GTI's Pipeline Infrastructure R&D Program

>Presented to

U.S. Department of Transportation
Joint Government – Industry
Pipeline Research and Development Forum

December 11, 2003

GTI's Pipeline Infrastructure R&D Program

- *Industry Issues and Needs*
- *Program Structure*
- *Future Needs and Opportunities*

GTI's Pipeline Infrastructure R&D Program

> ***Industry Issues and Needs***

- ✓ Enhanced Safety
- ✓ Assured Integrity
- ✓ Improved Deliverability
- ✓ Improved Reliability
- ✓ Cost Reduction / Containment

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GTI's Pipeline Infrastructure R&D Program

> ***Program Structure***

- Transmission Operations and
- Distribution Operations, including
  - ✓ Compressor Stations*
  - ✓ Storage*
  - ✓ Measurement*

* PRCI/GTI Joint Technology Development Program

GTI's Pipeline Infrastructure R&D Program

> ***Program Structure***

– Transmission Operations

- ✓ Pipeline Right-of-Way Management
- ✓ Third Party Damage Detection
- ✓ Improved Field Applied Coatings Performance
- ✓ Inline Inspection of "Unpiggable" Pipelines
- ✓ Microbially Influenced Corrosion Prevention

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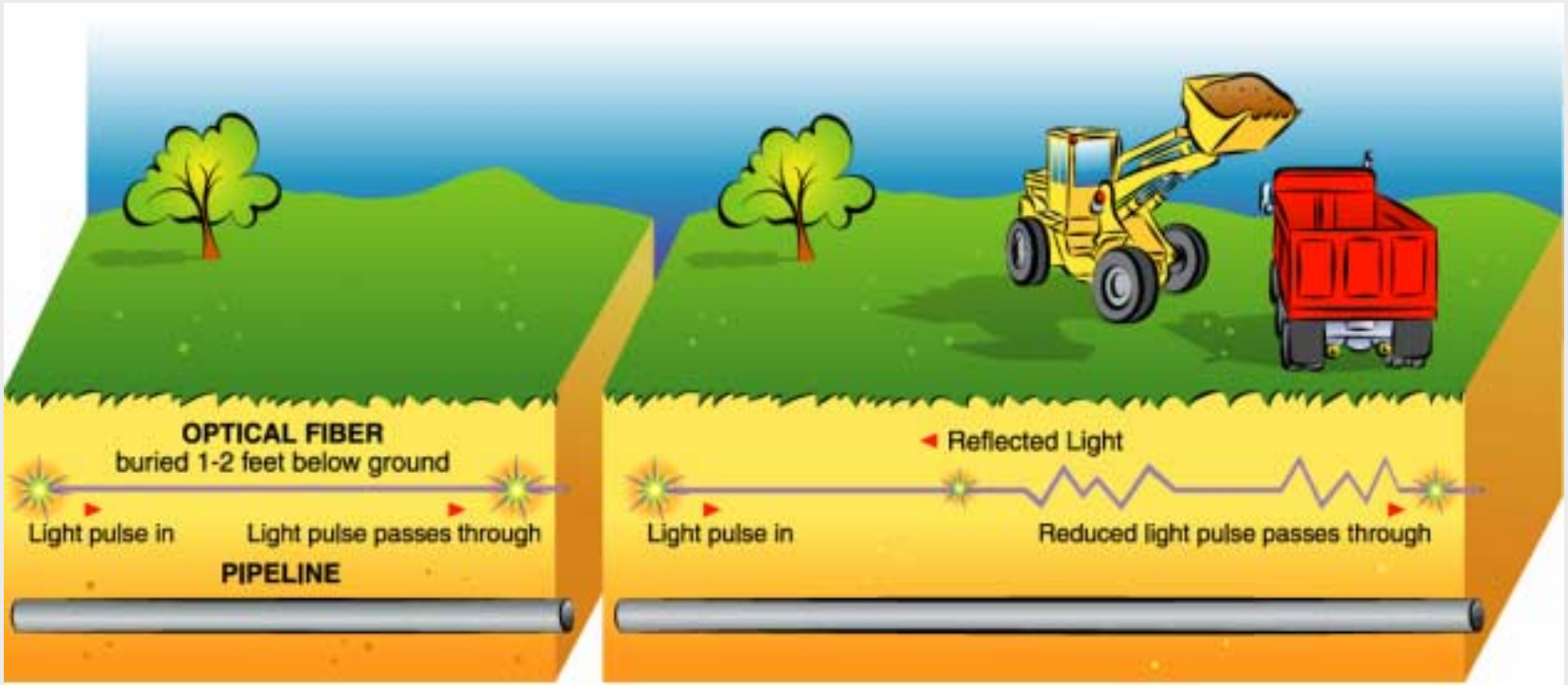
Pipeline Right-of-Way Management

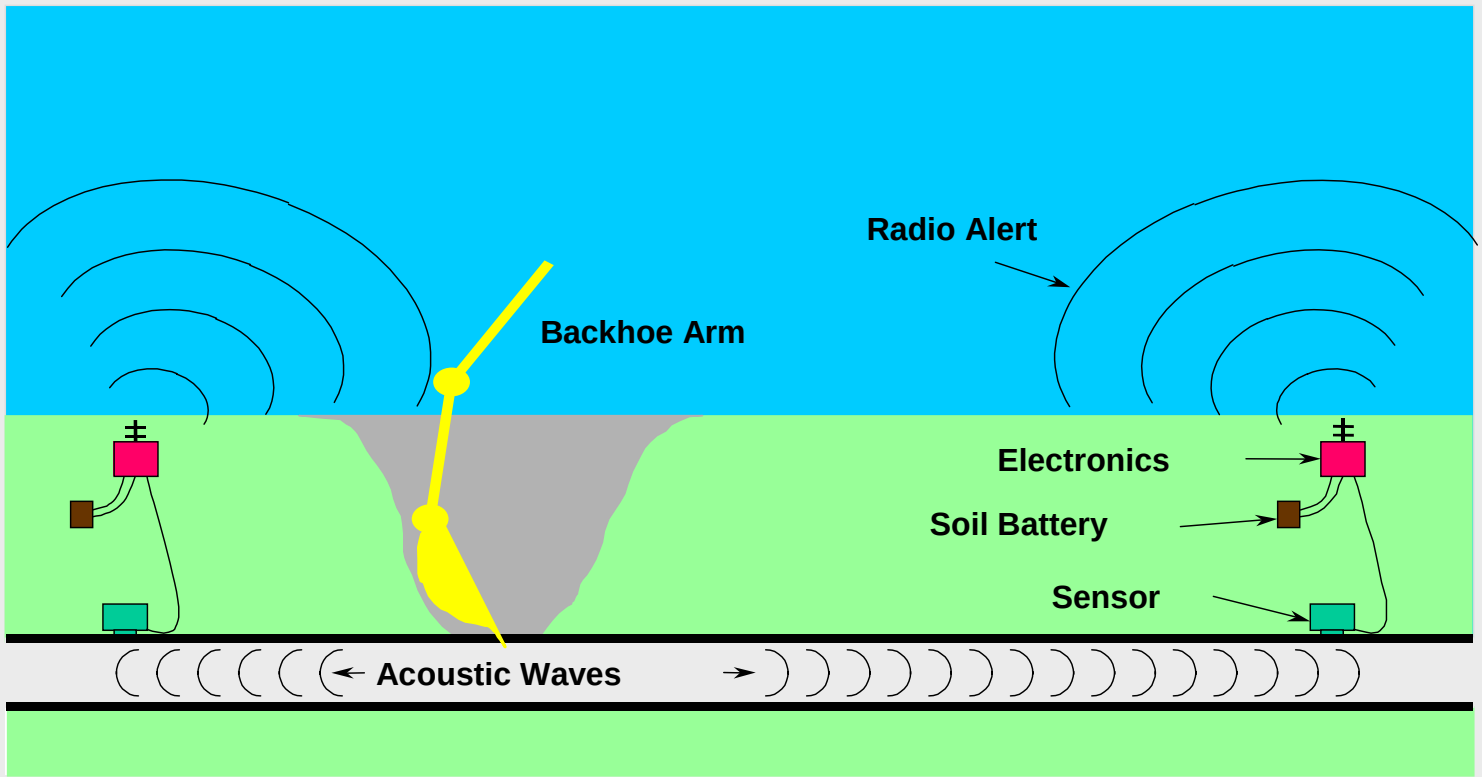
Pipeline Right-of-Way Encroachment Detection



Buried optical fiber is used to detect the presence and locate the position of construction equipment in pipeline ROW before it can damage a buried pipeline

Third Party Damage Detection

- Real-time third party damage detection, to monitor and alert in the event of unauthorized hard contact

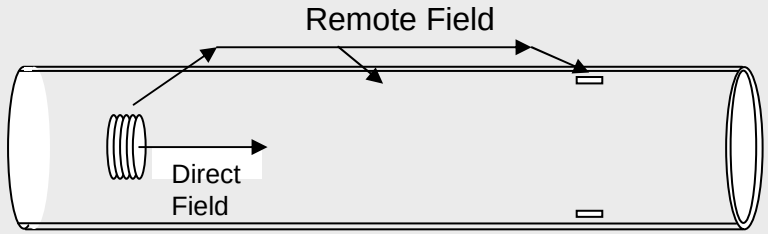


Improved Field Applied Coatings Performance

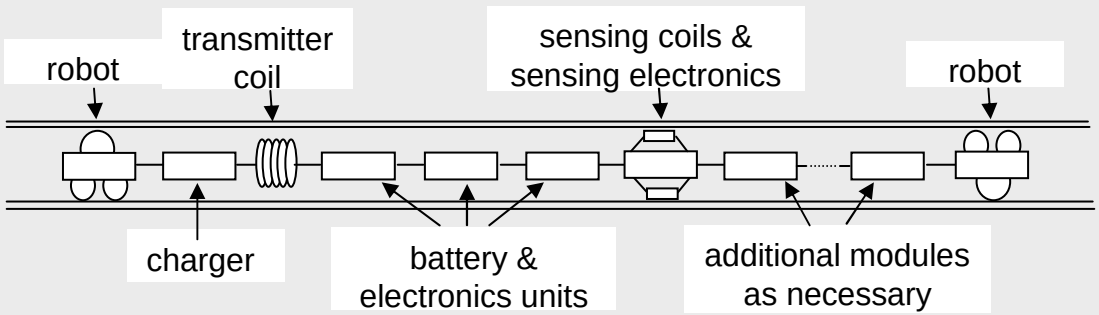
- 3,000 feet of pipe in clay, sand and rock
- 504 buried coated joints, plus 70 “control” joints for immediate testing
- 65 field applied coating systems from 20 North American and International vendors
- Removed for 1, 2 and 5 year performance evaluation

Inline Inspection of Unpiggable Pipelines

- Remote Field Eddy Current Sensor Development



- Simple exciter coil, less than 50% of pipe diameter
- Sensor array adjusts to match pipe diameter while passing small openings
- Accuracy comparable to MFL



RFEC Inspection Vehicle

- Bypass valve and bore restrictions
- Inspect multi-diameter pipes
- Go through back to back bends
- Go around tight bends and miter bends

GTI's Pipeline Infrastructure R&D Program

- **Program Structure**
  - Distribution Operations
    - ✓ Field Operations & Mechanical Engineering
      - Plastic and Metal Piping Systems
      - Improved Construction and Maintenance Tools and Equipment
      - "Trenchless Technologies"
      - Pipe and Leak Locations

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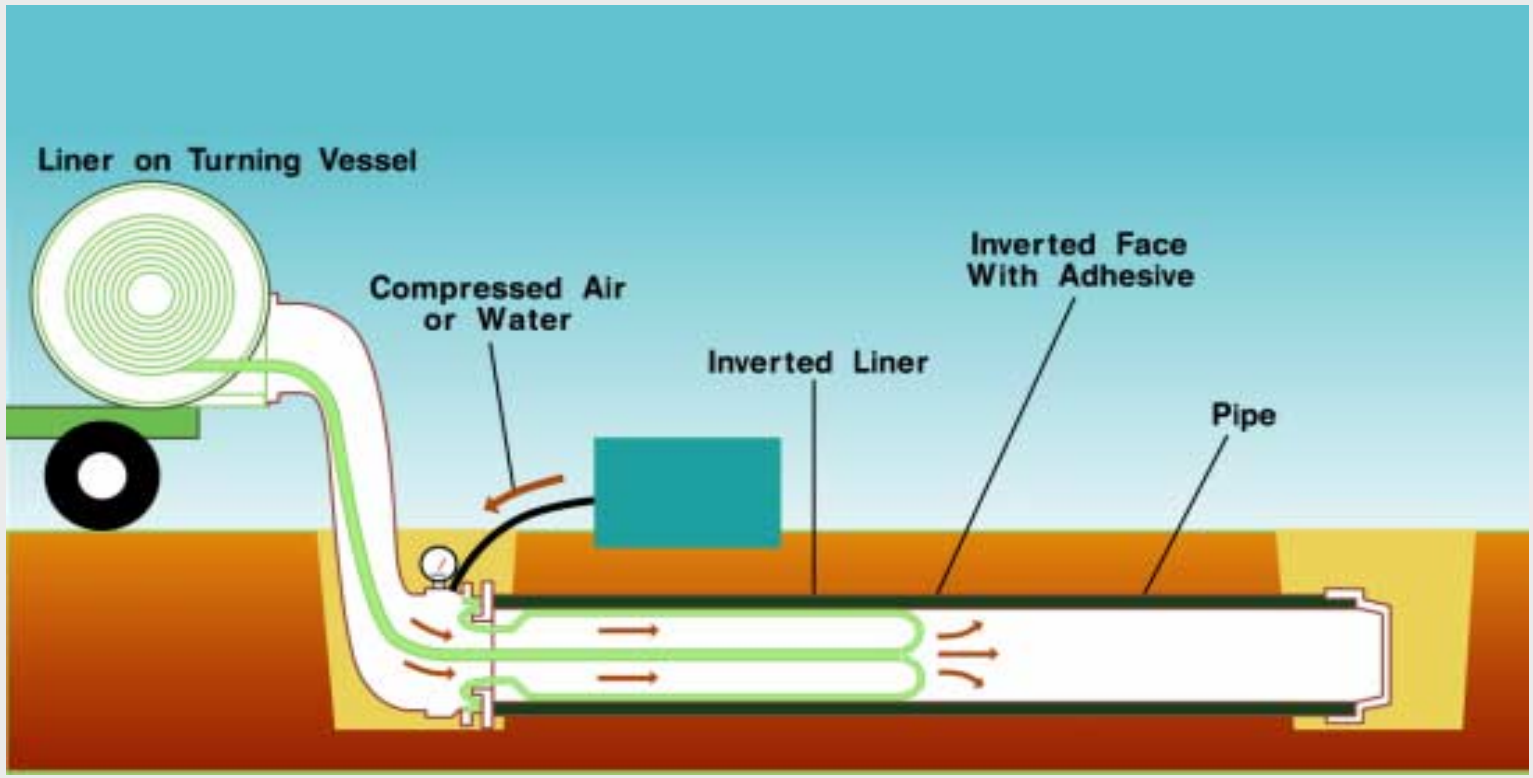
"Trenchless" Technologies

> High Pressure Pipe Liner



The HPL will be made for a full range of gas pipeline diameters and pressures to 1000 psi. Depending on the diameter, the HPL will install in 1500 ft of pipe with a single inversion.

GTI's Pipeline Infrastructure R&D Program

> ***Program Structure***

– Distribution Operations (cont.)

✓ Electronics and Telecommunications

- Remote Monitoring and Control
- Systems Automation
- Communication Encryption and Security
- Data Acquisition and Processing

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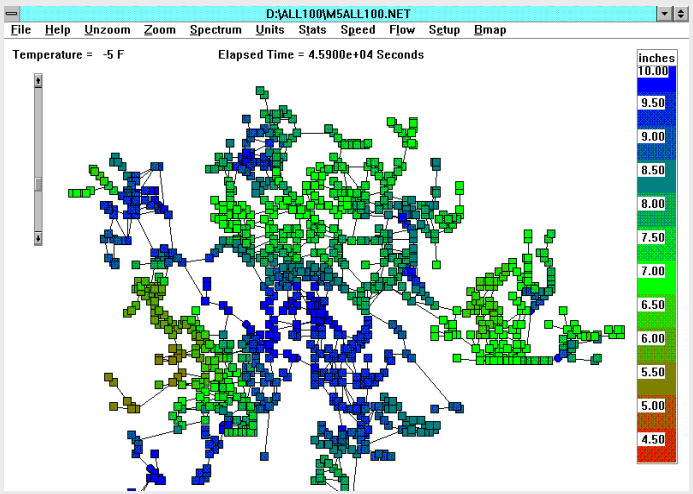
Systems Automation

- **Predictive Control System for District Pressure Regulation**
  - Real-time automatic pressure regulation based upon predicted future demand
  - Adaptive Control algorithms predict future demand based upon historical demand and experience
  - Commercially available as the Fisher “GridBoss” system



All Components Are Manufactured, Assembled, and Warranted By a Single Supplier

GTI's Pipeline Infrastructure R&D Program

> ***Program Structure***

– Distribution Operations (cont.)

✓ Civil and Geotechnical Engineering

- Soil excavation and backfilling
- Pavement Reinstatement
- Site Restoration
- "Keyhole" Operations

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Soil Excavation and Backfilling

- **Soil Nailing**
  - Technique commonly used in supporting large excavations
  - It involves drilling steel nails to increase the strength and stability of the soil mass, eliminating or reducing shoring requirements

Example of the use of Soil Nailing in stabilization of cuts.

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> ***Program Structure***

– Distribution Operations (cont.)

✓ Materials Testing and Evaluation

- Material Property Testing
- Failure Analysis
- New Product Evaluation
- Gas Quality Examination and Fuel Characterization

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GTI's Pipeline Infrastructure R&D Program

- ***Future Needs and Opportunities***
  - Significant ongoing R&D to address safety, integrity, reliability
  - PSIA will result in need for additional technology development
  - GRI / FERC R&D Program ending in 2004
  - Competitive energy market will restrict availability of T&D company R&D funding
  - Continued robust technology development will require additional/new collaborative research funding, and federal/state support.

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