Natural Gas Infrastructure R&D and Methane Emissions Mitigation Workshop

November 12-13, 2014
Advanced Materials Manufacturing and Innovative Technologies for Natural Gas Pipeline Systems and Components Panel

> November 12, 2014
> Pittsburgh, PA
> By Daniel Ersoy, GTI
GTI Company Overview

Established in 1941

> Independent, not-for-profit established by the natural gas industry

> Providing natural gas research, development and technology deployment services to industry and government clients

> Performing contract research, program management, consulting, and training

> Wellhead to the burner tip including energy conversion technologies
Addressing Key Issues Across the Energy Value Chain

Supply
- Expanding the supply of affordable energy

Delivery
- Ensuring a safe and reliable energy delivery infrastructure

End Use
- Promoting the efficient use of energy resources

Reducing carbon emissions to the environment

Supporting sustainable economic growth
GTI Locations

- 18-acre campus
- 200,000 ft²
- 28 specialized labs
## Presentation Overview

### MATRIX OF R&D NEEDS

<table>
<thead>
<tr>
<th>Legacy / Historic Items</th>
<th>Present Challenges</th>
<th>Future Targets</th>
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<tr>
<td><strong>Technology Development</strong></td>
<td>Understand Material Properties; Detect Defects</td>
<td>Mitigating Damage; Harden Infrastructure</td>
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<tr>
<td><strong>Materials, Testing, and Manufacturing</strong></td>
<td>Additive Manufacturing; Legacy Risk Models</td>
<td>Damage Propagation Prediction; New Material Development</td>
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Legacy / Historic Drivers

> Technology Development Needs
  ─ Confirm maximum allowable operating pressure and system component integrity, grade, and strength
  ─ Nondestructive materials verification without system shutdown: yield strength, toughness, and chemistry; improved technology needed to identify defects and anomalies

> Materials, Testing, and Manufacturing Needs
  ─ Mains replacement programs represent >$10billion/yr. of capital outlay over the coming decades to replacing aging distribution infrastructure
  ─ Rehab needs for additive manufacturing, e.g., liners, cladding, coatings
  ─ Need vintage asset risk models, e.g., cast iron, bare/unprotected steel, and vintage plastics

> Data, Information, and Decision Making Needs
  ─ Overcoming data silos, identify data and information
  ─ Verify quality and traceability, aggregate
  ─ Store in an accessible and relational databases/GIS
Present Challenges

> Technology Development Needs
  - Mitigating third party damage and corrosion and drive the reduction of ruptures, leaks, and emissions
  - Right of way encroachment detection, improved internal pipe inspection technology, and methods to harden the infrastructure

> Materials, Testing, and Manufacturing Needs
  - Understand hydrocarbon permeation of polymers and improve system chemical resistance
  - Develop improved cracking and other damage propagation models, followed by improved system materials and joining methods

> Data, Information, and Decision Making Needs
  - Big data overload, information upload backlogs, and quality issues
  - Asset lifecycle tracking to provide automation of data collection and upload, allowing system-wide tracking and traceability
  - Data mining and analytics for threat identification, interactions, and predictions; feeds risk assessment and management systems
Future Targets

> Technology Development Needs
  ─ Composite pipe (corrosion resistant-proof and increased strength)
  ─ Self-healing coatings and polymer pipe that repair themselves
  ─ Develop and validated joining, tapping, and inspection technology for these next generation / smart materials

> Materials, Testing, and Manufacturing Needs
  ─ Interchangeable fuels – need materials that can reliably transport hydrogen and other fuel blends
  ─ Multi-physics modeling to account for interactions of stress, strain, chemical/electrochemical, and fluid-solid interfaces
  ─ Strain detection on buried assets - settlement, frost heave, internal and external component wall loss, earthquakes, super storms, and floods

> Data, Information, and Decision Making Needs
  ─ Optimize decisions by combining all data, information, analytics, and material and system operations models
  ─ Account for the interconnectivity of infrastructure assets and their operations including gas, electric, liquids, etc.
### Summary

**Ultimate goal - increase safety, improve efficiency, provide sustainability and reliability of infrastructure systems**

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<td>Optimized Decision Making and Grid Interconnectivity</td>
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GTI is a company that solves important energy changes, a company that truly has...

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...“the Energy to Lead”