

DOE/AMO NG INFRASTRUCTURE R & D & METHANE EMISSIONS MITIGATION WORKSHOP

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NYSEARCH Program Research Areas

- Improved Installation, Maintenance & Repair
- Pipeline Integrity/Direct & Remote Assessment
- Pipe Location
- Leak Detection
- Real-time Sensing and Inspection for Distribution
- Environment/Reducing Greenhouse Gas Emissions
- Monitoring for Third Party Damage
- Evaluation of New Materials
- Gas Quality including sensing for trace constituents
- Quantum Leap Innovations – Oracle

Strategies Related to Methane Detection & Emissions

- Improve Safety through development of next generation, low-cost and more reliable methane and mercaptan sensors
- Evaluate SOA technologies that could serve to improve safety and leak detection in distribution sector
- Evaluate and develop technologies that can quantify and validate methane emissions on individual leaks in distribution environments

Ongoing Activities for Methane Emissions

- Recently completed first stage of three-stage technology assessment specific to evolving systems that can QUANTIFY emissions from rates from stationary or mobile platforms to prioritize Type 3 non-hazardous leaks
- Determining what test processes are necessary to fully characterize technologies' fit-for-purpose
- Addressing work required to gain consensus on operator validation practices for emissions quantification

NYSEARCH Technology Evaluation for Emissions Rate Measurement on Non-Hazardous Leaks

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- Objectives of Overall Program

- Overall Goal

- ✦ To identify and implement technology in order to develop a plan to prioritize non-hazardous leaks and minimize methane emissions

- Objectives of Phase I

- ✦ To identify technologies and methodologies that enables a cost effective means to measure Type 3 non-hazardous leaks

- Objectives of Phases II/III

- To identify, test and validate what technology or technologies can be applied to a mobile platform in an urban environment to quantify methane emission rates

- ✦ NYSEARCH RFP issued on 11/3/14 for PhII controlled testing

small Unmanned Aerial System (sUAS) Application Development

► Objectives

- Confirm FAA regulatory compliance of sUAS applications
- Evaluate the capabilities and benefits of an sUAS in performing routine and emergency gas pipeline inspections and surveys (at “tree-top” level)

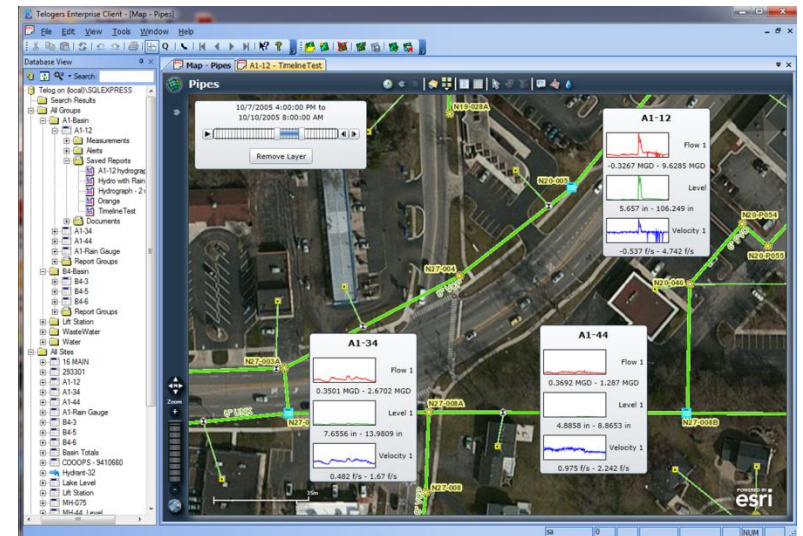


sUAS Application Development - Workscope

- ▶ **Task 1** – Participate in sUAS groups that work with the FAA to decide on appropriate regulation of flight requirements
- ▶ **Task 2** – Perform field demonstrations of routine survey and inspections with the current sUAS configuration
- ▶ **Task 3** – Collaboratively develop a methane leak detection device capable of mounting onto a sUAS



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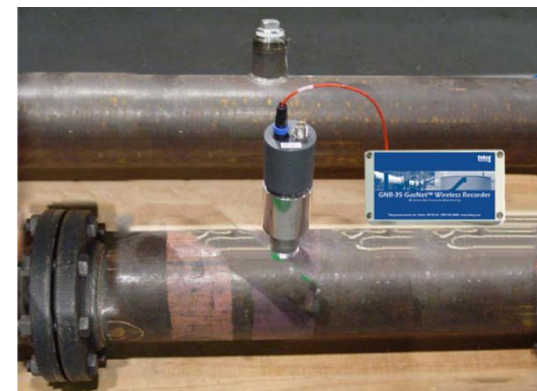
Real Time Distribution Sensing Network

Completing development/testing

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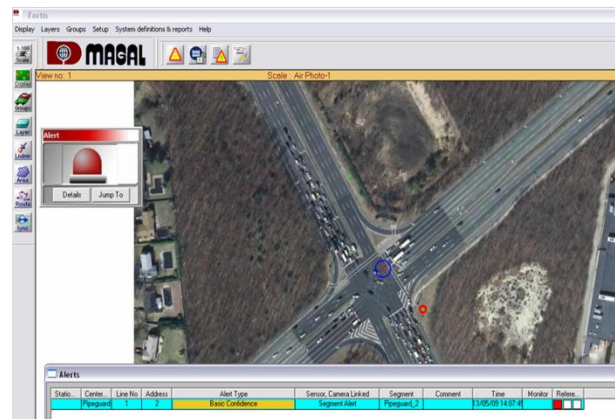
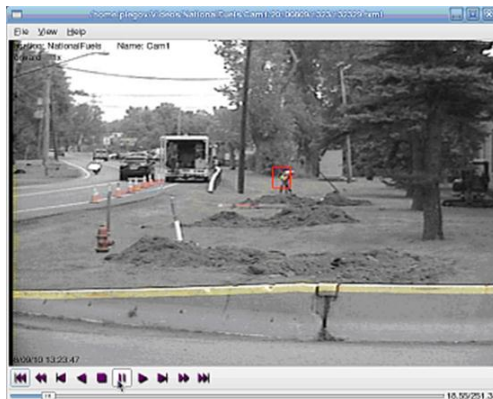
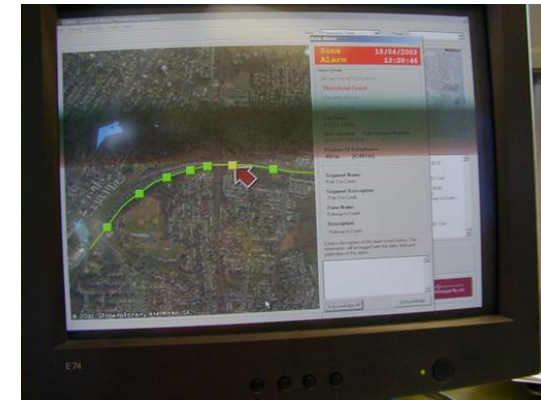
- ▣ Working with members on preferred sensor options based on range and accuracy
- ▣ Building alpha/pre-production prototypes
- ▣ Performing laboratory testing of selected technologies
- ▣ Field testing in 2015

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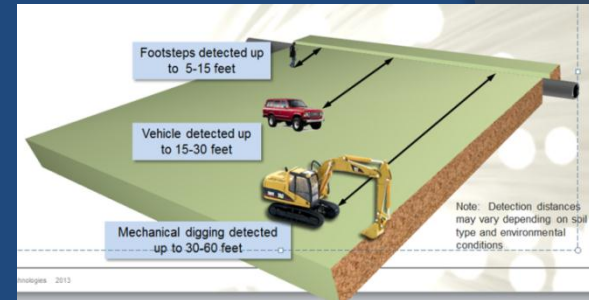
Damage Prevention Programs Since 2002

- ❑ Program with Multiple Projects; for Transmission and Distribution pipelines
 - Initial focus: Transmission; easier application
- ❑ Have been targeting proactive warning before encroachment

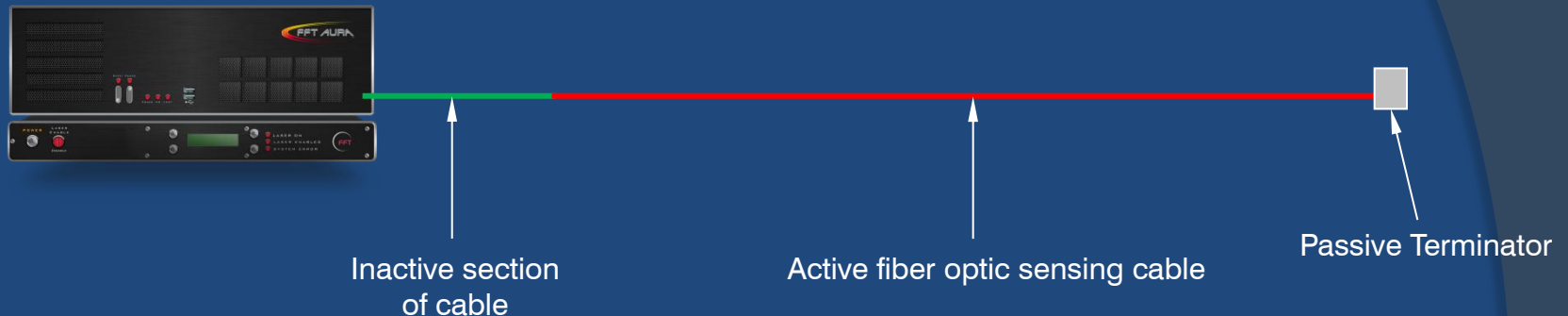


FFT Damage Prevention – Advances with Aura™

- Objective: Conduct Third Party Interference (TPI) tests on Aura™ system to determine advantages and disadvantages of higher resolution system
- Targets:
 - Real-time warning of TPI activities, identify and track vehicles, people, and digging activities above pipeline
 - Pinpoint location of TPI to 26 feet (8 meters) or better
 - Detect foot traffic up to 5 meters (16ft) and mechanical activity up to 20 meters (66ft) laterally from the buried sensor



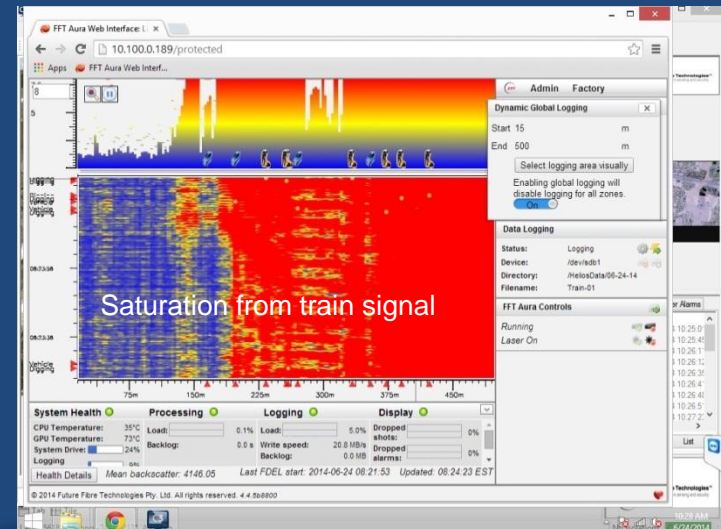
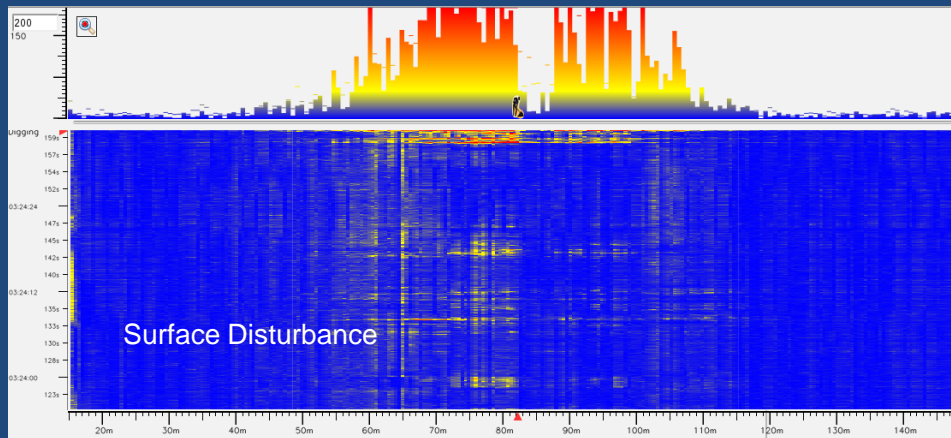
Aura™ Principle of Operation



- A single mode fiber optic cable is used as the sensor
- A pulsed light is sent down the fiber
- When any vibration acts on the active section of fiber, the reflected light is affected
- Light change is detected and intrusion event is classified

Sample Mechanical Testing on Aura™ System

- Mechanical Excavation
 - Energy is spread out over larger area
 - Surface energy is smaller as bucket creates less noise

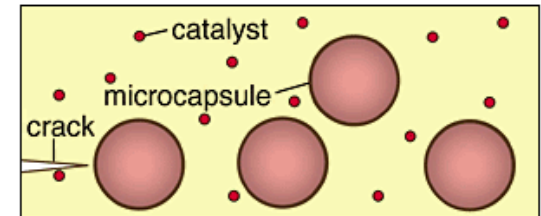


Self Healing of HDPE Pipes

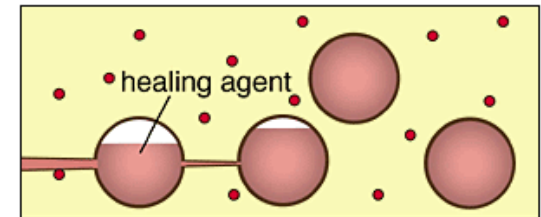
- Combination of microcapsules (including epoxy) and catalyst
- Issues with self healing in MD/HDPE are centered in the manufacturing process
 - Most established healing materials/agents cannot withstand the high temperatures of extrusion
- The problem requires the concurrent study of materials properties, structural analysis and manufacturing processes

The Autonomic Healing Concept

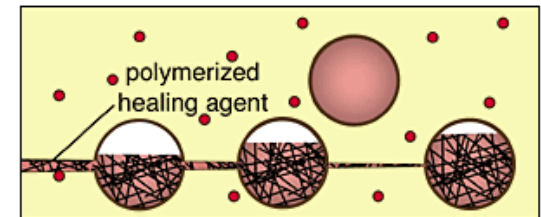
A microencapsulated healing agent is embedded in a structural composite matrix containing a catalyst capable of polymerizing the healing agent.



a) Cracks form in the matrix wherever damage occurs.



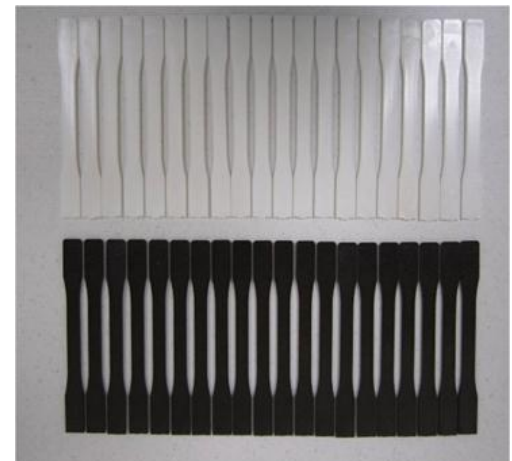
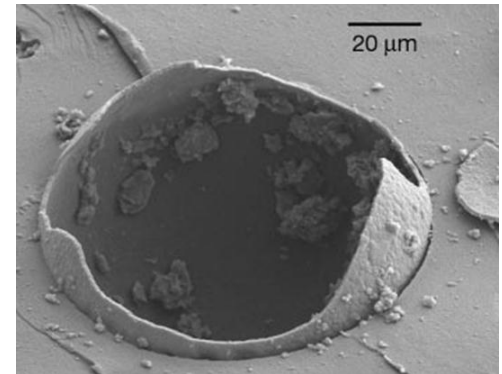
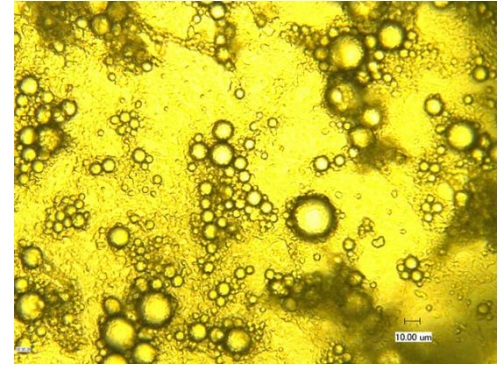
b) The crack ruptures the microcapsules, releasing the healing agent into the crack plane through capillary action.



c) The healing agent contacts the catalyst, triggering polymerization that bonds the crack faces closed.

Self-Healing Pipe Project

- Develop plastic pipe that self-heals when damaged by cracking or mechanical impact
- Deliverable: Prototype of PE pipe with self-healing characteristics
 - Nanocomposite material, with PE as the matrix material
- Completed Feasibility Study to determine proof-of-concept
- Currently moving into Phase III test effort
 - Nanocomposite material retained the mechanical properties of the matrix material (PE)
 - Testing for self-healing properties



Summary

- NYSEARCH's voluntary RD & D program has been focused on innovative product development in the gas operations arena for many years
- Several program areas are active that address methane mitigation and improving operations related to natural gas infrastructure
- We have collaborated with DOE/NETL in the past; have been active with PHMSA and others in several cofunded projects; some successfully completed

