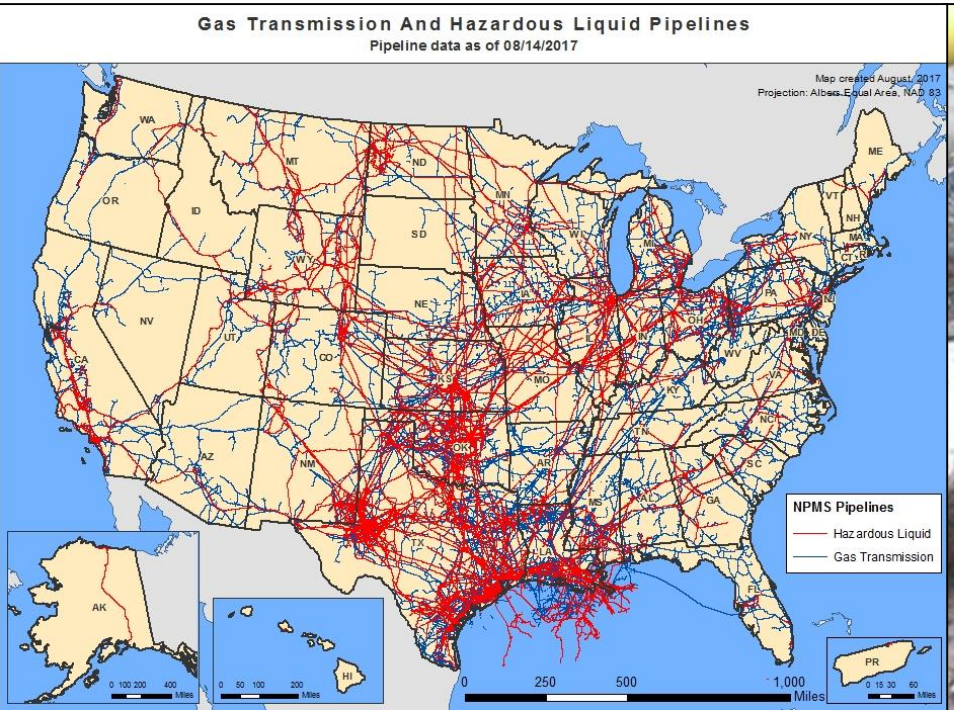
PHMSA Research & Development

Leak Detection/Mitigation

Buddy Secor – Engineering Ops Supervisor
June 7TH, 2018

Pipeline Safety Challenges

- US has the largest & oldest pipeline network in the world, resulting in many safety challenges
- Research is needed to improve pipeline safety by supporting technology & innovation



Pipeline Safety RD&T

Pipeline Safety RD&T Program Mission:

To sponsor research and development projects focused on providing near-term solutions that will improve the safety, reduce environmental impact, and enhance the reliability of the Nation's pipeline transportation system.

Key Points

- We employ a collaborative approach to address mutual challenges
- We help remove technical barriers on a given challenge
- We measure our research results/outputs/outcomes
- We are transparent – Interactive program website

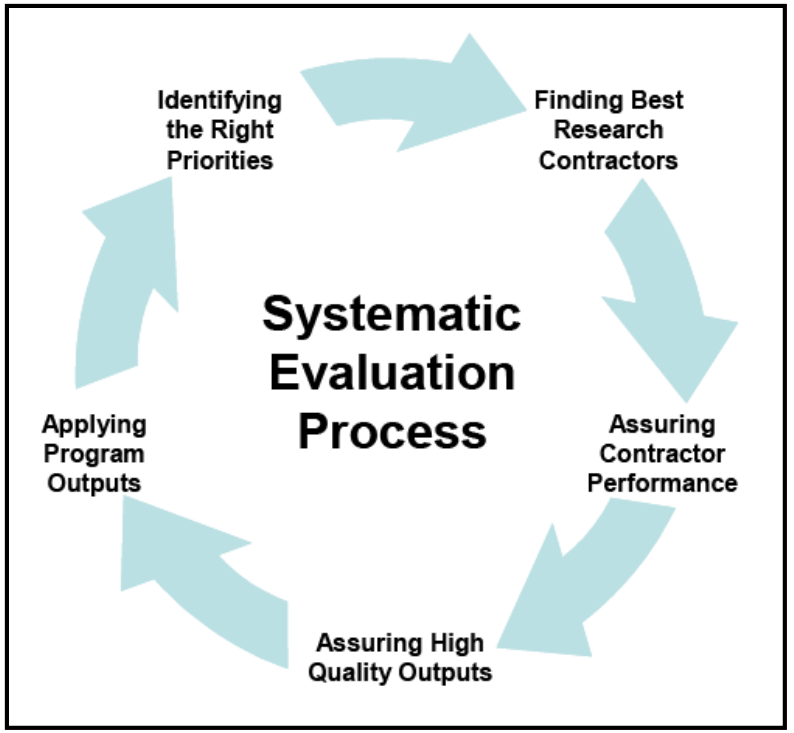
Pipeline Safety Improvement Act of 2002 established our modern program

RD&T Program Objectives

Developing Technology	Strengthening Consensus Standards	Promoting Knowledge
Fostering the development of new technologies so that pipeline operators can improve safety performance and more effectively address regulatory requirements.	Targeting and feeding new knowledge into the process of keeping standards relevant to their purpose.	Generating and promoting general knowledge to decision makers.

Collaborative and Coordinated Program Process

1. Stakeholder based, consensus driven research agendas and roadmaps
2. Interagency review of competitive pre-award process to reduce duplication, leverage resources and secure best researchers
3. Paperless & secure 21st Century solution used to monitor, report and assure contract performance
4. Post-award peer review process executed annually
5. Tech demonstrations and full use of contract authority to commercialize, disseminate and promote results



Overall Program Performance

Since 2002, awarded 270 Projects $109.7 million PHMSA + $101.3 million Resource Sharing

Program Status: Technology Impacts

Technology Impact Metric	Metric
Technology Projects	93
Technology Demonstrations	54
Patent Applications (U.S. + Other)	31
Commercialized Technologies[A]	28
Commercialization Success Rate[A]	35%

Program Status: Promoting Knowledge

Knowledge Promotion Metric	Count
Final Reports Publicly Available	223
Conference or Journal Papers	166
Public Events	37
Patent Applications (U.S. + Other)	34
Annual Peer Reviews Held	12

Communicating Knowledge to Stakeholders

Event Type	Events Held	Stakeholders Reached
Blue Ribbon Panel	2	39
Gov/Industry R&D Forums	7	1555
Interagency Coordination Meetings	13	101
R&D Workshops/Conferences	14	2135
Safety Advisory Committees	1	30
Grand Totals:	**37**	**3860**

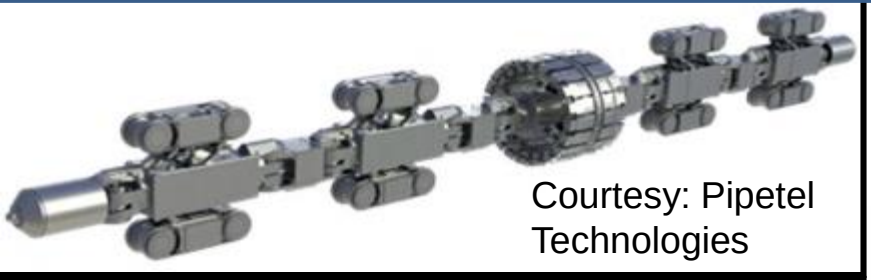
Programmatic Element & Technology Research Impact

Category	Technology Projects	Technology Demonstrations	Patent Applications (U.S. + Other)	Commercialized Technologies[A]	PHMSA ($M)
Threat Prevention	16	10	3	4	$ 5.92M
Leak Detection	13	6	2	4	$ 7.97M
Anomaly Detection	37	25	22	14	$23.29M
Anomaly Characterization	9	3		1	$ 4.32M
Materials	5	1	2	1	$ 7.36M
Welding	7	5		2	$ 4.92M
Joining	3	2	1		$ 1.35M
Alternative Fuels	3	2	1	2	$ 1.09M
Footnotes: A. Note: The measurement of "Commercialized Technologies" only occurs on non-active or completed projects.					
Grand Totals:	**93**	**54**	**31**	**28**	**$56.26M**

Website Usage

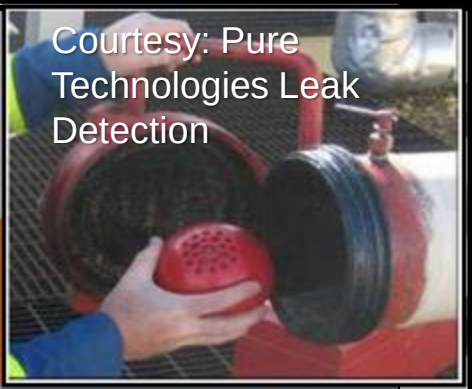
Website Usage Metric	Measure
Total Number of Hits	21,073,752
Average Number of Hits/Month	118,391
Files Downloaded (since 1/01/2008)	1,530,704

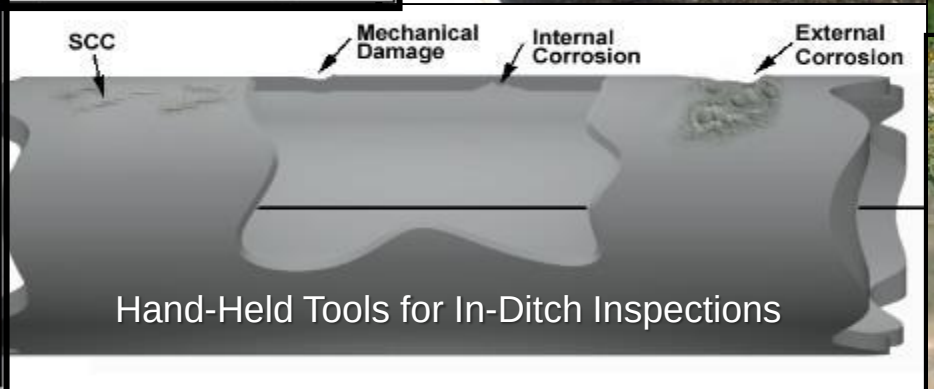
PHMSA RD&T SUCCESSES


Courtesy: Pipetel Technologies


Courtesy: Baker Hughes


Courtesy: Pipetel Technologies


Courtesy: Pure Technologies Leak Detection

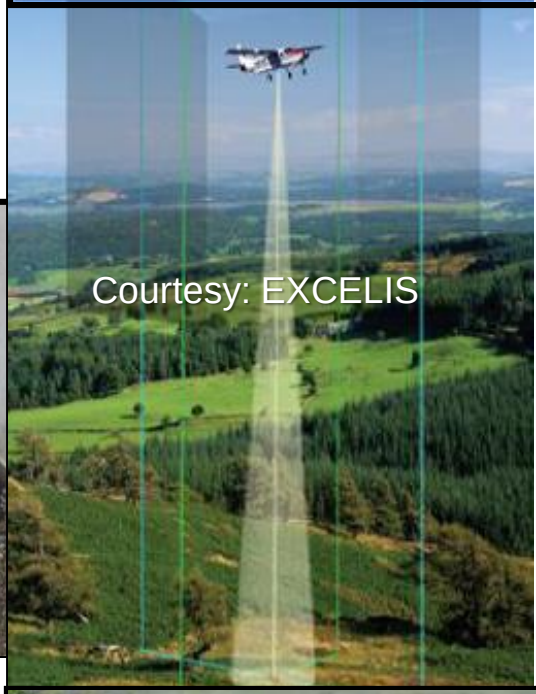


Hand-Held Tools for In-Ditch Inspections


Courtesy: CRC Evens


Guided Wave Ultrasonics


Courtesy: LASEN


Courtesy: EXCELIS


Gas/Liq Leak Detection by Fixed Wing/ Helicopter along pipeline

Competitive Academic Agreement Program (CAAP) Objectives

1. Spur innovation, high risk/high reward research
   – Feed hand-offs into PHMSA's core research program
2. Involve students with technical/engineering pipeline challenges

Transparent Project Pages

Development of a Free-Swimming Acoustic Tool for Liquid Pipeline Leak Detection Including Evaluation for Natural Gas Pipeline Applications

Main Objective

The main objective of the proposed research is to leverage a free-swimming acoustic leak detection tool that is currently used in the water pipeline industry and further develop the device for application in oil product pipelines and evaluate its potential for natural gas pipelines. The target is to develop a device capable of detecting very small leaks (< 1 gpm) and further develop a software program to provide on-site evaluation of results to the end user. The goal is to have a commercially available device within a 24 month project duration.

Public Abstract

Line leakage of oil and natural gas systems can result in significant financial and environmental consequences. Often, small leaks lead to ruptures in the pipeline that result in product escaping into the surround soil. The objective of this joint academic-industry research project is to develop and test a free-swimming device capable of detecting small leaks in oil product (< 1gpm) and natural gas pipelines. The SmartBall swims through the pipeline being assessed and produces results at significantly reduced cost to the end user compared to current leak detection methods. Additionally, the leak detection threshold of the SmartBall will be 50 to 100 times greater than currently provided by conventional computational pipe monitoring (CPM) systems. GIS based above ground loggers that are GPS synchronized will capture low frequency acoustic signatures and digitally log the passage of the SmartBall through a pipeline. The Arizona State University-Pure Technologies Limited team brings complementary expertise to the project. Additionally, industrial partners Imperial Oil and Southwest Gas will provide end user technical expertise during development.

FINAL REPORT

Final Report (DTPH56-07-BAA-000002)

FINAL_REPORT_(DTPH56-07-BAA-000002).PDF (3,607,324 bytes) [VIEW] [DOWNLOAD/SAVE...]

OTHER FILES

Success Story

LEAKDETECTION1.PDF (286,804 bytes) [VIEW] [DOWNLOAD/SAVE...]

Fast Facts	
Research Award Recipient:	Arizona State University 660 S. Mill Ave. Tempe, AZ 85281
AOR:	Dallas Rea, Dallas.Rea @ dot.gov, 404-832-1157
Contract #:	DTPH56-08-T-000007
Project #:	234
Researcher Contact Info:	Dr. Samuel T. Ariaratnam, Arizona State University Tel (480) 965-1769; fax (480) 965-1769 awards.management @ asu.edu ariaratnam @ asu.edu
Peer Review	More than Effective (PHP-4-2009, Apr 1-15, 2009)
Peer Review	Very Effective (PHP-5-2010, Apr 14-28, 2010)
Downloads of Project Reporting	
Since Jan 1, 2017	330
Technology and Commercialization	
Technology Demonstrated?	Yes
Commercialized (in whole/part)?	Yes
Commercial Partner	Pure Technologies Telephone: (403) 266-6794 http://www.puretechnologiesltd.com/
Net Improvement	SmartBall®is a new innovative leak detection technology for oil, gas and petroleum products pipelines larger than 4-inch (100 mm) diameter. It can be deployed to complement existing pipeline integrity programs or as an integrity check on non-piggable lines. The device consists of an instrumented aluminum core in a urethane shell. The device contains a range of instrumentation, including an acoustic data acquisition system that listens for leaks as the ball travels through the pipeline. External Link: http://www.youtube.com/watch?v=Z17awCAFF98
Financial and Status Data	
Project Status:	Closed
Start Fiscal Year:	2008 (06/01/2008)
End Fiscal Year:	2010 (08/31/2010)
PHMSA $$ Budgeted:	$388,332.00

Leak Detection

- Program Objective:

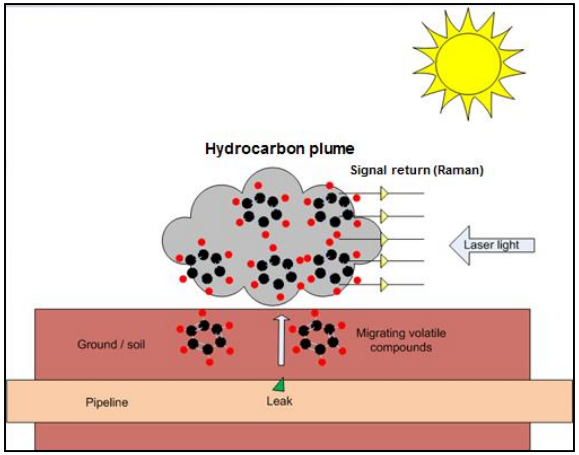
  Research in this area will develop new or improved tools and technology solutions for reducing the volume of product released into the environment and with identifying leaks before they lead to catastrophic ruptures.

- PHMSA's Research Portfolio:
  - 13 Leak Detection Oriented Projects
  - $8.4M PHMSA + Resource Sharing
  - Commercialized Technologies or Products
  - ~44% Technology Investment Success Rate in Research to Market
- Success in this area has seen new/improved technology to locate Oil/Gas leaks.

#	Project	Closed / Status	Contractor	PHMSA Support
1	DTRS56-01-X-0023, Airborne LIDAR Pipeline Inspection System (ALPIS) Mapping Tests	4/17/2009	LaSen and U.S. Air Force Research Laboratory	$2,245,204
2	DTRS57-04-C-10012, Intrinsic Distributed Fiber Optic Leak Detection	9/30/2004	Prime Research	$99,706
3	DTRS57-04-C-10016, Piezo Structural Acoustic Pipeline Leak Detection System	6/17/2004	Midé Technology Corporation	$100,000
4	DTPH56-08-T-000007, Development of a Free-Swimming Acoustic Tool for Liquid Pipeline Leak Detection Including Evaluation for Natural Gas Pipeline Applications	11/2/2010	Arizona State University	$388,332
5	DTPH56-10-T-000022, Development and Field Testing of a Highly Sensitive Mercaptans Instrument	7/27/2012	Northeast Gas Association	$246,496
6	DTRT57-12-C-10050, Smart Pipeline Network - Seal Sensor System	8/2/2013	Odyssian Technology LLC	$150,000
7	DTPH56-13-T-000003, INO Technologies Assessment of Leak Detection Systems for Hazardous Liquid Pipelines	5/29/2015	Electricore, Inc.	$551,388
8	DTPH56-13-T-000004, Advanced Leak Detection LiDAR	6/17/2016	Ball Aerospace & Technologies Corp.	$1,225,028
9	DTPH56-14-H-00007, Improving Leak Detection System Design Redundancy & Accuracy	4/24/2017	Kiefner Applus RTD	$832,036
10	DTPH5615T00012L, Emissions Quantification Validation Process	Active	Northeast Gas Association	$144,670
11	DTPH5615T00004L, Framework for Verifying and Validating the Performance and Viability of External Leak Detection Systems for Liquid and Natural Gas Pipelines	Active	C-FER Technologies	$1,663,882
12	Cost/Benefit of Deploying/ Retrofitting External Based Leak Detection Sensors	New	Not yet awarded	$348,396
13	Development of External Natural Gas Leak Detection Recommended Practice	New	Not yet awarded	$399,821

Notable Outputs/Impacts

Internal Liquid/Gas LDS transferred from the water pipeline industry



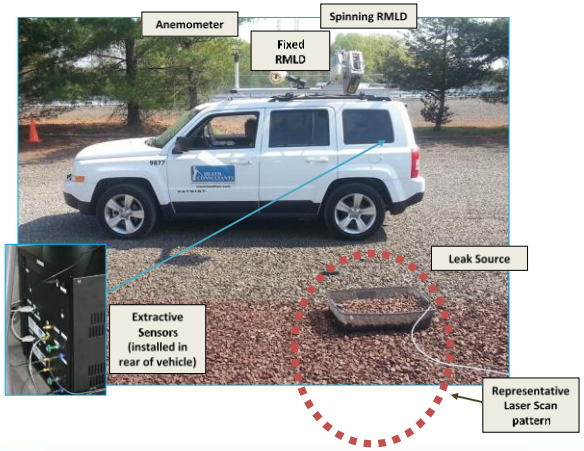
Detection of vapors from liquid petroleum pipeline leaks from a mobile platform with up to three spectroscopic instruments

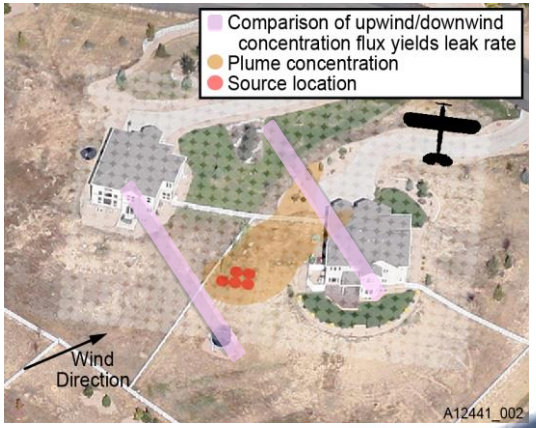
Helicopter based laser systems for methane vapor detection

Fixed wing based laser systems for Liquid/Gas vapor detection

Current Focus: Small Fugitive Methane Leaks

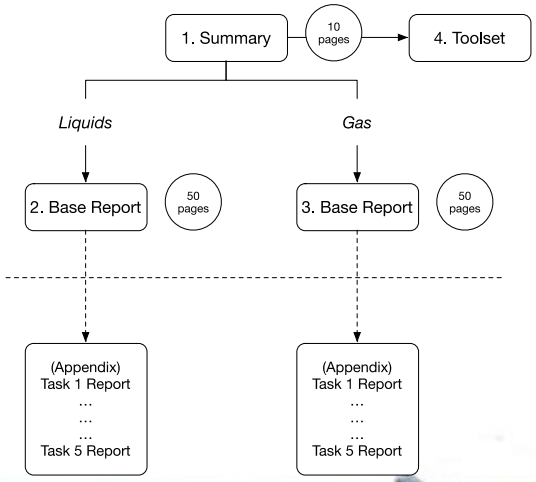
- Three projects investigating the detection and measurement of Grade 3 non-hazardous leaks
  - Results build technology utilization around a remediation plan
- These efforts designed by and coordinated with the industry, NAPSR, DOE, EPA and the EDF





Current Focus: Standardization & Comparison

- Leak Detection Evaluation Framework for verifying and validating leak detection technologies. The framework will include standardized methods to assess the performance of technologies intended to detect small release events (i.e. leaks) and quantitative criteria to rank the performance of these systems over a range of release scenarios
- Developing recommendations, expert guidance and draft procedures to standardize designing LDS for all pipelines, including smaller ones, without costly front-end engineering



Issues/Challenges

- LDS vendor claims don't always perform as advertised even after testing and fine tuning within a system
- Users don't always have true handle on capabilities and limitations
- Limited use of external systems as part of the overall umbrella of technologies in the toolbox
- 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 – goes both ways
  - Watch excessive marketing or PR spin: is real time, state-of-the-art really real-time, state-of-the-art?

Rupture Detection System

- Should sensors, perhaps at valves be connected to SCADA or be stand alone systems?
- Should they be tied to automatic valve closure if sensors are highly reliable, very dependable
  - How should false indications be handled?
- Personnel Roles – training of remote SCADA personnel and field responders

Mandates

- 2016 PSA Section 28 - The Comptroller General of the United States shall submit a report to Congress on the feasibility, costs, benefits, and affects of odorizing all combustible gas in pipeline transportation.

Thank You!/R&D Program Contacts

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