Northeast GAS ASSOCIATION

NYSEARCH

NYSEARCH Programs in Defect Detection/Characterization

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DOT R & D Forum

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NYSEARCH

The R&D Arm of the Northeast Gas Association

- Baltimore Gas & Electric
- Central Hudson
- ConEdison
- Enbridge
- Keyspan
- National Fuel Gas
- Niagara Mohawk
- NYSEG
- Orange &Rockland
- Public Service Electric & Gas
- Pacific Gas & Electric
- PECO Energy
- Questar Gas
- Rochester Gas & Electric
- South Jersey Gas
- Southwest Gas
- Southern California Gas
- Washington Gas & Light
- Yankee Gas

Accomplishments/Activities

- We have developed a pioneering robotic technology for 99% of the unpiggable gas pipeline market
- We have evaluated, advanced and field validated the current capabilities of Ultrasonic Guided Wave systems

- We are developing an inspection camera for inside pipe casings
- We are investigating some pioneering defect and/or problematic coating detection technologies from federal labs, universities and entrepreneurial service providers

Pipeline Integrity Needs of Members

- Pipelines may be unpiggable due to:
  - Obstacles (mitered bends, plug valves, etc.)
  - Low flow
  - Low pressure
- Members have pipes in hard-to-reach areas
  - Cased crossings such as highways, water/bridges, railroad
  - Overhead bridges

NYSEARCH Robotics Program for Unpiggable Pipelines

- Focused on addressing the ***most challenging segment*** of the unpiggable transmission pipelines market
  - Pipelines with
    - Low to no flow
    - Low pressure
    - Mitered bends and plug valves
  - ***High risk effort***; market is not being addressed by the inspection industry

NYSEARCH-Led Effort

- Objective
  - Develop robotic platforms able to carry sensors that will inspect unpiggable pipelines while negotiating all (or nearly all) obstacles that could be encountered
- Strategy
  - Fund development effort until the risk is mitigated to the point where a commercialization partner is attracted

Technology Background

- Following two independent feasibility studies, on identifying the technology to be used, funding consortium selected the Explorer I platform as the basic robotics technology tool
  - MFL sensor for larger sizes – widely accepted technology
  - RFEC for smaller sizes – new technology for pipeline applications
- NYSEARCH-OTD-DoT effort focusing on:
  - 6”-8” and 20”-26” as initial effort
  - 10”-16” and >26” to follow commercialization of tools under development

Platform Specifications

- TIGRE
  - Natural gas and dormant oil pipelines; 20” – 26” ; 750 psig
  - >3 mile range; 4 in/sec
  - Tetherless
    - Battery powered with in-line charging
    - Wireless communication
  - Negotiate all obstacles
  - Launch, operate and retrieve under live conditions
    - Vertical and angled launcher
  - Reliable and robust
- Explorer II
  - Natural gas and dormant oil pipelines; 6” – 8”; 750 psig
  - >1.5 mile range; 4 in/sec
  - Tetherless
    - Battery powered; no in-line charging
    - Wireless communication
  - Negotiate all obstacles, except plug valves
  - Launch, operate and retrieve under live conditions
    - Angled launcher
  - Reliable and robust

Sensor Specifications

- TIGRE
  - MFL sensor
    - 20/40 resolution
    - 30/10 if possible
  - External and internal defects; corrosion and some mechanical damage
  - Internal/external defect discrimination
    - Yes in 24”-26”
    - No in 20”-22”
  - Reliable and robust
  - 190-deg FOV camera
- Explorer II
  - RFEC sensor
    - Equivalent to 20/40 resolution
  - External and internal defects; corrosion and some mechanical damage
  - Internal/external defect discrimination
  - Reliable and robust
  - 190-deg FOV camera

Long Range Guided Ultrasonics Objectives & Benefits

- To further develop and validate the capabilities and applications of TWI/Petrochem and SwRI MsS Guided Wave Ultrasonic Technologies
  - Extend test range and flaw discrimination capabilities
  - Improve capability in complex pipe networks
  - Improve application of LRUT to coated pipe
  - Engineer new LRUT techniques into robust field-hardened package

- Benefits
  - Address hard-to-reach areas
  - Meet requirements for ECDA and ICDA under OPS rules
  - Avoid extremely high costs associated with inspection by excavation or removal of pipe features such as casings
    - Estimated cost (upstate) for standard casing removal, inspection, re-instatement: $400/ft

Long Range Guided Ultrasonics Results and Status

- Results
  - TWI/FBS advances are being made on focusing and on better application to coated pipe
  - Field tests of advanced procedures/tool show progress
  - MsS for LT monitoring has completed proof-of-concept and defect sizing/modeling tasks are showing potential

- Status
  - TWI/FBS validation is complete; results are being tabulated
  - MsS Phase II development in progress; moving from modeling assessments to field validations in ‘07

Collaborative Demonstration on GUT

- Objectives
  - Evaluate the capabilities of various GUT providers in a known setting on cased pipes
  - Exchange info among regulators, operators and providers to determine important technical parameters
- Status
  - Tests completed by (3) vendors on (2) above-ground and (1) below-ground cased pipe
  - Results have been analyzed and reported
  - NYSEARCH/NGA will not make comparisons and cannot release test bed info
  - Will publish public report on behalf of DOT/NYSEARCH with overall conclusions

Devt of Mini-Camera for Inspection Inside Casings

- Objective
  - To develop a mini-camera that can locomote & provide visual images in the annular space of a casing for all areas of carrier pipe except spaces <1 ¼" and under spacer hubs
- Status
  - Design concepts available; project just approved; prototype ready for testing in 6 – 9 months

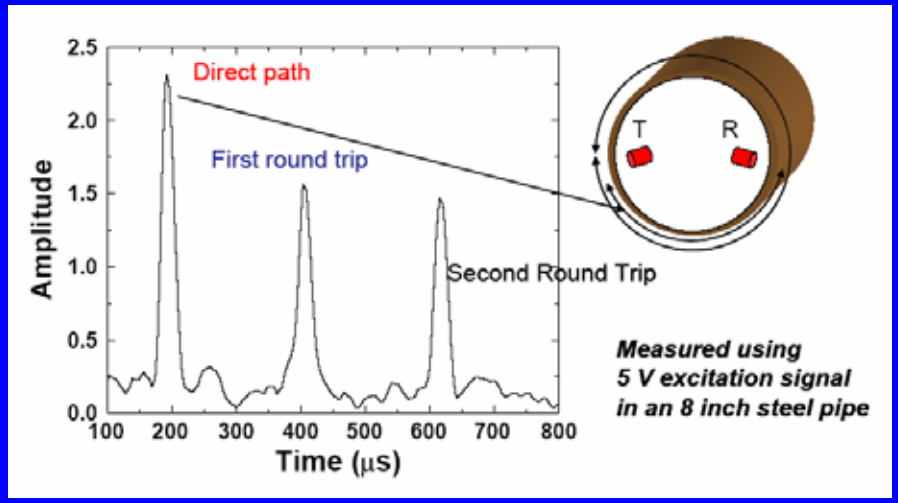
LANL Acoustic Stand-off Technique for Internal/External Inspection

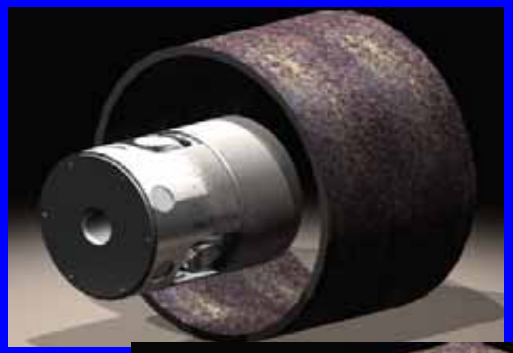
- Objective
  - To evaluate feasibility of LANL Acoustic Stand-Off Technique for use with Inspection Platforms
- Features
  - Non-Contact (stand-off distance ~1 in)
  - Small Size
  - Low Power Requirements
    - Estimated total power consumption 4 – 8 W
    - High frequency (1-3MHz) operation allows extremely small size electronics packages
  - Rugged and Reliable
  - No magnetic or other such drag forces
  - Low profile for minimum aerodynamic forces
  - No moving parts

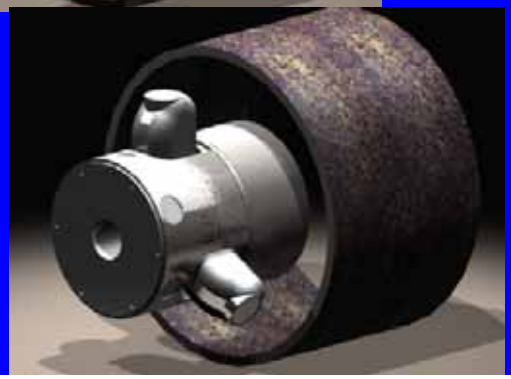
LANL Acoustic Stand-off Technique for Internal/External Inspection (cont.)

- Principle
  - high-bandwidth frequency sweep measurement associated with narrow band filtering to achieve high signal-to-noise ratio
  - novel air-coupled transducers that enables high-efficiency air-coupled excitation of guided waves in pipes.

- Status
  - National Grid funded initial experiments
  - NYSEARCH supporting measured feasibility study based on successful outcome of initial experiments







Polytechnic Corrosion Camera
Objective & Applications

- Objective
  - To study the feasibility of an imaging system for the evaluation of pipeline corrosion

- Applications
  - Utilize thermal or spectroscopic imaging from commercially available digital cameras
  - Inspect coated/painted pipeline surfaces
  - Evaluate corrosion at various stages of its development

Corrosion Camera Status

- Funders providing samples of corroded pipe
- Funders completed survey on types of coating
  - Particularly interested in coated pipe with corrosion blisters
- Corrosion tests for Proof-of-Concept are underway in laboratory and in field

Summary

- NYSEARCH has pioneered product development for applications such as
  - Un-piggable pipelines
  - Hard-to-reach areas in HCAs
- Several projects have been active and are producing commercial results
- DOT/PHMSA has provided significant and critical cofunding for our top priority programs
- Other needs still exist; users and developers are jointly seeking innovation for defect detection and characterization