



PHMSA RESEARCH & TECHNICAL PERSPECTIVES



Working Group 2 – Leak Detection/Fugitive Methane
Gov/Industry Pipeline R&D Forum
Max Kieba

August 6-7, 2014



Haz. Liq. Leak Detection Research

- Stakeholder input sought/generated for Leak Detection (LD) improvements at 5 Pipeline R&D Forums
- Solicited for LD topics in 6 research solicitations since 2002
 - However not all LD topics successful in becoming new research
- HL LD Investment: 6 technology development projects using \$1.5M (PHMSA)
- Success in 2 technology improvements to market addressing airborne and internal leak detection systems





Nat. Gas Leak Detection Research

- Stakeholder input sought/generated for Leak Detection (LD) improvements at 5 Pipeline R&D Forums
- Solicited for LD topics in 6 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





Recap of 2012 Forum - Gaps

- **Top 4 Identified R&D Gaps**
 - Gap #1 – Reducing False Alarms of Leak Detection Systems
 - Gap #2 – Leak Detection for New and Existing Systems
 - Gap #3 – Smart System Development
 - Gap #4 - Mobile Based Leak Detection System Testing
- See report out for more info:
<http://primis.phmsa.dot.gov/rd/mtgs/071812/WG2-ReportOut.pdf>



Topics solicited by PHMSA based on 2012 Forum

- Technology/Knowledge - Reducing False Alarms of Leak Detection Systems
- Technology/Knowledge/Standards - Leak Detection for New and Existing Systems
- Technology - Smart Leak Detection System Developments
- General Knowledge/Standards - Improving Leak Detection System Design Redundancy & Accuracy
- See announcement for more information on each:
<http://primis.phmsa.dot.gov/matrix/RfpInfo.rdm?rfp=41>



Recently Completed Research

Odorant Effectiveness

Project objective: Provide a "Practical Pipeline Operator Guide" to manage odor fade issues associated with typical gas system operating conditions materials of construction.

Project results were provided to AGA for possible revision of their guide on odorants.





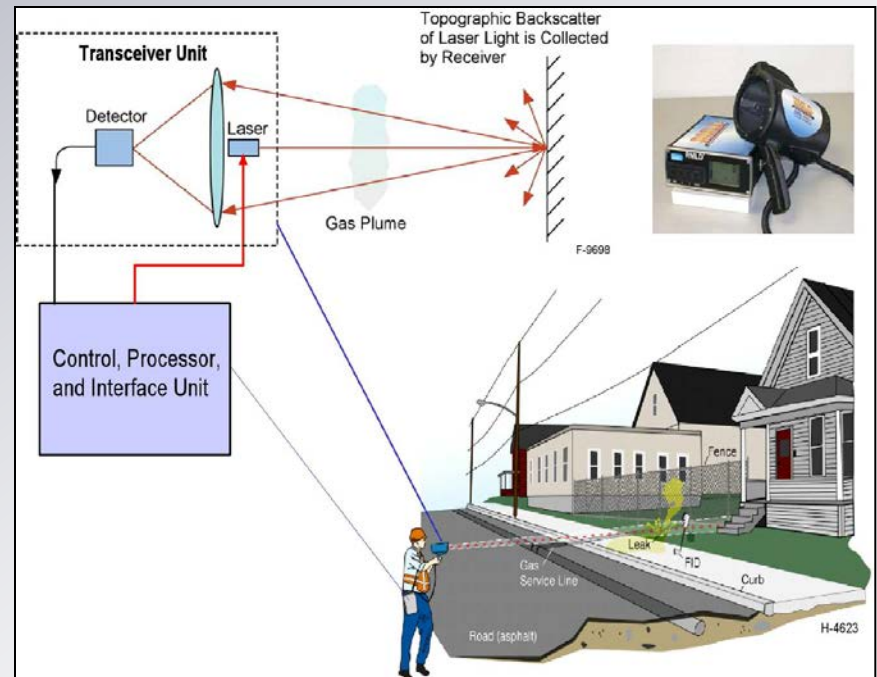
Current Research

Fuelfinder: Remote Leak Detector for Liquid Hydrocarbons

Testing improvements to the Remote Methane Leak Detector for wavelength specific detection of gasoline blends and ethanol.

Main objective to develop a portable, hand-held sensor for detection of petroleum product leaks from buried pipelines at stand-off distances up to 30 meters or about 98 feet.

Possible market penetration in late CY 2014.





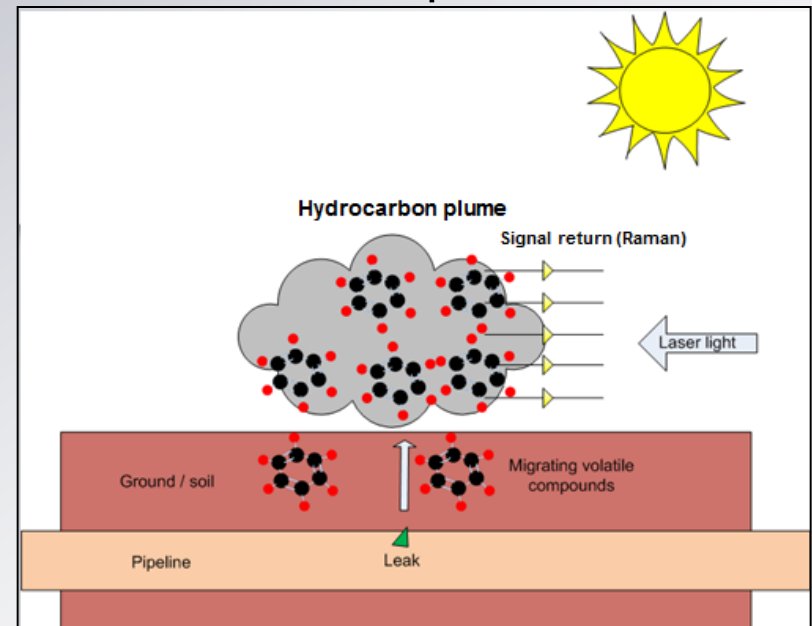
Current Research

INO Technologies Assessment of Leak Detection Systems for Hazardous Liquid Pipelines

The project aims to detect vapors from liquid petroleum pipeline leaks. Prototype sensor on a mobile platform will include one or more of three spectroscopic instruments : 1) a standoff UV laser induced fluorescence device, 2) a UV Raman remote sensor, and 3) an open path, active, laser based IR Differential Optical Absorption Spectroscopy sensor.

Remote capability up to 100 yards will be evaluated for several concentrations of vapors from petroleum products (typically transported by pipelines) in a laboratory and simulated pipeline setting.

Possible market penetration in late CY 2015.





Current Research

Advanced Leak Detection LiDAR

This project is investigating novel technical approaches for an airborne differential absorption LiDAR system to achieve lower-cost, higher-performance pipeline leak detection.

The research aims to prove that adaptation of commercial lasers and detectors from the communications industry can achieve higher-performance instrumentation for detection of leaks from liquid pipelines with less than 50% of today's operational cost for airborne detection of gas pipeline leaks.

Possible market penetration in late CY 2015.





Current Research

Advanced Development and Technology Transfer of a Methane/Natural Gas Microsensor

This project supports advanced development and technology transfer of a next generation, highly accurate, robust and low cost microresonator-based methane sensor that can be applied as an analytical in-line or off-line measurement tool for gas operation applications or a fixed safety monitoring (alarm) device for residential, commercial or industrial applications.

Possible market late CY 2014 or early CY 2015.





Current Research

Improving Leak Detection System Design Redundancy & Accuracy

This project will develop recommendations and guidance to standardize designing LDS for all pipelines, including smaller ones, without costly front-end engineering. The project will concentrate on some key issues, including:

- The LDS design process as a whole with a systematic focus on assessing requirements.
- One single technology will probably not provide perfect performance for all objectives on a given pipeline. Therefore, a key issue is exploring ways to combine multiple technologies / physical principles into one system in order to address each requirement optimally.
- Allowing the operator to be able to predict performance – and therefore cost/benefit – more reliably from the design

Results anticipated by late CY 2016.



Putting Leak Detection Systems into Context

- One of many layers of defense in pipeline safety
- Includes technology, people, operating environment, and procedures
- Too much focus on any one discrete element without considering the others or how they interact, and system may fail
- Leak detection vs. rupture detection. Some consider leak detection all encompassing and rupture detection a higher risk/consequence subset. Some consider them separate with their own unique challenges, but exact dividing line not always clear.



Putting Leak Detection Systems into context

- No one size fits all. Multiple considerations needed given type and complexity of system, product(s) transported and size of release
 - Ruptures or rupture-like events
 - Smaller but still sizeable leaks
 - Tweeners
 - Weepers/Seepers
 - Gas vs. liquid vs. multi-phase
- Cost vs. complexity: Higher cost and complexity does not necessarily translate to better performance



Ongoing Leak Detection Issues

- Recognizing and pinpointing leaks: NTSB P-11-10
 - Require gas transmission and distribution operators to equip SCADA systems with tools to assist in recognizing and pinpointing leaks
- Swiftness of leak detection and accident/incident response overall (in line with GAO Study, Kiefner 2012 Leak Detection study and others)
 - Some critics think response to many events is slow, and too often the public is first to identify
 - Others believe it could take 60+ minutes to properly identify ruptures and begin isolation. Smaller leaks can take much longer
- Pending PHMSA rulemaking on Rupture Detection and Valve Placement may address many aspects above. TBD.



Other Issues

- LDS vendor claims look good on paper, but don't always perform as advertised even after testing and fine tuning within a system or users don't have true handle on capabilities and limitations
- Use and effectiveness of external systems in the LDS toolbox
- Improving ability to detect the tweeners
- Improving ability to characterize severity of leaks
- Cultural and perception issues
 - Changing mindset from “it can't be a leak, prove to me it is” to “it may be a leak, prove to me it's not”
 - Public awareness and perception
 - More transparency and facts, less spin and sugar coat
 - Is real time, state-of-the-art really real time, state-of-the-art?



Fugitive Methane

- PHMSA's regulatory strategy is focused on pipeline safety
- Primary focus on preventative and mitigative measures to keep product in the pipeline and reducing consequence of release, but...
- Performance and risk based considerations along with other technical and operational realities do allow for product to leave the pipeline
 - Relief devices used for overpressure protection
 - Venting or drain down following an incident or accident
 - Grade 1, 2 & 3 leak classification and management
 - Permeation of hydrocarbons through certain materials like plastic
 - Not just a distribution issue. Anticipate increased use of plastics and composites in transmission and oil and gas gathering



Fugitive Methane

- PHMSA closely following the issues and policy development by others, particularly as they relate to pipeline safety
- Coordinated with EPA with meetings and PHMSA participation at EPA Gas Star Program events
- Coordinating with the Environmental Defense Fund efforts and added EDF representation on PHMSA's congressionally mandated Pipeline Advisory Committee
- Coordinating with various industry efforts and co-funding LDS research to prevent/minimize leaks
- Reviewing natural gas regulations to understand leak paths and possible actions germane to our statutory mission



Potential Leak Paths

- **Natural Gas Gathering, Transmission, Distribution and LNG systems**
 - Piping (various), Flanges, Gaskets, Meters, Compressors, Line Valves (various), Relief Valves, Drip Traps, Pig Launchers/Receivers, etc.
 - Leak rates vary due to...
 - Gas pressure, quality, temperature, dew point, etc. & Pinhole leak or full rupture



Potential Leak Paths

- **Natural Gas Gathering, Transmission, Distribution and LNG systems**
 - Example of Challenge - Pressure relief devices that vent gas have a major safety function and can't be easily eliminated
 - Perhaps capture gas?
- **Hazardous Liquid Systems**
 - Vapor from Breakout Tanks



Thank you!

Questions?