for carbon dioxide.

Dates for NPRM:

Action	Publication Date	FR Cite
NPRM	10/00/2024	

Research awards since PHMSA May Press Release

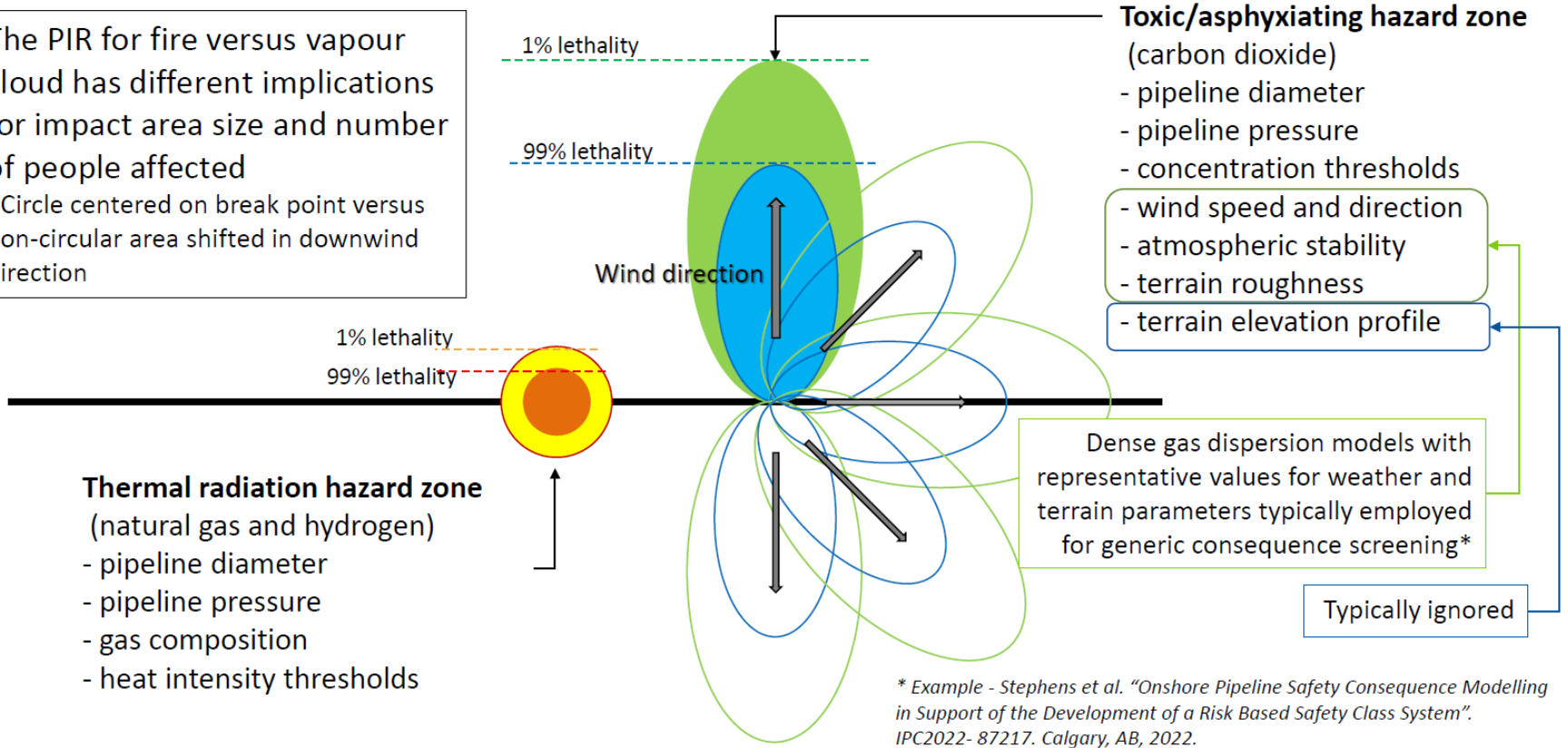
- Competitive Academic Agreement Program (CAAP)
  - Texas A&M Engineering Experiment Station "Determination of Potential Impact Radius for CO2 Pipelines using Machine Learning Approach“
- Core program
  - BMT Commercial USA, Inc. "Developing Design and Welding Requirements Including Material Testing and Qualification of New and Existing Pipelines for Transporting CO2"

December 2022 Public Meeting – Potential Impact Radius Panel (Mark Stephens)

C-FER Technologies
A SUBSIDIARY OF ALBERTA INNOVATES

Factors Affecting Potential Impact Areas

The PIR for fire versus vapour cloud has different implications for impact area size and number of people affected
- Circle centered on break point versus non-circular area shifted in downwind direction



Toxic/asphyxiating hazard zone
(carbon dioxide)
- pipeline diameter
- pipeline pressure
- concentration thresholds
- wind speed and direction
- atmospheric stability
- terrain roughness
- terrain elevation profile

Dense gas dispersion models with representative values for weather and terrain parameters typically employed for generic consequence screening*

Typically ignored

Thermal radiation hazard zone
(natural gas and hydrogen)
- pipeline diameter
- pipeline pressure
- gas composition
- heat intensity thresholds

** Example - Stephens et al. "Onshore Pipeline Safety Consequence Modelling in Support of the Development of a Risk Based Safety Class System". IPC2022- 87217. Calgary, AB, 2022.*

www.cfertech.com

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Resources

- PHMSA May 2022 Press Release
  - https://www.phmsa.dot.gov/news/phmsa-announces-new-safety-measures-protect-americans-carbon-dioxide-pipeline-failures
- Rulemaking status
  - https://www.transportation.gov/regulations/report-on-significant-rulemakings
- CAAP Project (PIR for CO_2) Public Page: https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=987
- Core Project (Design and Welding Requirements for CO_2) Public Page: https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=996
- PHMSA December Public Meeting
  - General Meeting Page with full agenda and recordings: https://primis.phmsa.dot.gov/meetings/MtgHome.mtg?mtg=161
  - Mark Stephens Presentation: https://primis.phmsa.dot.gov/meetings/FilGet.mtg?fil=1393

Thank You

Questions?