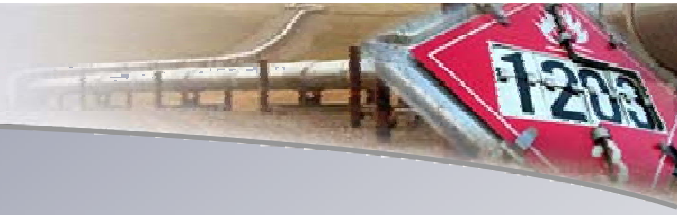
U.S. Department of Transportation
Pipeline and Hazardous Materials
Safety Administration

Considerations for Natural Gas Pipeline Leak Detection Systems

Federal Regulatory Perspective

811
Know what's below.
Call before you dig.

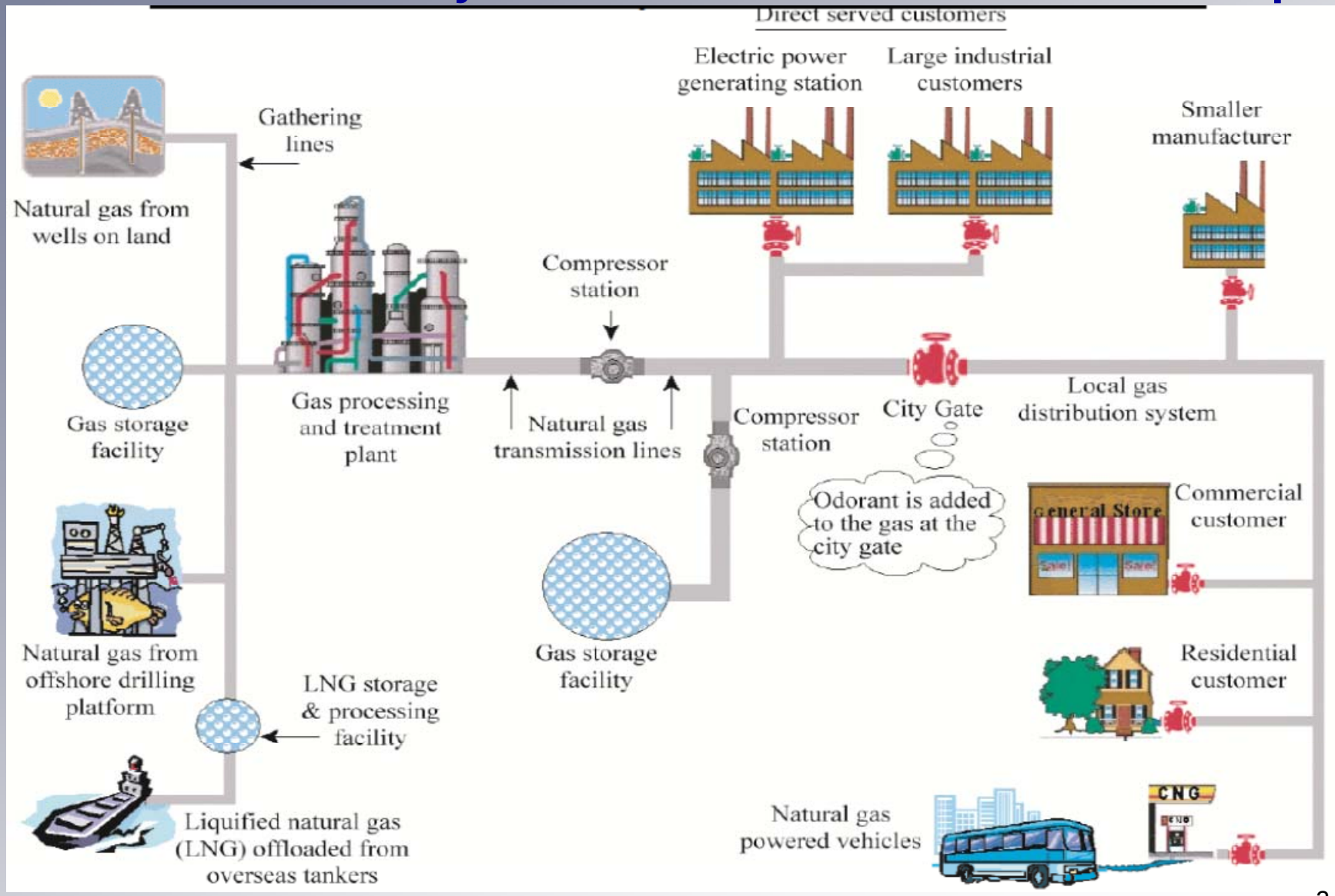
Jeffery Gilliam
Director- Engineering & Research Division **202 366-0568**
PHMSA Office of Pipeline Safety **jeffery.gilliam@dot.gov**

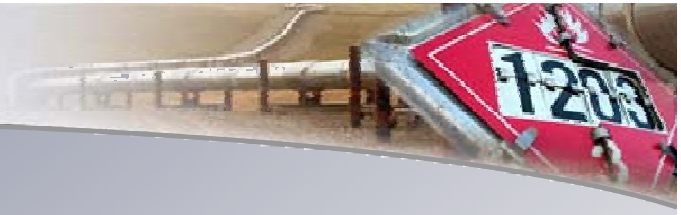


Outline

- General Perspectives on Natural Gas Leak Detection Systems
- System Specific Considerations, Code Requirements, Standard Issues We See
- PHMSA recent actions
- Questions

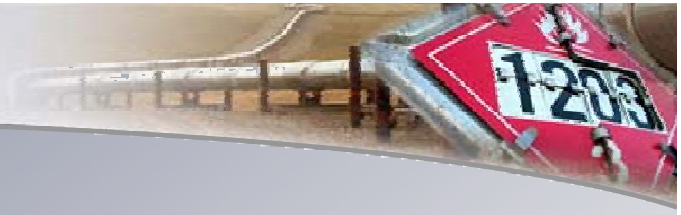
Natural Gas Industry – From the Well Head to the Burner Tip





General Perspective

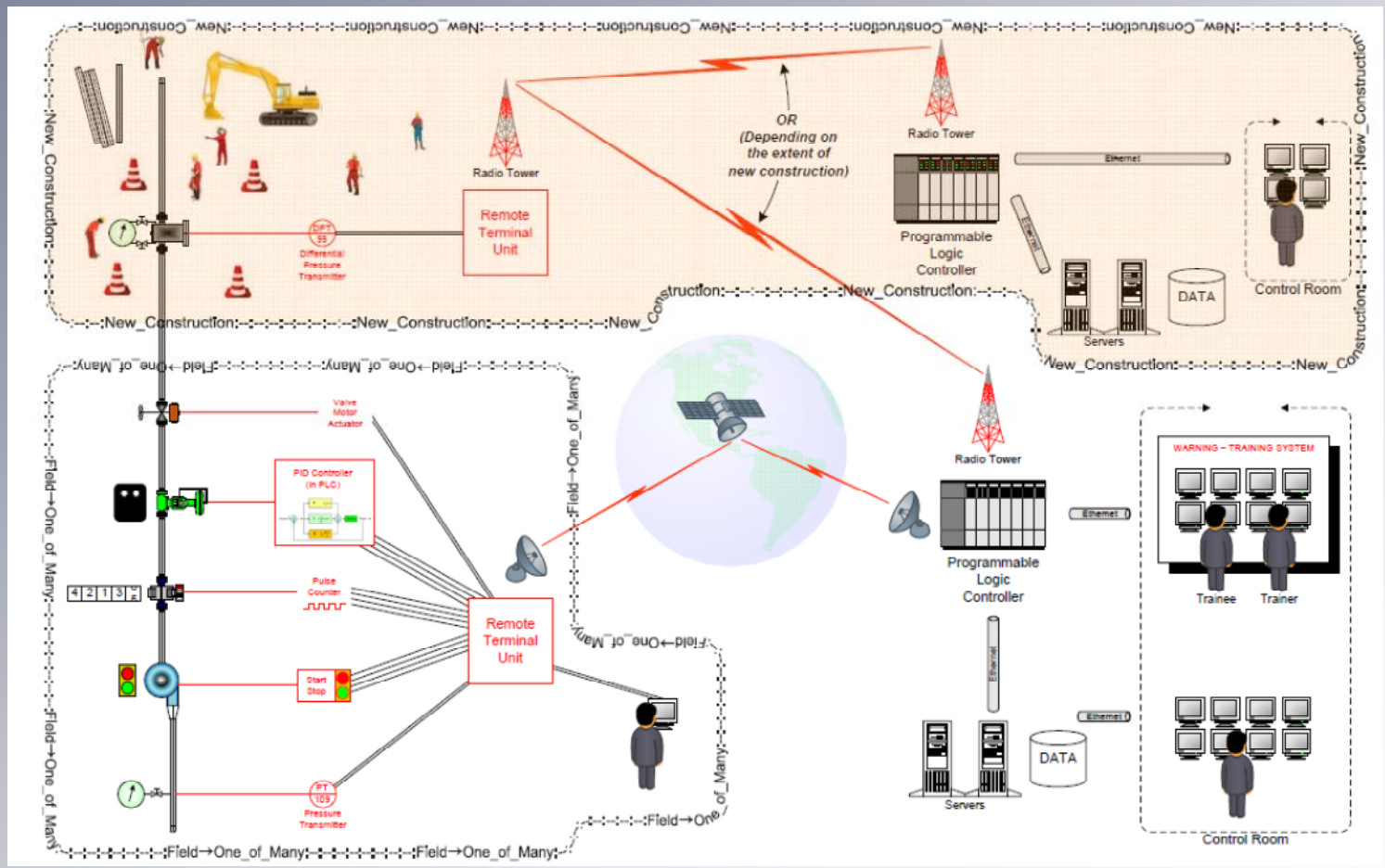
- Leak detection system chosen depends on the pipeline system and the needed capabilities
- Tradeoffs between cost, reliability, sensitivity, detection speed, flexibility and ease of use
- Public and environmental safety is the priority
- Types of leak detection
  - Visual
    - Aerial
    - Ground patrols via vehicle or on foot
  - Using leak detection equipment
    - Aerial
    - Ground patrols via vehicle or on foot



Leak Detection – "Simple" way

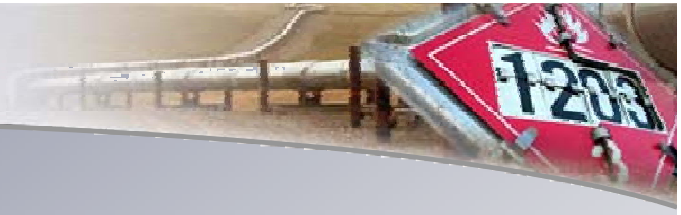
- Pressure gauge senses the pressure and displays it via the needle reading, and the individual reading it can pass it on to another individual elsewhere.

Leak Detection – more complex



General Perspectives

- Small pipelines generally operated using manual valves
- As complexity increases, so does the need for more complex leak detection systems
- SCADA systems employed in many pipeline control centers are very sophisticated
- There are some manually operated pipelines that may warrant SCADA or other sophisticated technologies
- There are some very sophisticated systems that could improve on design, management, and operation



Automation vs. People

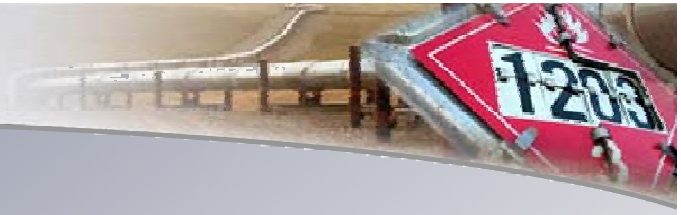
- What is the right balance between relying on automation and experienced, qualified individuals?
  - It depends on the system
  - A well-trained and vigilant individual should always play a critical role in pipeline operations regardless of complexity of system – field techs, controllers, supervisors, management and anyone else in the chain
- Human factors and safety culture considerations important for all, even if not explicitly required in all parts of the code

Gas Specific Considerations

- Highly compressible
- Risk/reward considerations when trying to push more volume overall through the pipeline system
  - larger diameters, newer materials, higher pressures, or
  - making the most out of existing infrastructure if technical and safety benefits outweigh the costs or public/environmental impacts of new construction
- In case of release, velocity fixed by laws of thermodynamics but mass flow rate changes

Comprehensive Leak Detection Program

- A shared responsibility with all stakeholders
- Choose appropriate leak detection system and methodology to address system specific risks
- Take into account interactive threats
- Equally important to identifying leaks is how you respond to them
- Lack of appropriate mitigation following detection affects outcomes
- Programmatic, operational and physical improvements will be needed to implement an effective leak detection system



Emergency Response

How are people internally and externally involved?

- Are all key personnel involved with safety and operational decisions?
- What is the relationship and interface with emergency responders, public?
- If public detects a leak first do they know where to call?
- Can the company's leak detection system be improved to see these leaks first?

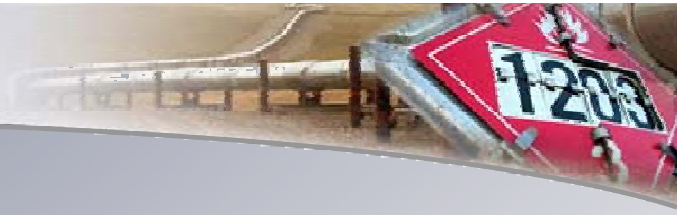
Leak Detection in the code

- Covered in multiple sections and paragraphs throughout Part 192.
- Some prescriptive requirements depending on systems, but mostly performance based in nature and requires a number of considerations and actions as part of a comprehensive program. Some examples
  - **§192.605(b)** Respond promptly to a report of gas odor in or near a building, unless covered by emergency plan in 192.615
  - **§192.613** Continuing surveillance and take appropriate action… changes in leak history, failures, etc.

Control Room Management

CRM

- **§192.631** – Control Room Management (if operator subject to CRM… code does not require SCADA, etc)
  - Roles and responsibilities, adequate information, fatigue mitigation, alarm management, operating experience from incidents
  - All have an impact on improved leak detection, prompt response, involvement by all stakeholders
  - Tie in human factors and safety culture considerations



Repairing Leaks

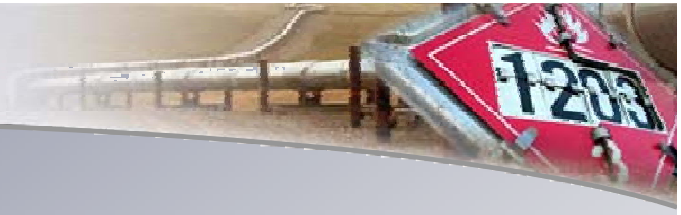
- **§ 192.703** General
  - Each segment must be maintained in accordance with this Subpart.
  - Each unsafe segment must be repaired, replaced or removed from service.
  - Hazardous leaks must be repaired promptly.

Patrolling/Surveys

- Transmission
  - **§ 192.705 (a):** Must look for leaks, construction activity, and other factors affecting safety
  - **§ 192.705 (b):** Establishing frequencies must consider operating pressures, class location, terrain, weather, other relevant factors, not longer than max intervals
- Distribution
  - **§ 192.721:** frequency determined by severity of conditions which could cause failure or leakage
  - **§192.723:** type and scope of leakage control program determined by nature of operations

§ 192.741 – Pressure Limiting and Reg Stations: gauges

- **Telemetering or recording gauges.**
  - (a) Each distribution system supplied by more than one district pressure regulating station must be equipped with telemetering or recording pressure gauges to indicate the gas pressure in the district.
  - (b) On distribution systems supplied by a single district pressure regulating station, the operator shall determine the necessity of installing telemetering or recording gauges in the district, taking into consideration the number of customers supplied, the operating pressures, the capacity of the installation, and other operating conditions.

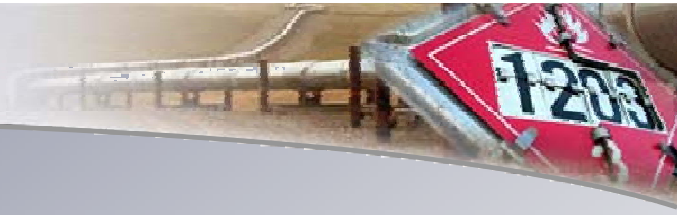


Operator Qualification (OQ)

- Part 192 Subpart N
  - Covered tasks as defined by § 192.801(b) can include meter or regulator installation/replacement, odorizing of gas, odorant sampling, pipeline patrolling, leak survey, maintaining SCADA equipment

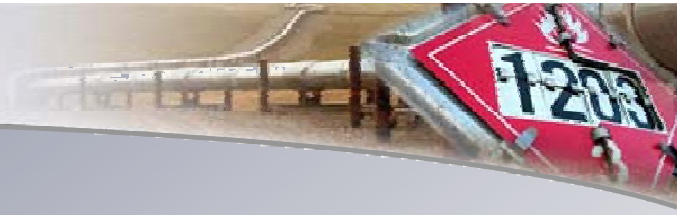
192.935 – Gas IM additional preventive mitigative measures

- (a) *General requirements* - An operator must take additional measures beyond those already required by Part 192 to prevent a pipeline failure and to mitigate the consequences of a pipeline failure in a high consequence area… Such additional measures include, but are not limited to, installing Automatic Shut-off Valves or Remote Control Valves, **installing computerized monitoring and leak detection systems**…



192.935 cont'd

- (d) *Pipelines operating below 30% SMYS. …*An operator of a transmission pipeline operating below 30% SMYS located in a Class 3 or Class 4 area but not in a high consequence area must follow the requirements in paragraphs (d)(1), (d)(2) and (d)(3) of this section.
- (3) Perform semi-annual leak surveys (quarterly for unprotected pipelines or cathodically protected pipe where electrical surveys are impractical).

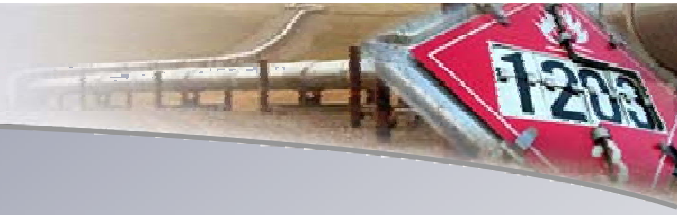


Standard Issues

- Not choosing the best methods or technologies for the specific product(s) or complexity of system, or in some cases making it too complex for your personnel
- Sometimes more basic issues
  - Odorant effectiveness
  - Proper grading of leaks
  - Proper repair of leaks, or timeliness of follow-up to repair was adequate
  - Records management in general or properly considering and integrating all threats, data etc

Nat. Gas Leak Detection Research

- Stakeholder input sought for Leak Detection (LD) improvements at 4 Pipeline R&D Forums
- Solicited for LD topics in 5 research solicitations since 2002
  - However not all LD topics successful in becoming new research
- Natural Gas LD Investment: 7 technology development projects using $3.7M (PHMSA)
- Success in 3 technology improvements to market addressing airborne and internal leak detection systems
- Research success reported at PHMSA's Pipeline Safety Research Program website



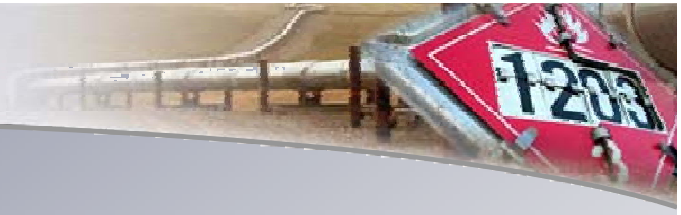
Active/New Research?

Development and Field Testing of a Highly Sensitive Mercaptans Instrument

Development and field testing of a new portable, low-cost instrument for the measurement of hydrogen sulfites and mercaptans, which are routinely encountered in natural gas, renewable natural gas, biogas, landfill gas, etc. The instrument will allow the detection and measurement of such compounds at the part per billion level, thus also serving as an artificial human nose. Possible market penetration in 2012.

Next R&D Forum July 2012 will provide for public input and gap analysis identifying new topics for PHMSA research solicitations.

http://primis.phmsa.dot.gov/meetings/



Other PHMSA Actions

- Gas ANPRM
  - Currently reviewing comments (100+) received
  - Timing and content of next step to be determined
- Pipeline Emergency Response Forum Held December 9, 2011
- Leak Detection Study
  - Congressional Mandate
  - NTSB Recommendation P-11-10
- This workshop

Congressional Mandate

- Pipeline Safety, Regulatory Certainty, and Job Creation Act of 2011 **SEC. 8. LEAK DETECTION.**

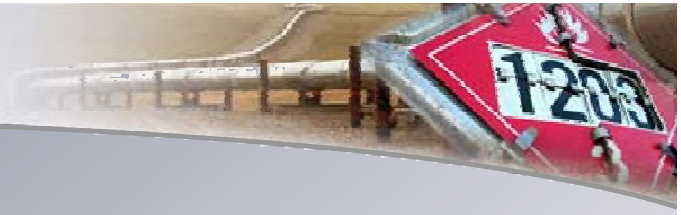
  (A) an analysis of the technical limitations of current leak detection systems, including the ability of the systems to detect ruptures and small leaks that are ongoing or intermittent, and what can be done to foster development of better technologies; and

  (B) an analysis of the practicability of establishing technically, operationally, and economically feasible standards for the capability of such systems to detect leaks, and the safety benefits and adverse consequences of requiring operators to use leak detection systems.

NTSB Recommendation

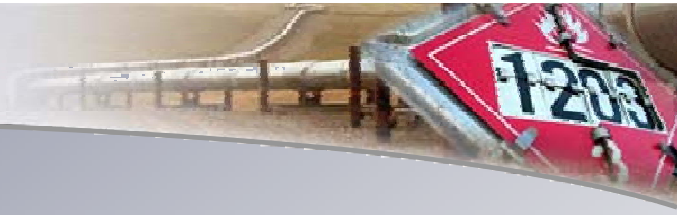
- **NTSB Recommendation P-11-10**

Require that all operators of natural gas transmission and distribution pipelines equip their supervisory control and data acquisition systems with tools to assist in recognizing and pinpointing the location of leaks, including line breaks; such tools could include a real-time leak detection system and appropriately spaced flow and pressure transmitters along covered transmission lines.



Leak Study

- Analyze technical limitations of current leak detection systems for natural gas (transmission and distribution) and hazardous liquid pipeline facilities (including transmission and transportation-related flow lines)
- Determine ability of the systems to detect ruptures and small leaks that are ongoing or intermittent
- Identify any leak detection technology gaps that may need to be addressed, and analyze the practicability of establishing technically, operationally, and economically feasible leak detection standards that can be implemented for natural gas (transmission and distribution) and hazardous liquid transmission pipelines.



Leak Study – cont'd

- The leak study will examine past pipeline incidents, including consideration of any non-PHMSA datasets that may provide useful insight and analysis to meet project objectives.
- Study will try to determine whether implementation of further leak detection capabilities would mitigate effects on the public and surrounding environment. The potential impact of a leak must take into account standard fire science practices.

Carry over into technology panel

- Are current leak detection systems and methodologies adequate?
- What technology advancements are needed, or how can we make existing technology more cost effective and practical?
- Do more sophisticated/robust methods need to be applied that incorporate conservation of mass and mass balancing in their methodologies?
- How do we maximize the pros and address some cons to the sophisticated methods and more simplistic methods?
- What does the technology community need from PHMSA? More funding? More regulation?

Questions?