



# Learning from Past Accidents

Sara Lyons, P.E.

Pipeline Accident Investigator

PHMSA's Failure Investigation Forum, December 13, 2022



# Response Operations Center (ROC)



- Operates 24/7 365 days a year
- Staffed by at least 2 watch officers
- Monitors and collects accident information for all modal offices
- Provides logistical support during launches

# Pipeline Duty Officers



Sean Lynum, Chief

## Hazardous Materials Investigators



Paul Stancil



Rachael Gunaratnam



Marc Dougherty

## Pipeline Investigators



Kim West



Sara Lyons



(vacant)



(vacant)



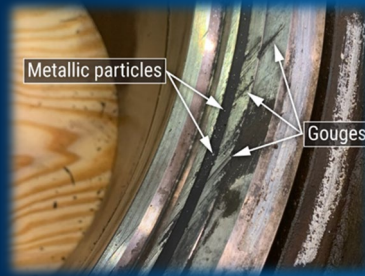
# Accident Investigation Process

## On-Scene



Go Team  
Groups & Parties  
Family Briefings\*  
Media Briefings\*  
News Releases\*

## Fact Gathering



Preliminary Report  
Investigative Updates  
Engineering Studies  
Public Hearing\*

## Fact-finding

## Factual Reports



Technical Review  
Docket Opening

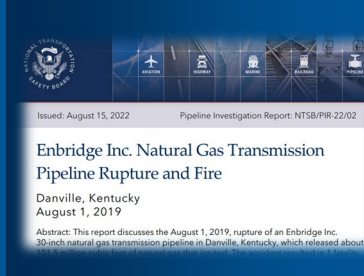
## Analysis



Party Submissions  
Findings  
Conclusions  
Probable Cause  
Safety Recs\*  
Board Meeting\*

## Analysis

## Final Report



Final editing  
Docket Update

## Beyond the Investigation



Track Progress of Safety Recs  
Safety Advocacy

\* if needed

# Safety Advocacy



**DEC 1+2 2022**

**PIPELINE SAFETY TRUST**  
Annual Conference

**KEYNOTE SPEAKERS**  
The Honorable Jennifer Homendy  
*Chair, NTSB*  
The Honorable Tristan Brown  
*Deputy Administrator, PHMSA*

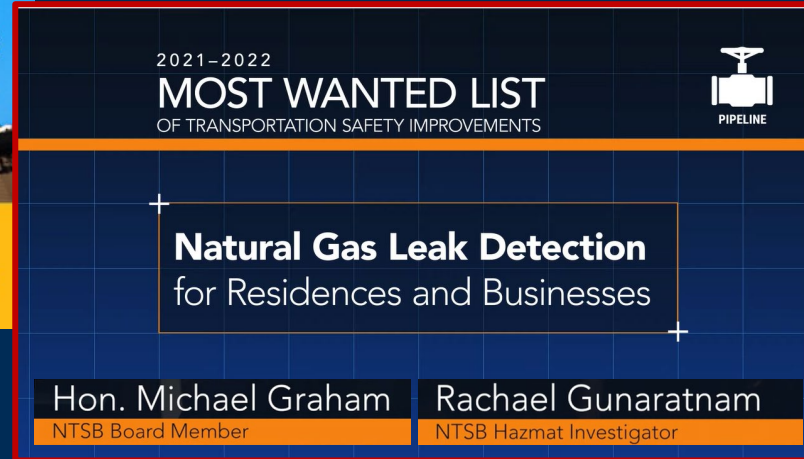
Rue D'Orléans  
**Orleans**

Registration, lodging, and more at [pstrust.org](http://pstrust.org)

**HOTEL MONTELEONE** New Orleans, LA

**Pipeline Safety TRUST** Credible. Independent. In the public interest.

Since 2006, The Pipeline Safety Trust Annual Conference offers a forum for the affected public, local governments, the pipeline industry, and government regulators to come together to discuss barriers to safer pipelines.



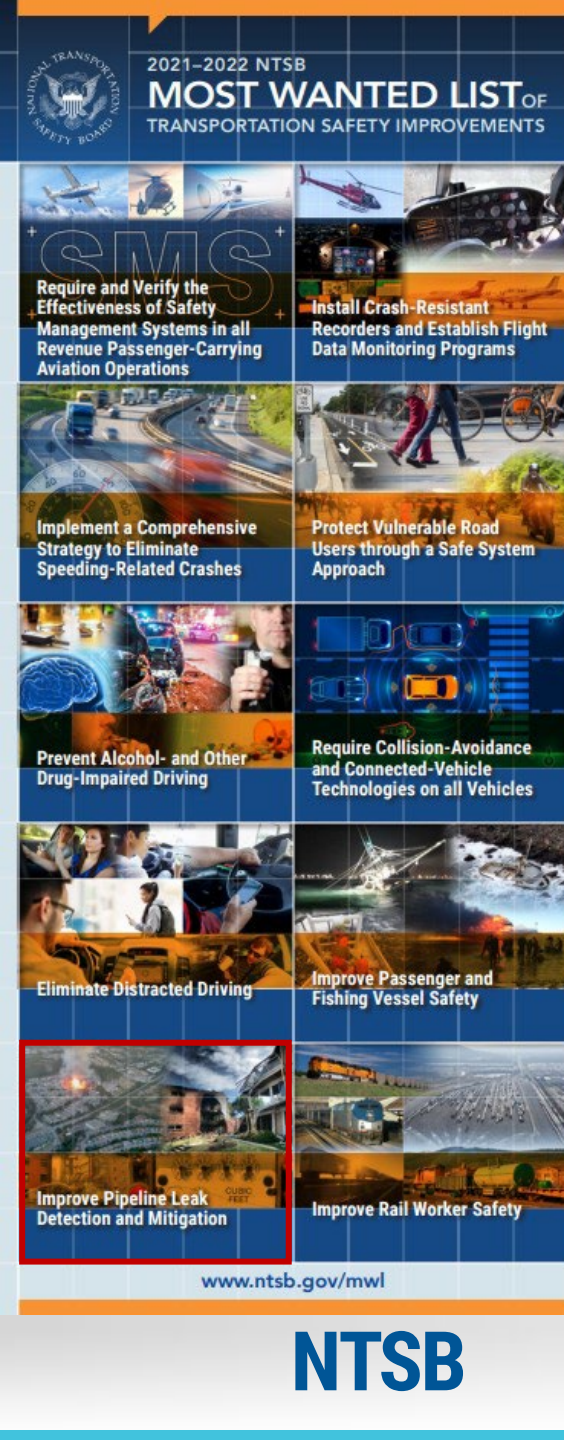
2021-2022  
**MOST WANTED LIST**  
OF TRANSPORTATION SAFETY IMPROVEMENTS

**Natural Gas Leak Detection for Residences and Businesses**











Hon. Michael Graham  
NTSB Board Member

Rachael Gunaratnam  
NTSB Hazmat Investigator

PIPELINE



2021-2022 NTSB  
**MOST WANTED LIST** OF  
TRANSPORTATION SAFETY IMPROVEMENTS

 <b>Require and Verify the Effectiveness of Safety Management Systems in all Revenue Passenger-Carrying Aviation Operations</b>	 <b>Install Crash-Resistant Recorders and Establish Flight Data Monitoring Programs</b>
 <b>Implement a Comprehensive Strategy to Eliminate Speeding-Related Crashes</b>	 <b>Protect Vulnerable Road Users through a Safe System Approach</b>
 <b>Prevent Alcohol- and Other Drug-Impaired Driving</b>	 <b>Require Collision-Avoidance and Connected-Vehicle Technologies on all Vehicles</b>
 <b>Eliminate Distracted Driving</b>	 <b>Improve Passenger and Fishing Vessel Safety</b>
 <b>Improve Pipeline Leak Detection and Mitigation</b>	 <b>Improve Rail Worker Safety</b>

[www.nts.gov/mwl](http://www.nts.gov/mwl)

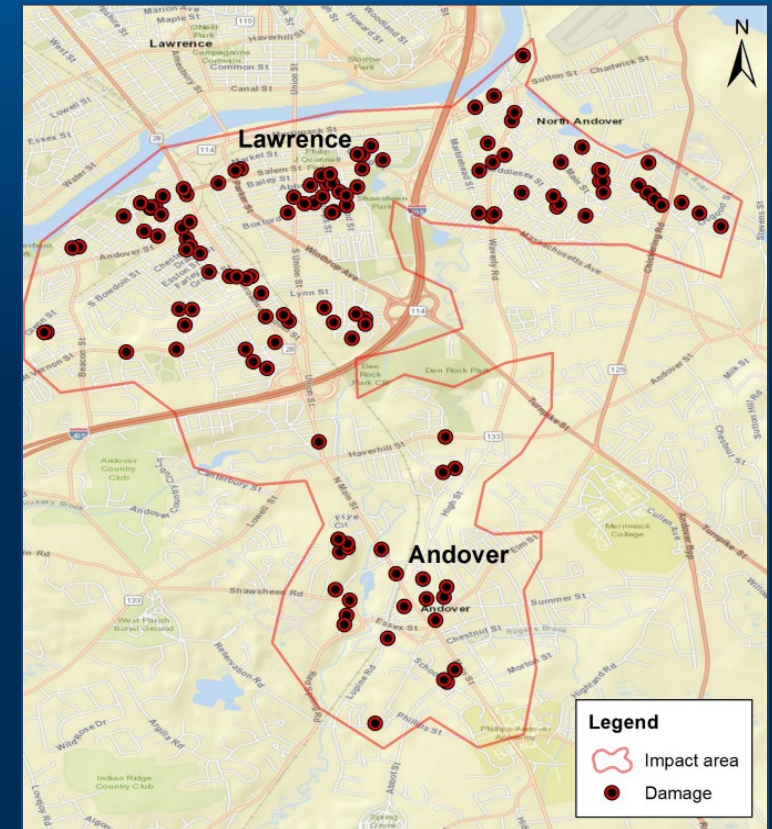


# What can we learn from studying previous accidents?

Merrimack Valley, Massachusetts, September 13, 2018

1 fatality, 29 injuries, Cost >\$1.5B

Contributing cause: Low-pressure system designed and operated without adequate overpressure protection



[pld18mr003.aspx \(nts.gov\)](https://www.nts.gov/pld18mr003.aspx)

# Preceding Merrimack Valley



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# Preceding Merrimack Valley



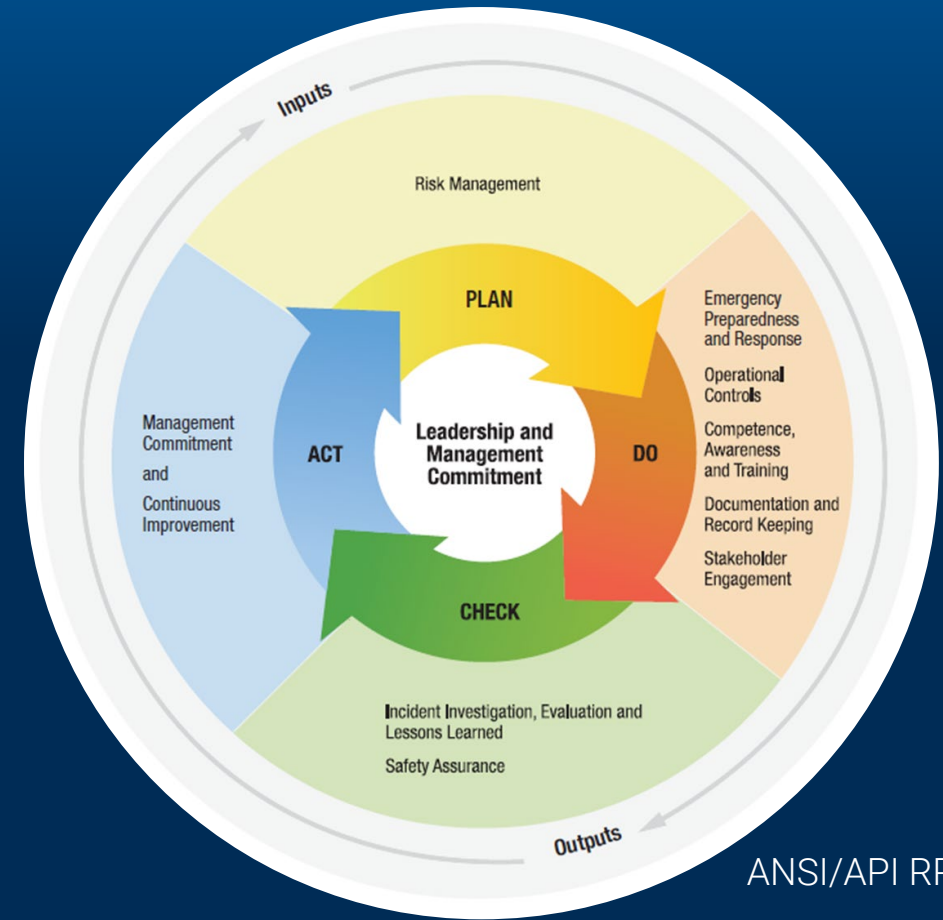
All 14 events resulted from common cause failures.

# Merrimack Valley Safety Recommendations (subset)

- P-18-008 TO NISOURCE: Apply management of change process to all changes to adequately identify system threats that could result in a common mode failure. (Urgent)
- P-19-014 TO PHMSA: Revise Title 49 Code of Federal Regulations Part 192 to require overpressure protection for low-pressure natural gas distribution systems that cannot be defeated by a single operator error or equipment failure.
- P-19-015 TO PHMSA: Issue an alert to all low-pressure natural gas distribution system operators of the possibility of a failure of overpressure protection; and the alert should recommend that operators use a failure modes and effects analysis or equivalent structured and systematic method to identify potential failures and take action to mitigate those identified failures.

# Pipeline Safety Management Systems

“The creation of a learning environment for continuous improvement is achieved by investigating incidents thoroughly, fostering non-punitive reporting systems, and communicating lessons learned.”



ANSI/API RP 1173

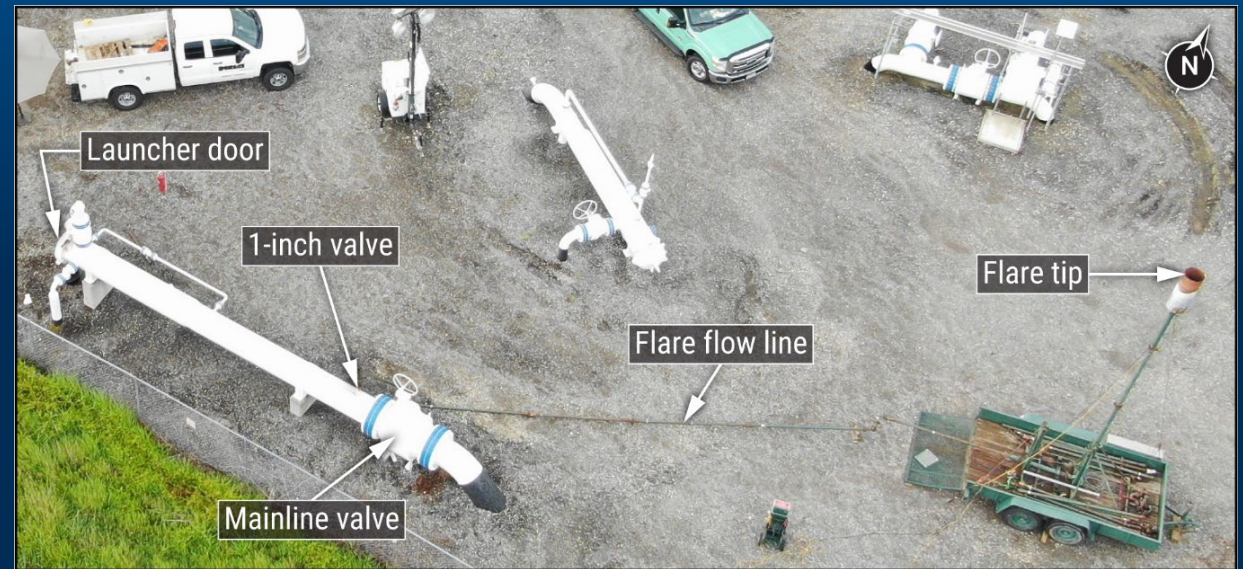


# What can we learn from studying previous accidents?

Farmersville, Texas, June 28, 2021

2 fatalities, 2 injuries

Contributing: Procedures and training practices that did not prepare workers to recognize and safely respond to abnormal operating conditions.

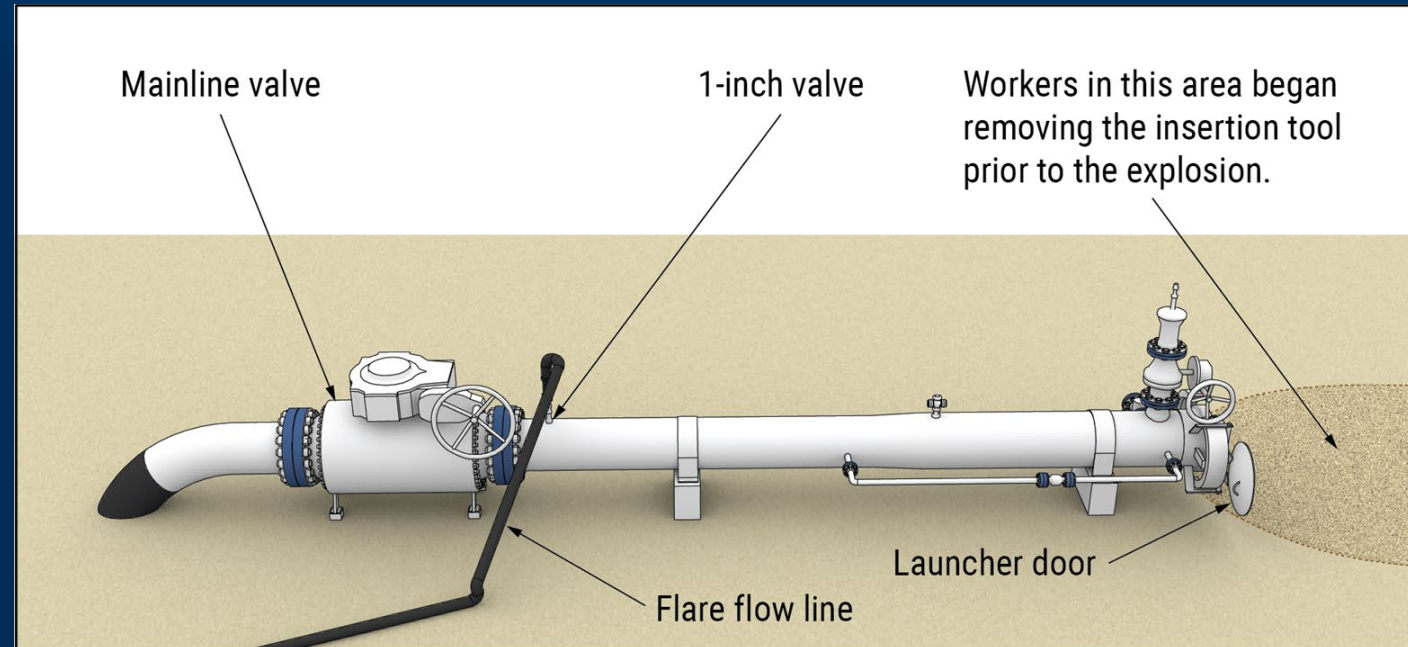


Photograph courtesy of Wylie Fire Department

[PLD21FR002.aspx \(nts.gov\)](https://www.nts.gov/PLD21FR002.aspx)

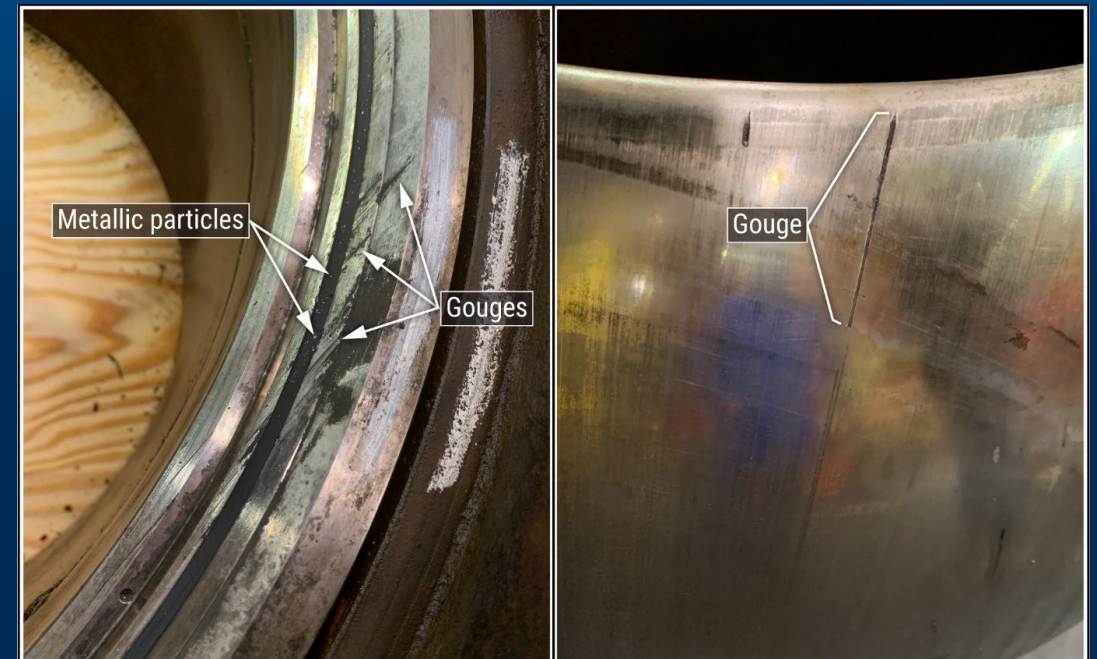
# Farmersville Accident Sequence

Time	Description
	Flare burned and extinguished
<b>3:28 PM</b>	Workers took photos of pig
	Workers opened launcher door
	Workers lifted pig with excavator
	Worker attached grounding cable
	Workers manually inserted pig into launcher
	Workers further inserted pig with excavator
	Workers determined that pig was fully inserted
	Workers began removing insertion tool
	Explosion occurs
<b>3:34:48 PM</b>	Worker calls 911



# Farmersville Valve Testing and Examinations

- Mainline valve found to be leaking
- Scratched and gouged sealing surfaces
- Consistent with foreign debris entering the valve from an external source

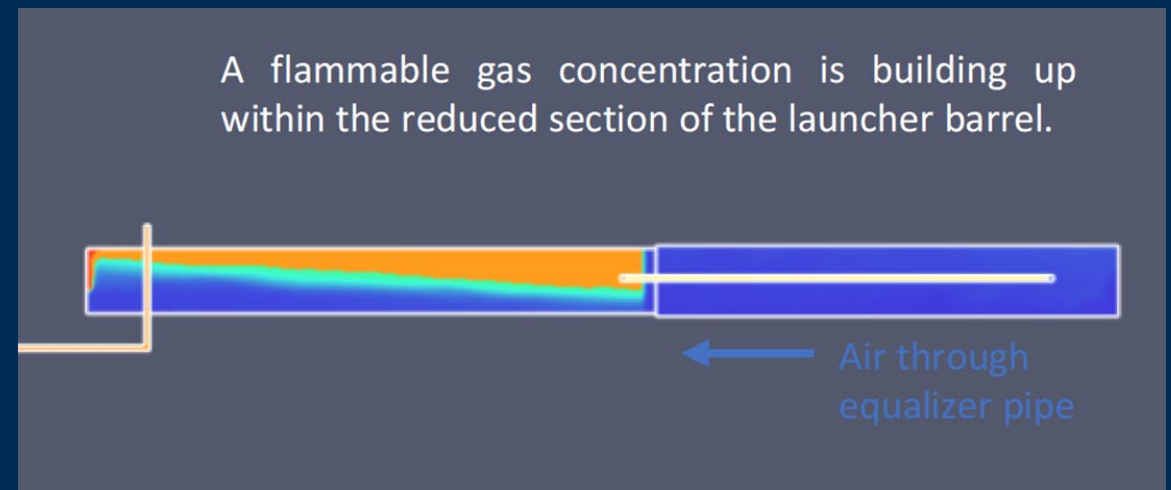
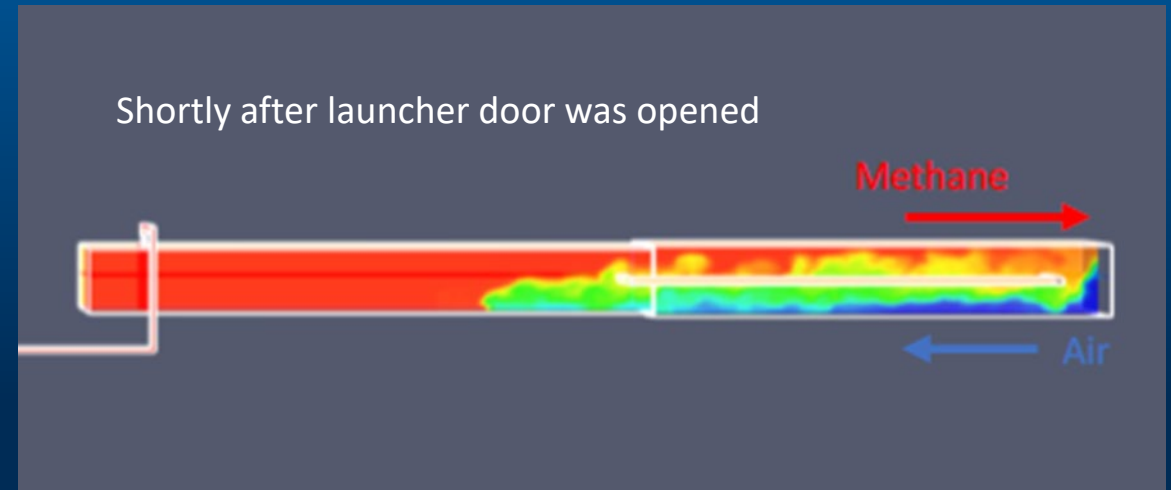


Leaking mainline valve from Farmersville



# Farmersville Flammability Study

- Natural gas concentration at about 100 percent after the flare extinguished
- After launcher door was opened
  - Air enters, creating explosive mixture
  - Falls below LEL within a few minutes\*
- Once pig was introduced
  - Air flowed through equalizer piping
  - Flammable mixture persists between pig and mainline valve



\*When the mainline valve leak was modeled, a thin, flammable gas-air mixture layer persisted in the top of the launcher.

# Preceding Farmersville

- Slaughters, KY, October 29, 2007. *Launcher pig trap valve was reportedly leaking, causing build-up of pressure behind the pig. Pig dislodged and broke off launcher door, pinning the worker between door and backhoe. (PHMSA Incident Report 20070138)*
- Gulf of Mexico, October 23, 2008. *Pig launcher was reportedly isolated and depressurized. After the pig was loaded, the pig ejected backwards, striking the worker on his right arm. Isolation valves were found to be leaking.*

# Preceding Farmersville

PHMSA investigated a fatal pig receiving accident that occurred in Meade, KS on March 26, 2020, noting:

- Lack of site-specific procedures
- Failure to follow procedures
- Insufficiently placed pressure gauges
- Leaking valves
- Operator did not comply with OQ requirements

[Interpretation Response | PHMSA \(dot.gov\)](#)



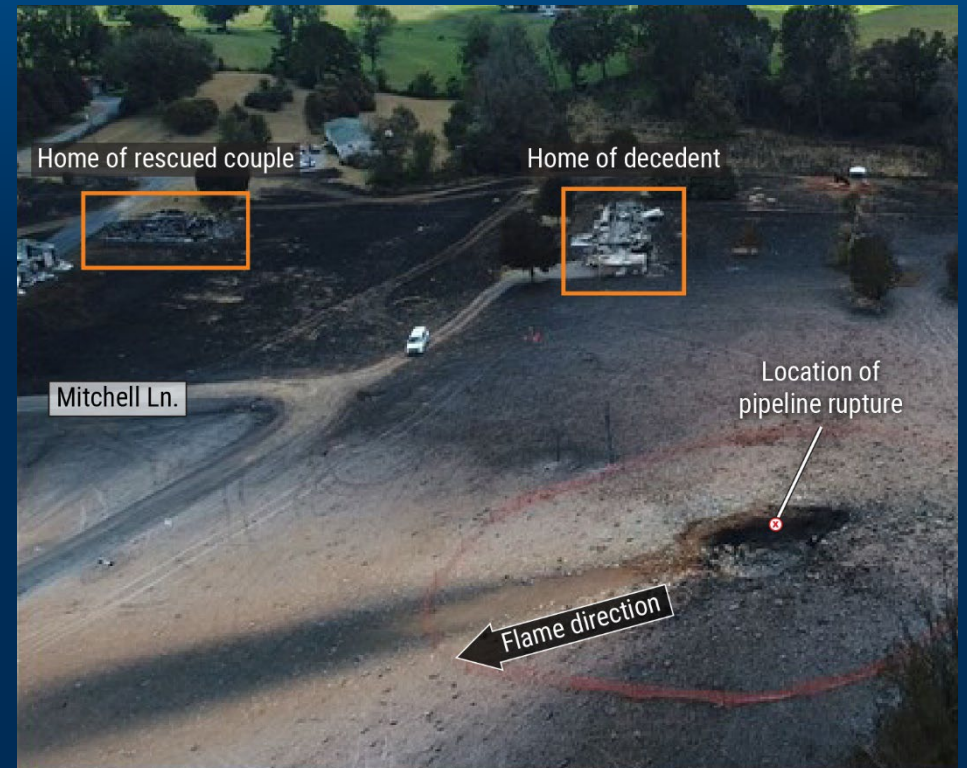
# Post-Accident Actions

- Immediately suspended pigging operations on in-service pipelines
- Worked with other companies to benchmark procedures and practices
- Standardized launcher and receiver designs (including retrofits)
- On-site tool and grounding requirements
- Established new covered task
- Revised procedures
  - Site-specific valve sequencing plan
  - Job Safety Analyses
  - Lockout/tagout
  - Gas and pressure monitoring
  - Nitrogen purge
  - Mandatory stabilization periods
  - Criteria for stopping work
  - Delineation of hazard zones

# What can we learn from studying previous accidents?

Danville, Kentucky, August 1, 2019

1 fatality, 6 other injuries



[PLD19FR002.aspx \(ntsb.gov\)](https://www.ntsb.gov/PLD19FR002.aspx)

# Potential Impact Radius (PIR)

The radius of a circle within which the potential failure of a pipeline could have significant impact on people or property.

49 CFR 192.903

# Potential Impact Radius (PIR)

$$PIR = 0.69 \times \sqrt{p \times d^2}$$

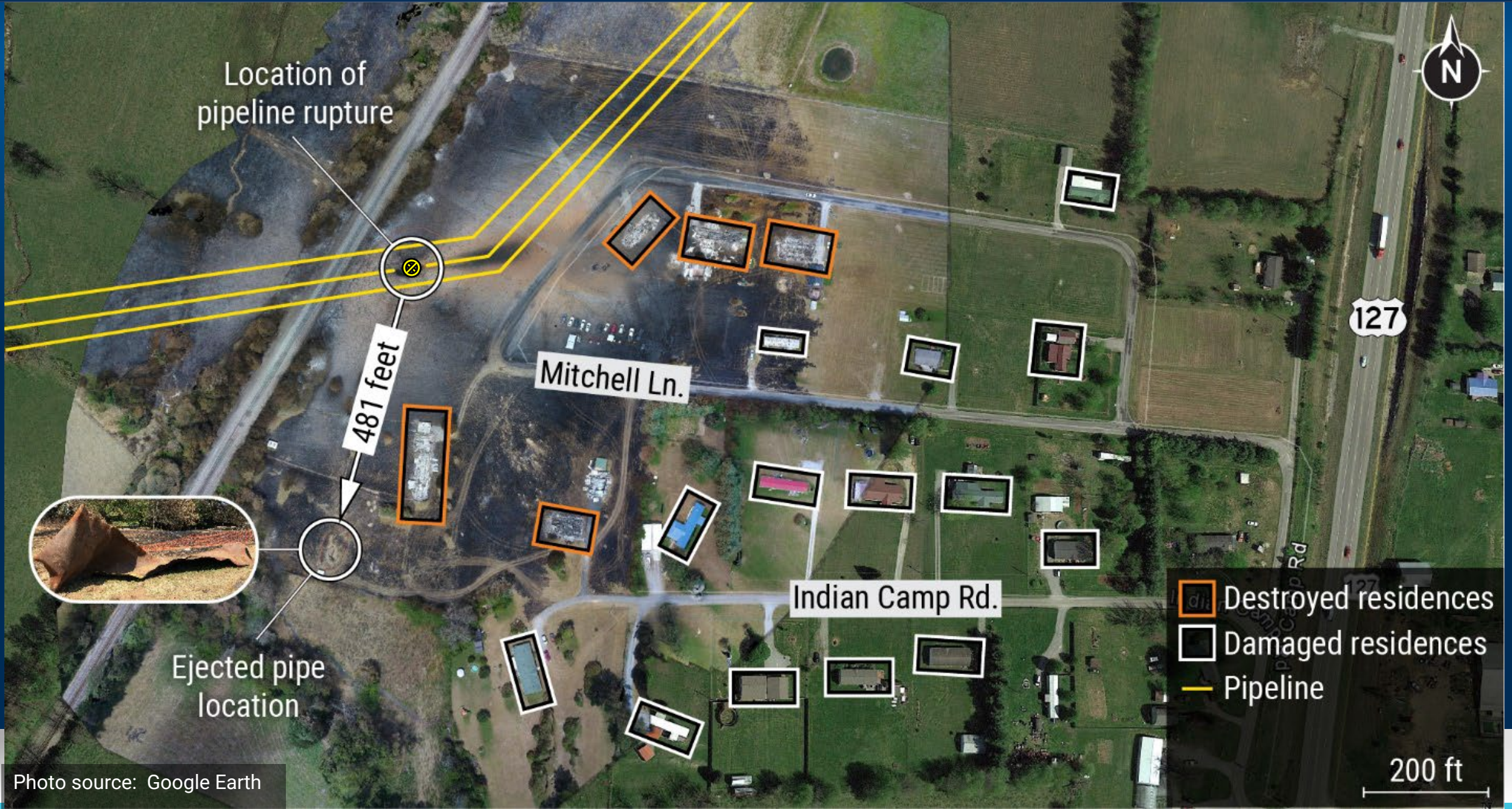
where  $p$  is the maximum allowable operating pressure (MAOP) in psi  
 $d$  is the nominal diameter of the pipeline in inches

There is model uncertainty associated with the use of this equation.



Danville, KY – August 1, 2019

1 fatality, 6 others injured, 5 homes destroyed, 14 damaged

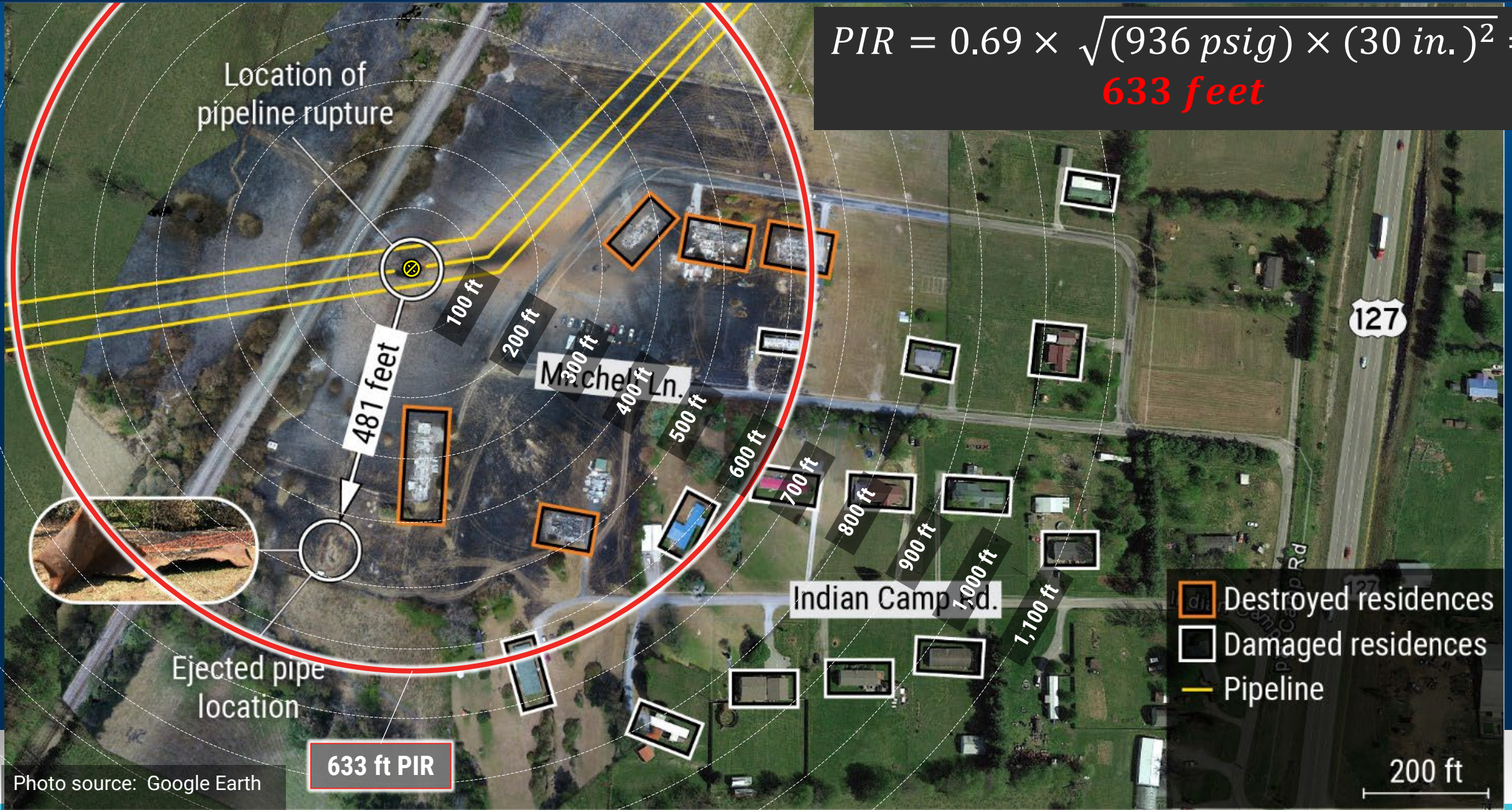




Danville, KY – August 1, 2019

1 fatality, 6 others injured, 5 homes destroyed, 14 damaged

$$PIR = 0.69 \times \sqrt{(936 \text{ psig}) \times (30 \text{ in.})^2} = \mathbf{633 \text{ feet}}$$

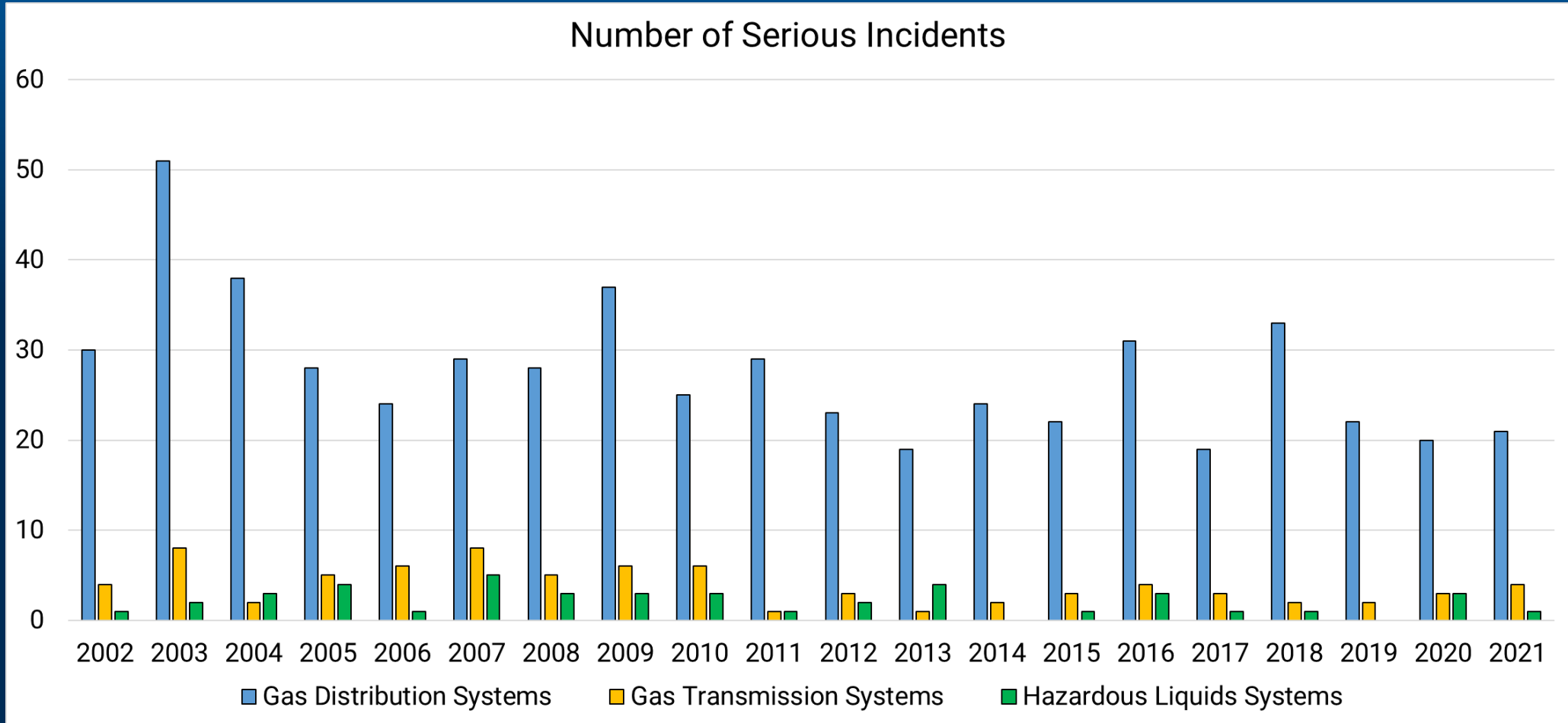




# Preceding Danville

Accident Investigation	PIR (ft)	MAOP (psig)	Diameter (in)	Damage and Injuries Outside the PIR
Edison, NJ (3/23/1994)	776	975	36	Destroyed buildings ~1000 ft
Indianapolis, IN (7/21/1997)	417	913	20	<i>Minor damage, unless adjusted for pressure</i>
Carlsbad, NM (8/19/2000)	599	837	30	12 fatalities ~675 ft
Palm City, FL (5/4/2009)	365	866	18	
Cleburne, TX (6/7/2010)	805	1051	36	
San Bruno, CA (9/9/2010)	414	400	30	Destroyed/Damaged homes ~600/~1100 ft
Sissonville, WV (12/11/2012)	436	1000	20	Burn limits
Danville, KY (8/1/2019)	633	936	30	Destroyed/Damaged homes ~675/~1150 ft
Hillsboro, KY (5/4/2020)	633	936	30	
Coolidge, AZ (8/15/2021)	636	944	30	Deceased animals ~700 ft

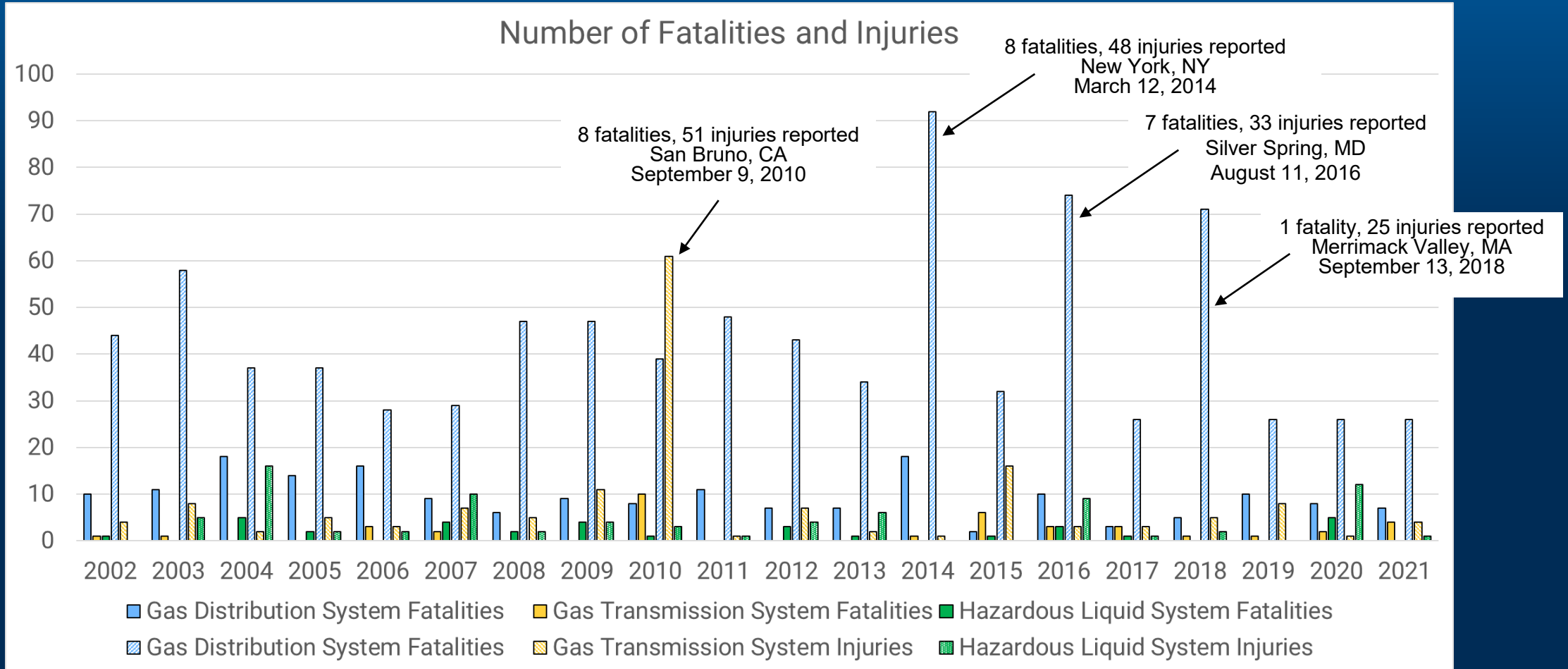
# How are we doing?



<https://www.phmsa.dot.gov/data-and-statistics/phmsa-data-and-statistics>



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<https://www.phmsa.dot.gov/data-and-statistics/phmsa-data-and-statistics>



[nts.gov](https://www.nts.gov)