

DOE Natural Gas Infrastructure Reliability



*API Pipeline Conference
April 14, 2004*

*Rodney Anderson
Technology Manager*

Strategic Center for Natural Gas



National Energy Technology Laboratory

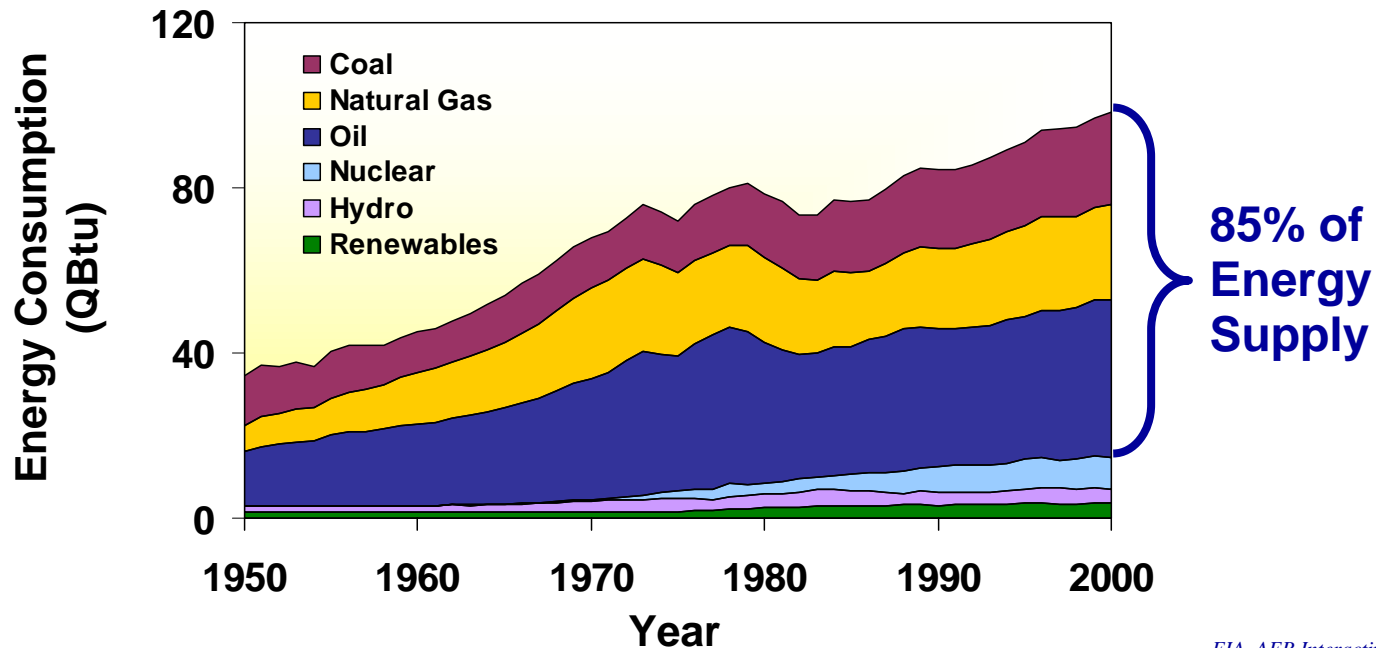


- **One of DOE's 17 national labs**
- **Government owned/operated**
- **Sites in Pennsylvania, West Virginia, Oklahoma, Alaska**
- **More than 1,100 federal and support contractor employees**
- **FY 03 budget of \$750 million**



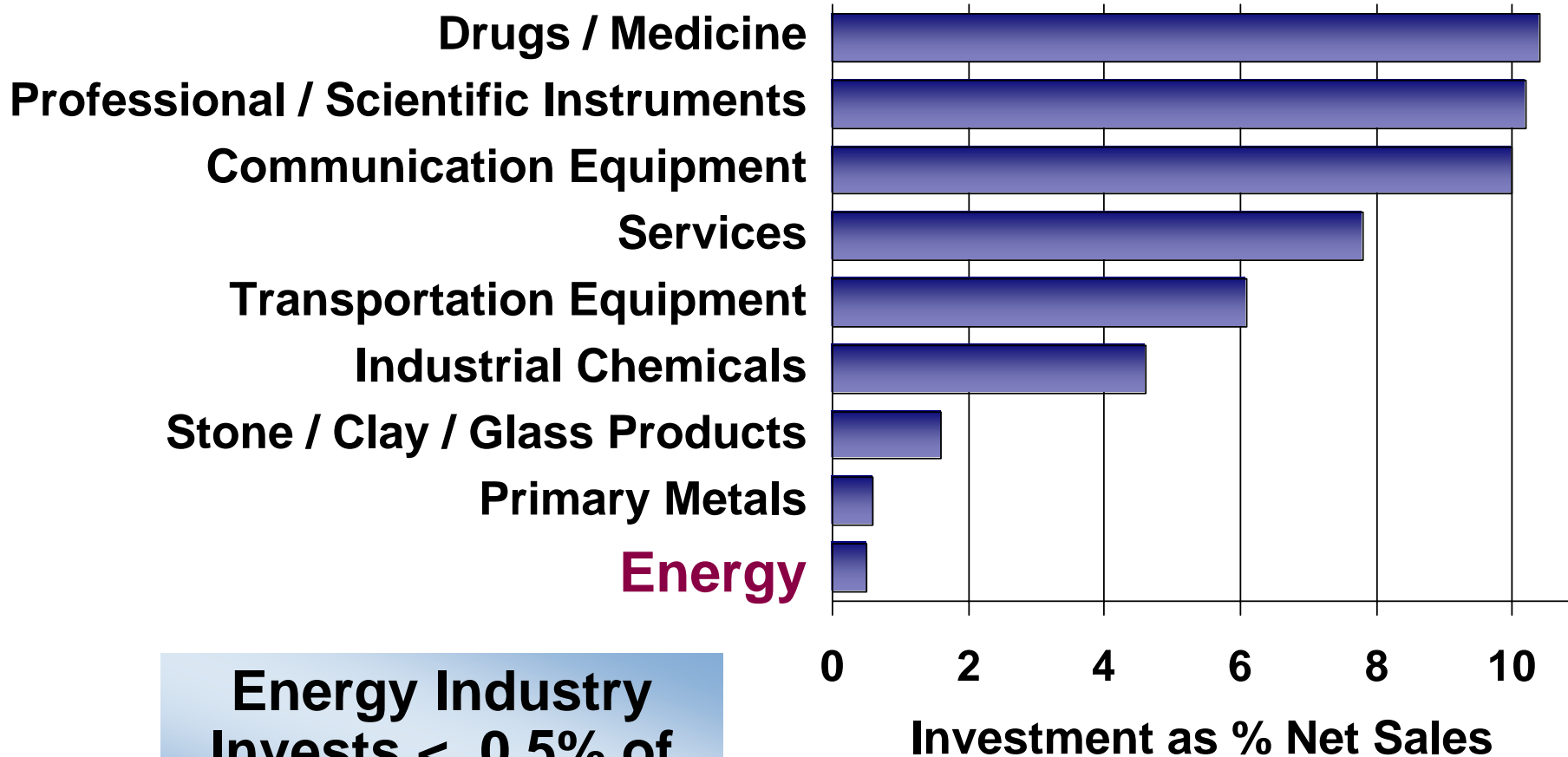
Fossil Fuels Today

- Provide 85% of U.S. energy
- Will provide 87% of U.S. energy in 2020
- Supply should last throughout this century
- Infrastructure to deliver at low cost



EIA, AER Interactive Data Query System

Energy Sector R&D Investments Low



**Energy Industry
Invests < 0.5% of
Sales**



1995 Data - NSF) Margolis & Kammen, Science, 1999

Gas Infrastructure Reliability

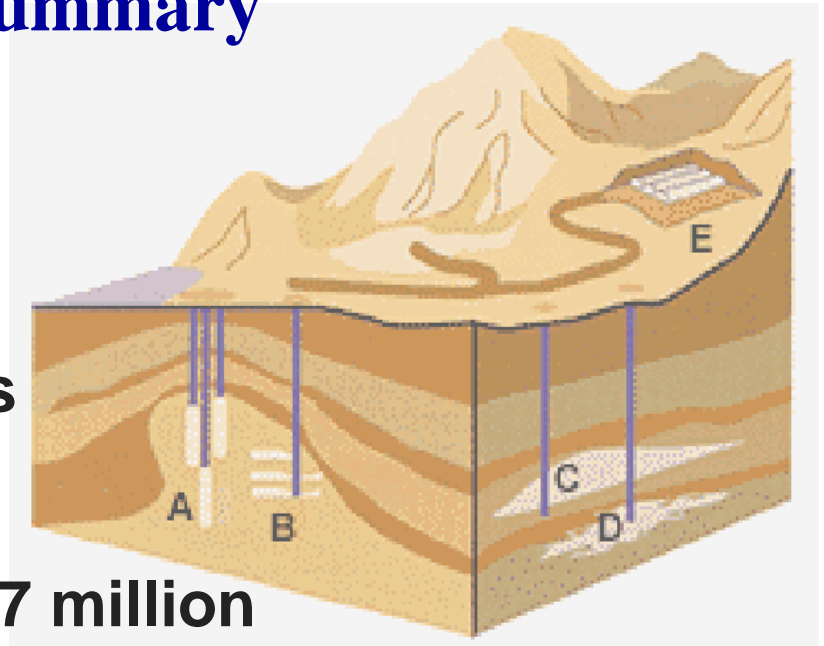


- **Transmission, distribution, storage & LNG**
- **Program goals:**
 - Maintain/enhance system reliability and integrity
 - Increase gas deliverability
 - Reduce environmental impact
 - Address gas & electric interdependencies
 - Develop technology for future gas delivery system
 - Support infrastructure security
- **Budget: FY04**
 - \$2 million storage technology
 - \$7 million infrastructure reliability



Program Summary

- 63 current active projects
- 26 completed projects
- Total program value > \$47 million
- Several projects near hand-off phase
- Industry supported field tests necessary
- Commercialization path still difficult
- Industry involvement required



Infrastructure Activities

Interagency Workshop

March 22 & 23, 2000 Washington, DC
DOE, DOT, FERC, EPA, DOI

Visioning Workshop

May 3, 2000 Pittsburgh, PA
15 industry executives

Roadmapping Workshop

June 6 & 7, 2000 St. Louis, MO
40 industry experts

Roadmap Update Workshop

January 29 & 30, 2002 Pittsburgh, PA
40 industry experts

Industry Forum

September 16 & 17, 2002
Morgantown, WV
100 attendees

Workshop Goals

Elicit stakeholder input

- Vision
- Technology needs & opportunities

Determine government role

Gas Storage Workshop

November 29, 2001
Pittsburgh, PA
50 industry experts

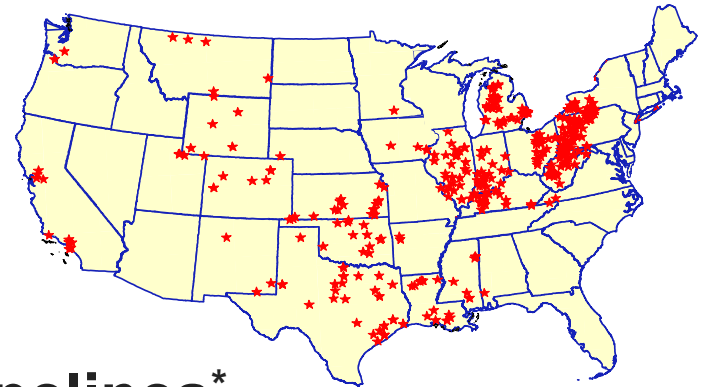
GTI/PRCI Storage Committee

Bi-annual meetings
20 industry experts



Natural Gas Industry Background

- 410 storage fields
- 500 bcf of LNG imports for 2003
- 270,000 miles of transmission pipelines*
- 952,000 miles of distribution pipelines*
- \$8 billion/yr investment in infrastructure*
- Energy companies dominating the industry
- R&D viewed as expense, not investment
- FERC-funded R&D loss
- Security difficult with dispersed assets



**NPC Report, December 1999*

Core R&D Areas & Issues

- **Inspection Technologies**
 - Robotic platforms
 - Sensors
 - Pigs
 - Automation
- **Remote Sensing**
 - 3rd party damage
 - Underground imaging
 - Leak detection
- **Materials**
 - Repair
 - Smart Pipe
 - Liners
- **Operational Technologies**
 - Compressors
 - Modeling
 - Corrosion
- **Deliverability enhancement and reservoir management**
 - Storage well deliverability
 - Storage resource efficiency
- **Metering and Measurement**
 - Accuracy and real-time measurement of both gas volume and energy content
- **Advanced Storage Concepts**
 - Storage alternatives
- **LNG**
 - Education
 - Safety
 - Transportation/storage



Implementation Strategy

- **Focus on high risk, innovation, and leap frog technologies**
- **Strong industry participation**
 - Input to R&D priorities
 - Feedback on program & project status
 - Collaborations & cost sharing
- **Balanced R&D program**
 - Distribution, transmission, & storage
- **Most funding dedicated to private sector projects**
- **National laboratory efforts focused on innovation**
- **Some quick wins to demonstrate progress**

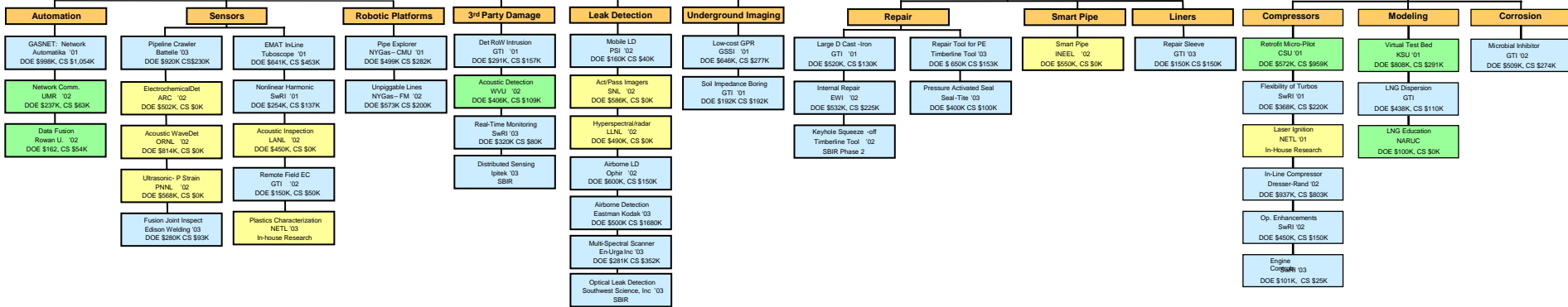


Inspection Technologies

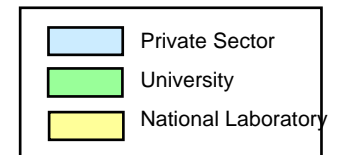
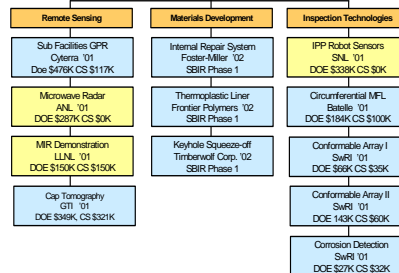
Remote Sensing

Materials Development

Operational Technologies

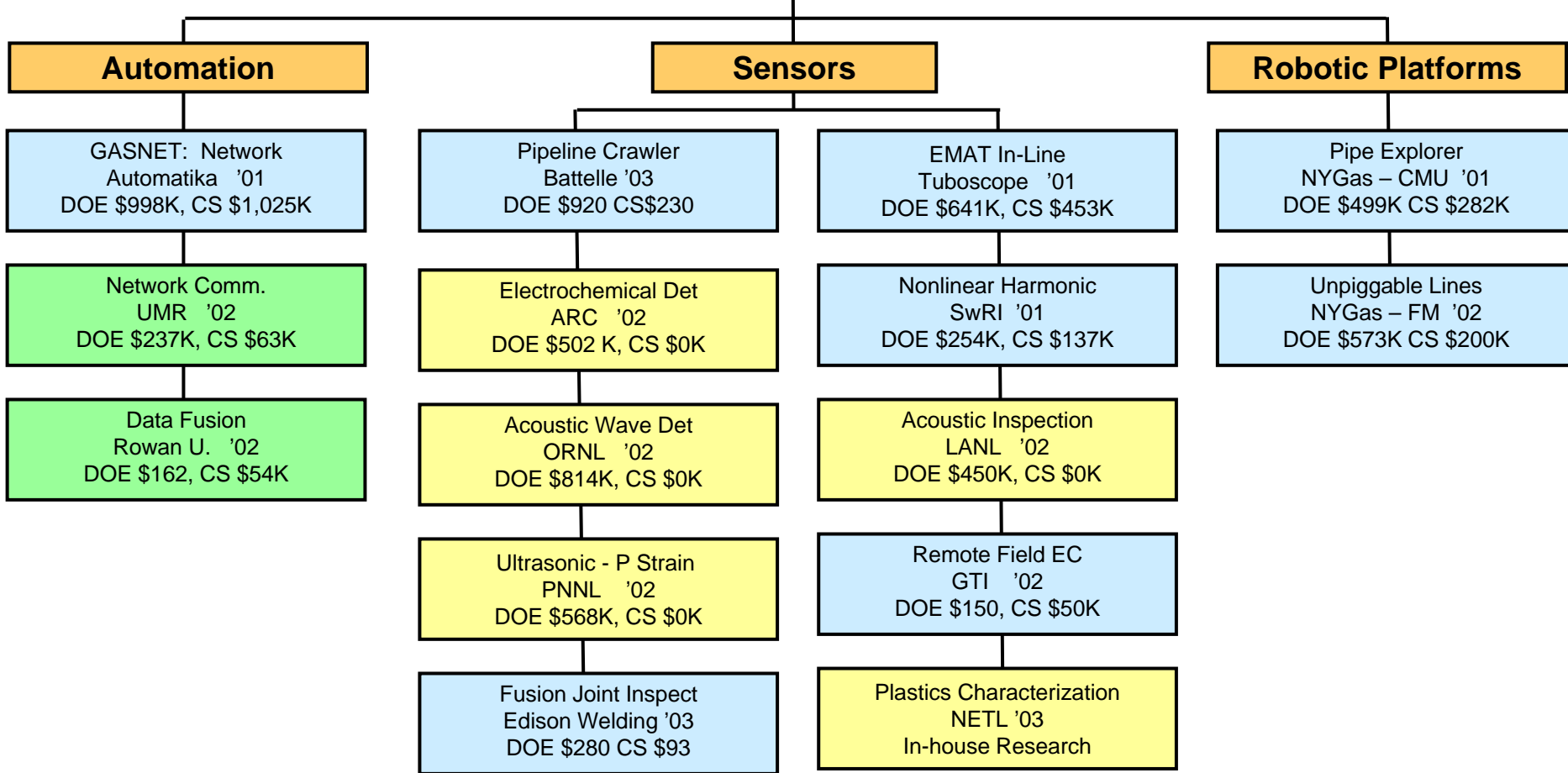


Completed Projects



Note: 01, 02 & 03 refer to fiscal year of award

Inspection Technologies



	Private Sector
	University
	National Laboratory

Note: 01, 02 & 03 refer to fiscal year of award



Conformable Array for Mapping Corrosion Profiles

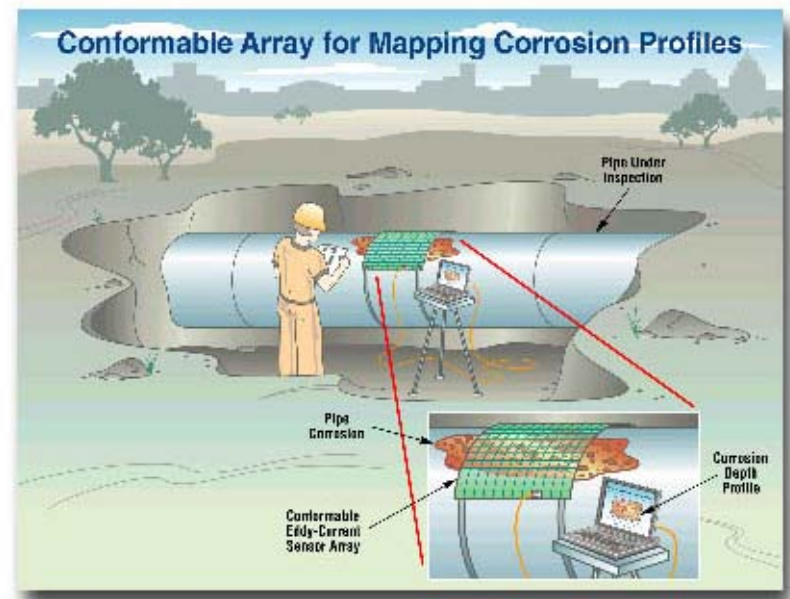
Southwest Research Institute

Description: A simple, rugged, low cost device that that can be used to quickly map the corroded surface of a pipe, without cleaning of the pipe surface. The device will use eddy current sensing coils in a conformable array that can be wrapped around the pipe surface.

Schedule/Status:

- Start Date: 8/1/01
 - End Date: 9/30/03
- (2 Projects)

Partners: Clock Spring Inc.



Innovative Sensors for Pipeline Crawlers to Assess Pipeline Defects and Conditions

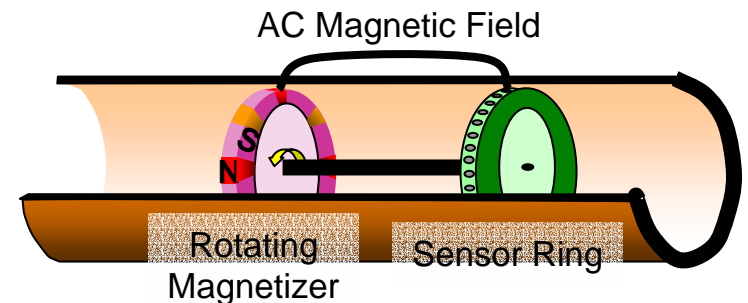
Battelle

Description: The project will design and develop Remote Field Eddy Current Sensors to detect internal and external pipeline corrosion. The last phase of the work will attempt to integrate these sensors with autonomous robotic platforms.

Schedule/Status:

- Start Date: 9/30/03
- End Date: 9/29/06

Partners: Platform developer - TBD



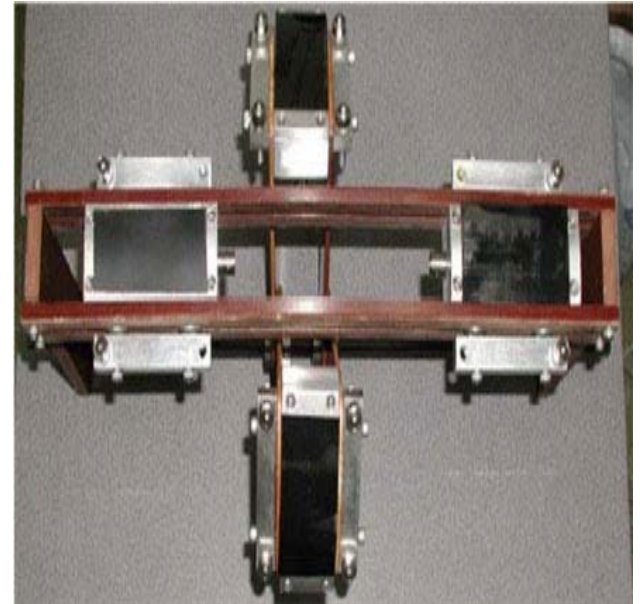
New Acoustic Wave Pipe Inspection System

Oak Ridge National Laboratory

Description: This project will develop and demonstrate a new waveguide pipe flow detection technique that has the potential to detect pipeline flaws in a single pass at speeds of approximately 2 miles per hour.

Schedule/Status:

- Start Date: 8/13/01
- End Date: 12/31/04



Ultrasonic Measurements of Plastic Strain in Pipelines

Pacific Northwest National Laboratory

Description: PNNL will develop and demonstrate a novel ultrasonic nondestructive test method to detect and evaluate the severity of third party damage in pipelines.

Schedule/Status:

- Start Date: 8/13/01
- End Date: 12/31/04

Partners: Battelle Memorial Institute Pipeline Inspection Facility, National Institute of Standards, Pacific Gas and Electric



EXPLORER: A Long Range Untethered Live Gasline Inspection Robot System

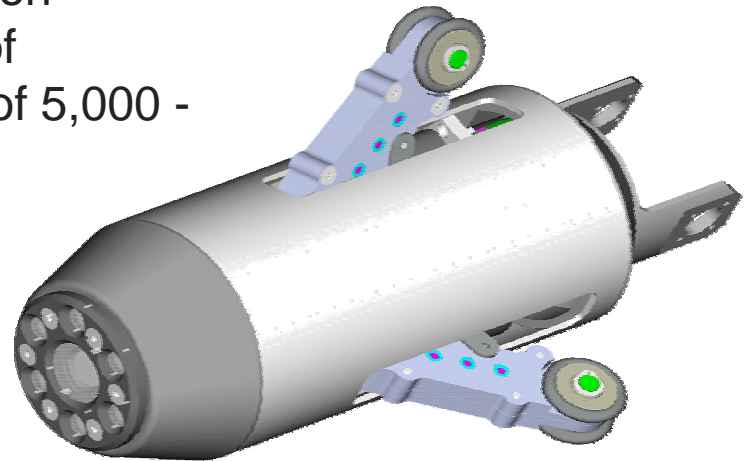
Northeast Gas Association (New York Gas Group)

Description: A long-range untethered visual inspection robot prototype for use in distribution pipelines 6 to 8 inches in diameter, capable of independent movement and communication of 5,000 - 10,000 ft.

Schedule/Status:

- Start Date: 9/26/01
- End Date: 6/30/04

Partners: Carnegie Mellon University, Keyspan, Central Hudson Gas and Electric, Consolidated Edison of New York, Niagara Mohawk Power Corporation, New York State Electric and Gas, Orange and Rockland Utilities, Rochester Gas and Electric, NASA



Roboscan – A Robotic Inspection Platform and Sensors for Assessing Corrosion and Mechanical Damage in Un-Piggable Transmission Mains

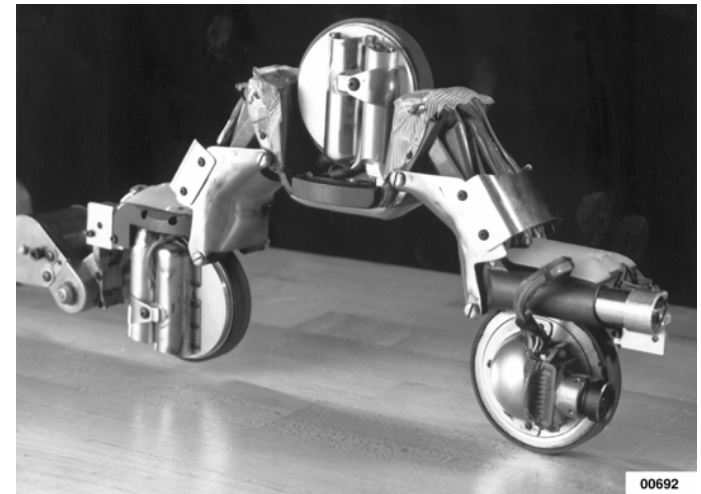
Northeast Gas Association (New York Gas Group)

Description: A Pipeline Inspection Robot to overcome the shortcomings of transmission pigs. Self-powered and self-propelled. Capable of carrying NDE sensors, navigating both in both directions. Negotiate mitered elbows, tees and back to back bends. Passable through partially ported plug valves. Automatically adaptable, by a factor of two, to changes in pipe diameter.

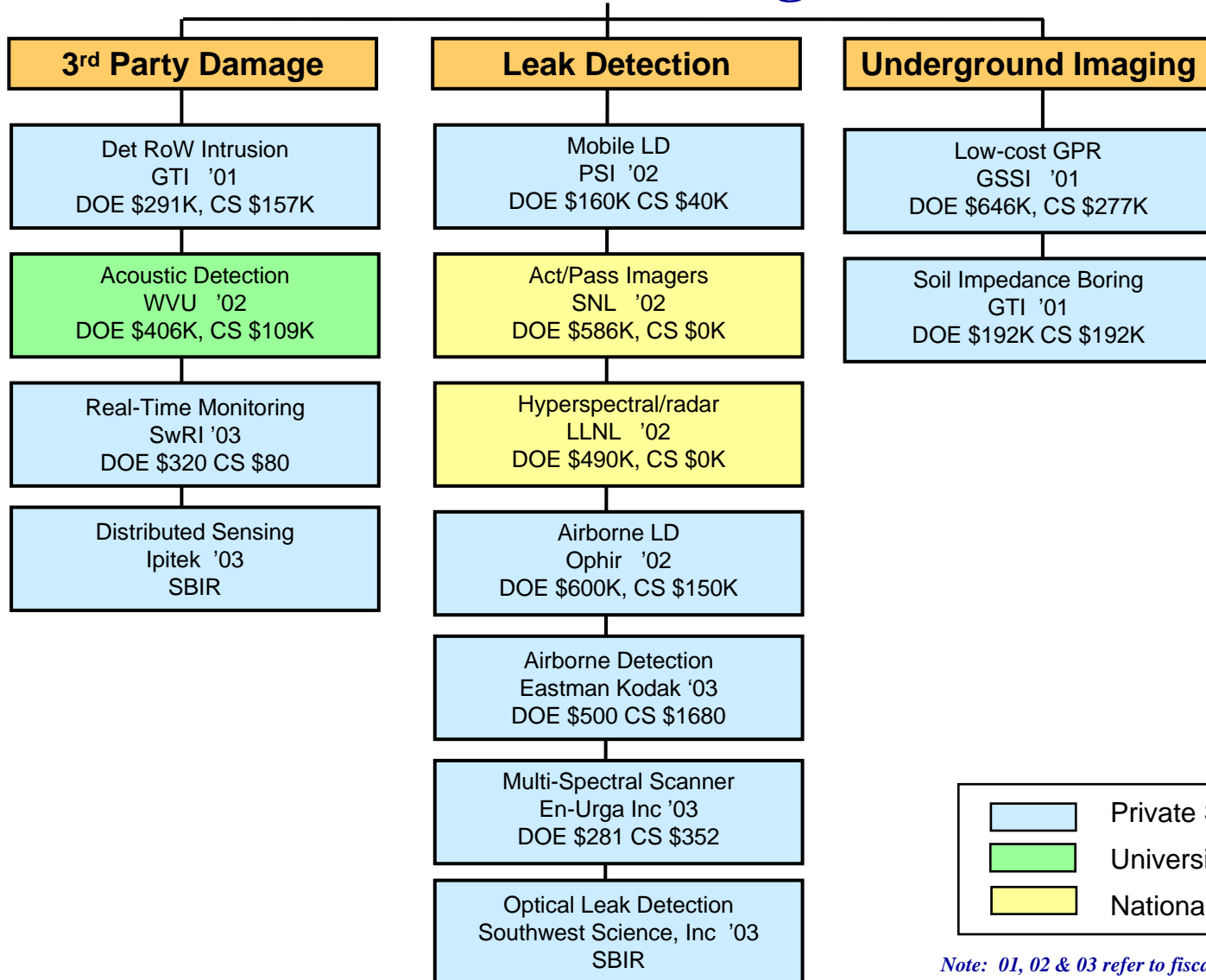
Schedule/Status:

- Start Date: 9/30/02
- End Date: 2/29/04

Partners: Foster-Miller, PII North America, Public Service Electric & Gas Company, and Southern California Gas Company



Remote Sensing



Note: 01, 02 & 03 refer to fiscal year of award



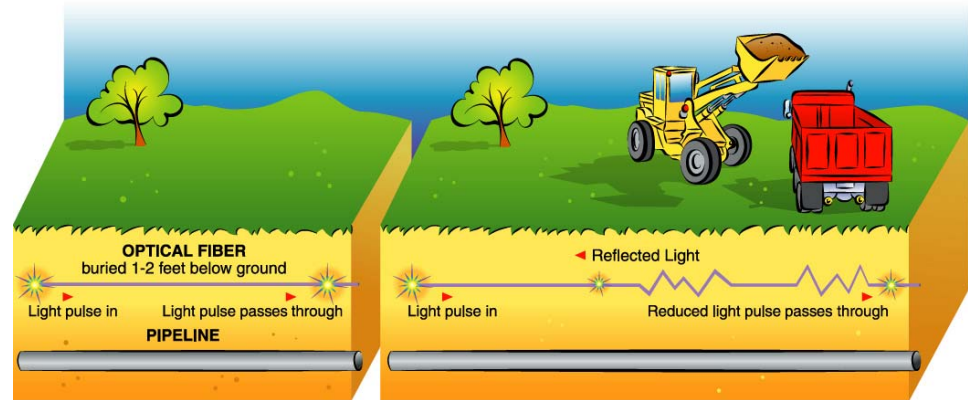
Detection of Unauthorized Construction Equipment in Pipeline Right-of-Ways

Gas Technology Institute

Description: Develop and demonstrate an optical fiber intrusion detection device that will prevent outside force damage by detecting and alarming when construction equipment is near a natural gas pipeline.

Schedule/Status:

- Start Date: 9/13/01
- End Date: 9/30/04



Partners: ANR Pipeline, Gas Research Institute
(IL)



Acoustic Detecting and Locating Gas Pipeline Infringement

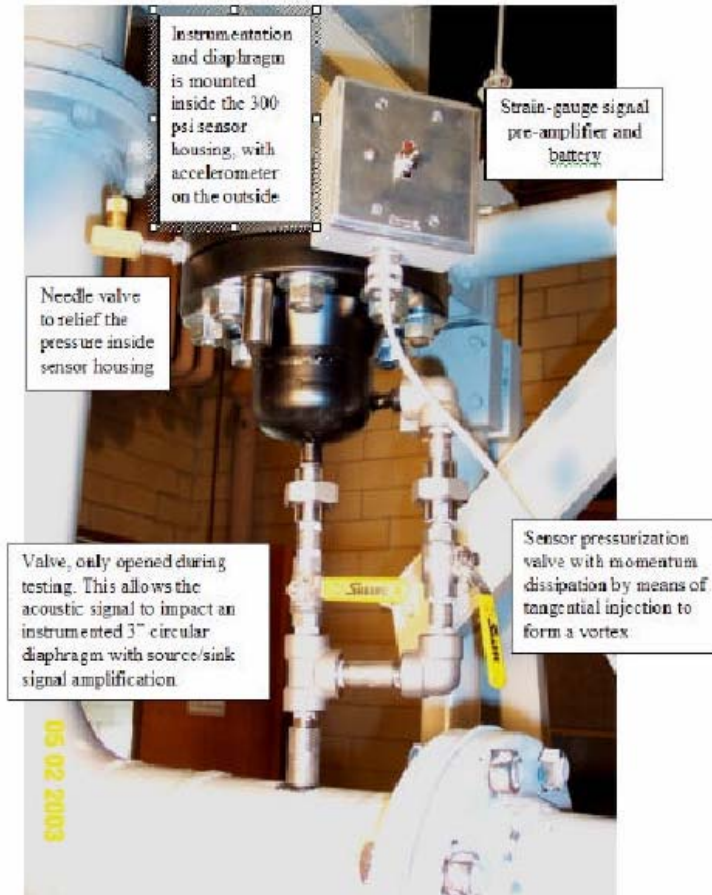
West Virginia University

Description: This project will develop a system to detect the unique sound wave generated when a pipeline break releases a large discharge of gas after being damaged by landslides, excavations, or other disturbances. The system will be designed to monitor the background noise inside the pipe and pick up any sudden new frequencies that might signal a sudden pipeline rupture.

Schedule/Status:

- Start Date: 7/5/02
- End Date: 7/4/04

Partners: Dominion Transmission



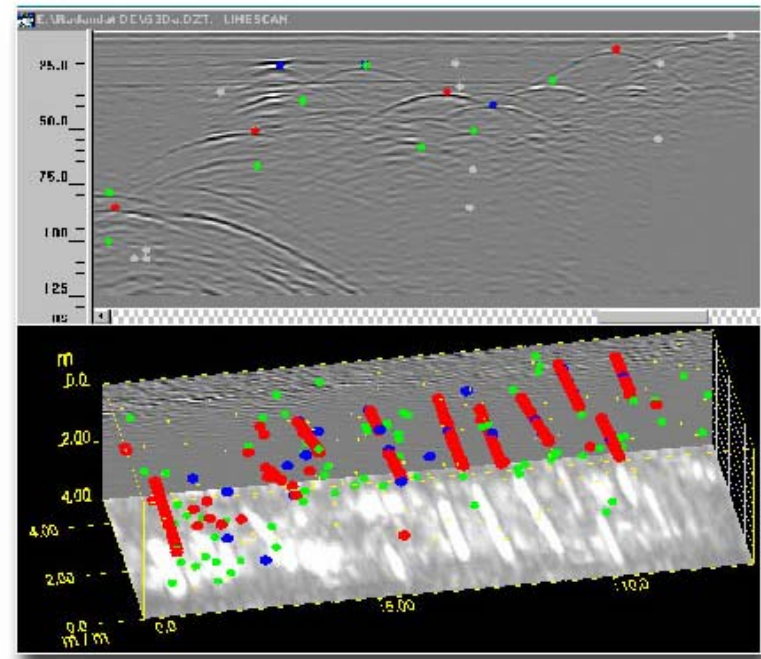
A Low-Cost GPR Gas Pipe and Leak Detector

Geophysical Survey Systems Inc.

Description: A low-cost, easy-to-use, Ground Penetrating Radar (GPR) for locating metallic and non-metallic gas pipelines, as well as the remote detection of pipeline leaks.

Schedule/Status:

- Start Date: 10/1/01
- End Date: 9/30/04



Differential Soil Impedance Obstacle Detection

Gas Technology Institute

Description: A unique down-hole obstacle detection sensor for Horizontal Directional Drilling (HDD) equipment. This sensor utilizes a differential soil impedance measurement technique that will be sensitive to the presence of plastic, ceramic, and metallic obstacles in the proximity of the HDD head.

Schedule/Status:

- Start Date: 3/25/02
- End Date: 9/30/04



Mobile Sensor for Remote Detection of Natural Gas Leaks

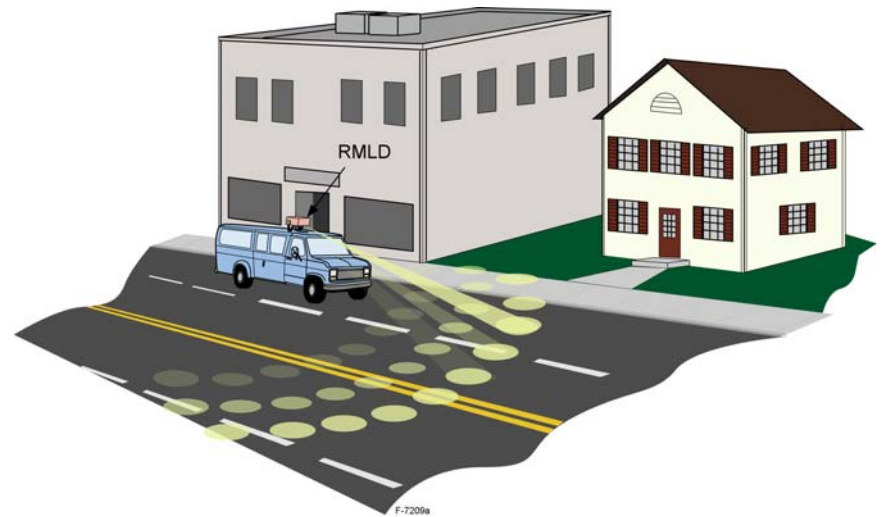
Physical Science Inc.

Description: Development of mobile gas leak detector technology capable of quantifying and distinguishing natural pipeline gas leaks from other hydrocarbon leaks or ambient methane sources. R&D will focus on extending the performance and applicability of the Remote Methane Leak Detector (RMLD) developed by PSI.

Schedule/Status:

- Start Date: 9/30/02
- End Date: 3/31/04

Partners: Heath Consultants



Testing of an Advanced Airborne Natural Gas Leak Detection System

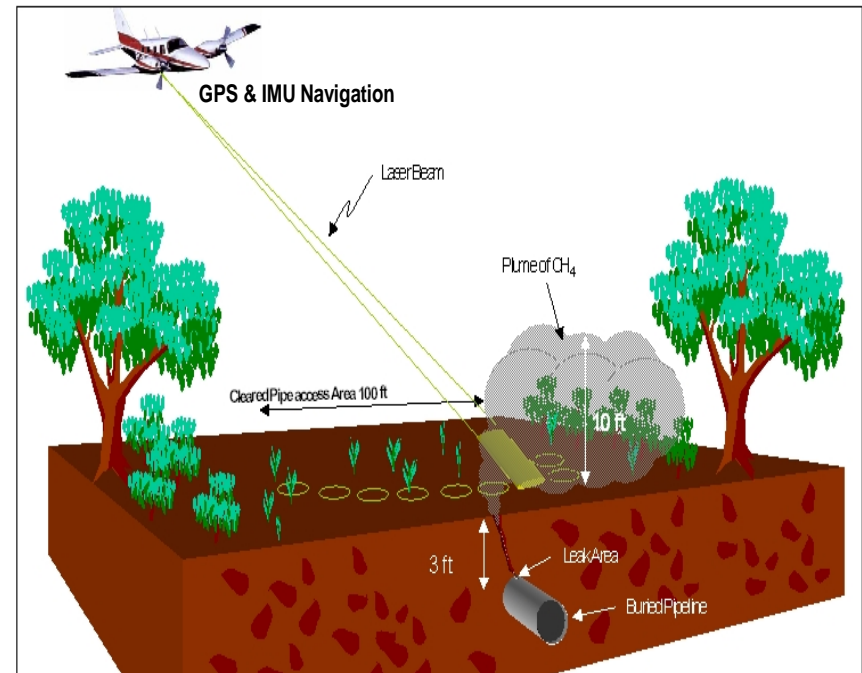
Eastman Kodak

Description: The project objective is to flight test a high-sensitivity, broad-coverage, natural gas leak detection system in an operational environment. The system will accurately detect and locate small concentrations of natural gas leaks from transmission pipelines with very high confidence.

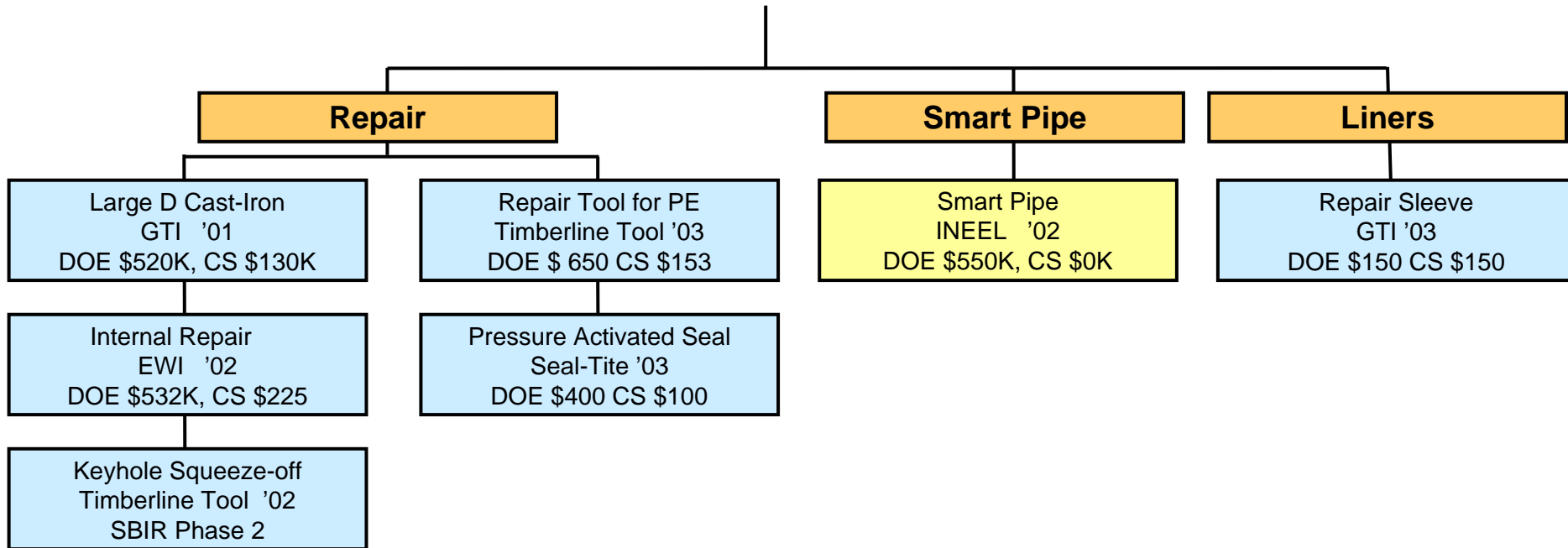
Schedule/Status:

- Start Date: 9/30/03
- End Date: 12/31/04

Partners: Coherent Technologies



Materials Development



Note: 01, 02 & 03 refer to fiscal year of award



Internal Repair of Pipelines

Edison Welding Institute

Description: The work will evaluate, develop and validate internal repair methods for pipelines, perform laboratory demonstrations of potential internal pipeline repair techniques and develop a functional specification for a combined prototype system to perform internal inspection and repair of pipelines.

Schedule/Status:

- Start Date: 9/30/02
- End Date: 3/31/05



“Smart Pipe”

Integral Communication, Damage Detection and Multiple Sensor Application in Pipelines

Idaho National Engineering and Environmental Laboratory

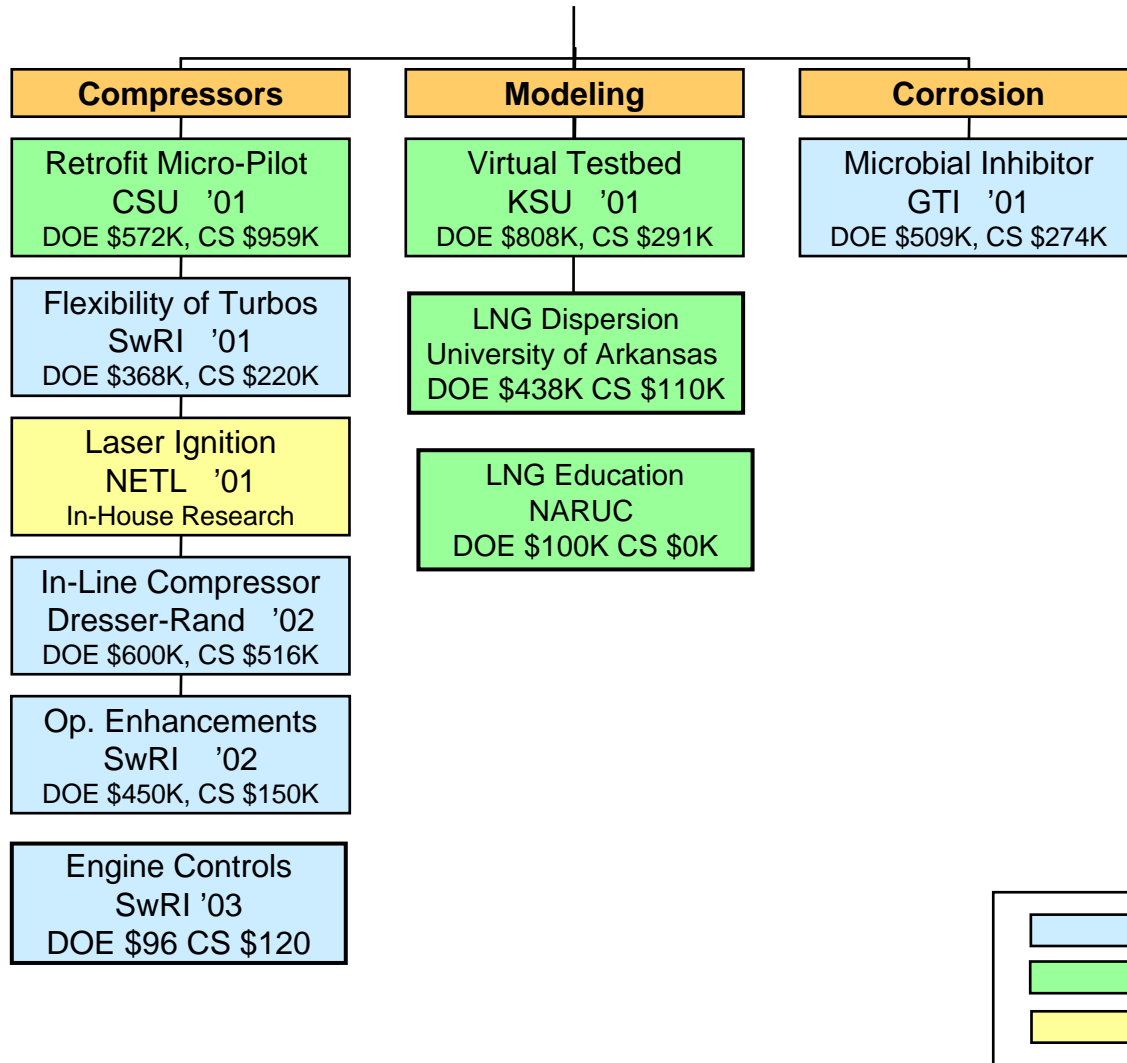
Description: Thermally sprayed conductive traces applied in natural gas transmission and distribution pipelines that can be used for pipeline communications, detection and location of damage and as a conductive pathway for attaching or embedding sensors for performance monitoring.

Schedule/Status:

- Start Date:
- End Date:



Operational Technologies



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IEMDC - Totally Enclosed In-Line Electric Motor Driven Gas Compressor

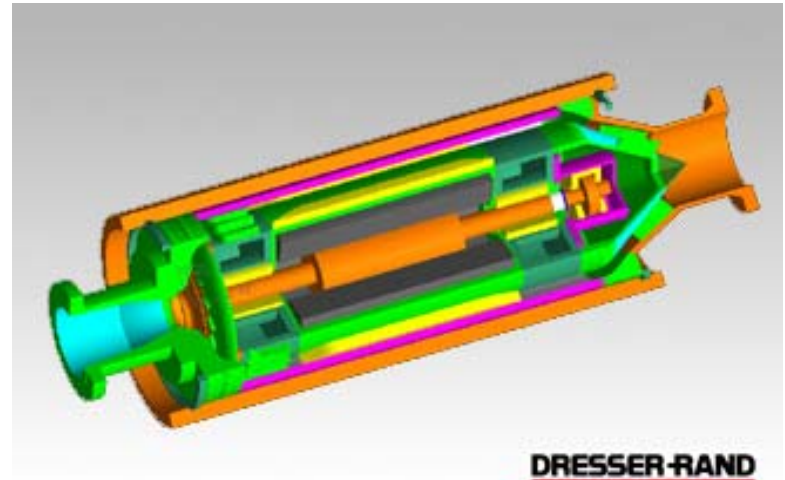
Dresser-Rand Company

Description: Development of the world's first gas compressor that can be installed directly into the pipeline (possibly underground.) The unit will utilize a direct coupled, variable speed induction motor with magnetic bearings mounted inside the casing of a 10 MW centrifugal compressor.

Schedule/Status:

- Start Date: 01/01/03
- End Date: 06/30/04

Partners: Curtiss-Wright / Westinghouse
Electro-Mechanical Division (EMD)



Technologies to Enhance Operation of the Existing Natural Gas Compression Infrastructure

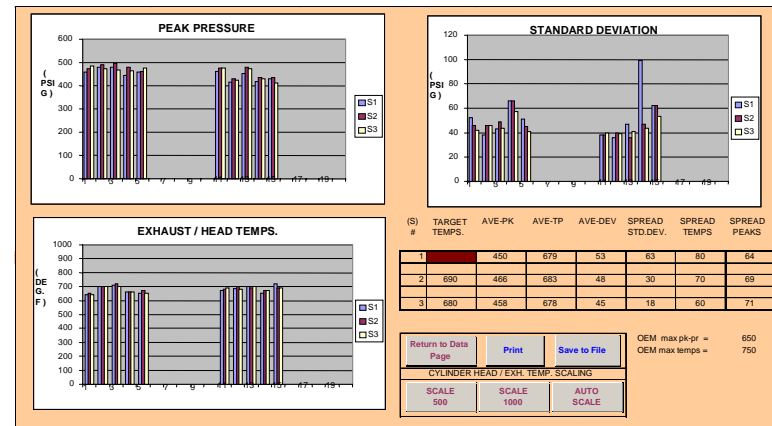
Southwest Research Institute

Description: Develop and substantiate methods for operating integral reciprocating engine / compressors to reduce fuel consumption, increase capacity, and enhance mechanical integrity. The approach to optimization is by balancing engine power cylinders, and distributing the load in the compressor cylinders so as to minimize fuel consumption, minimize damage rate, and maximize capacity.

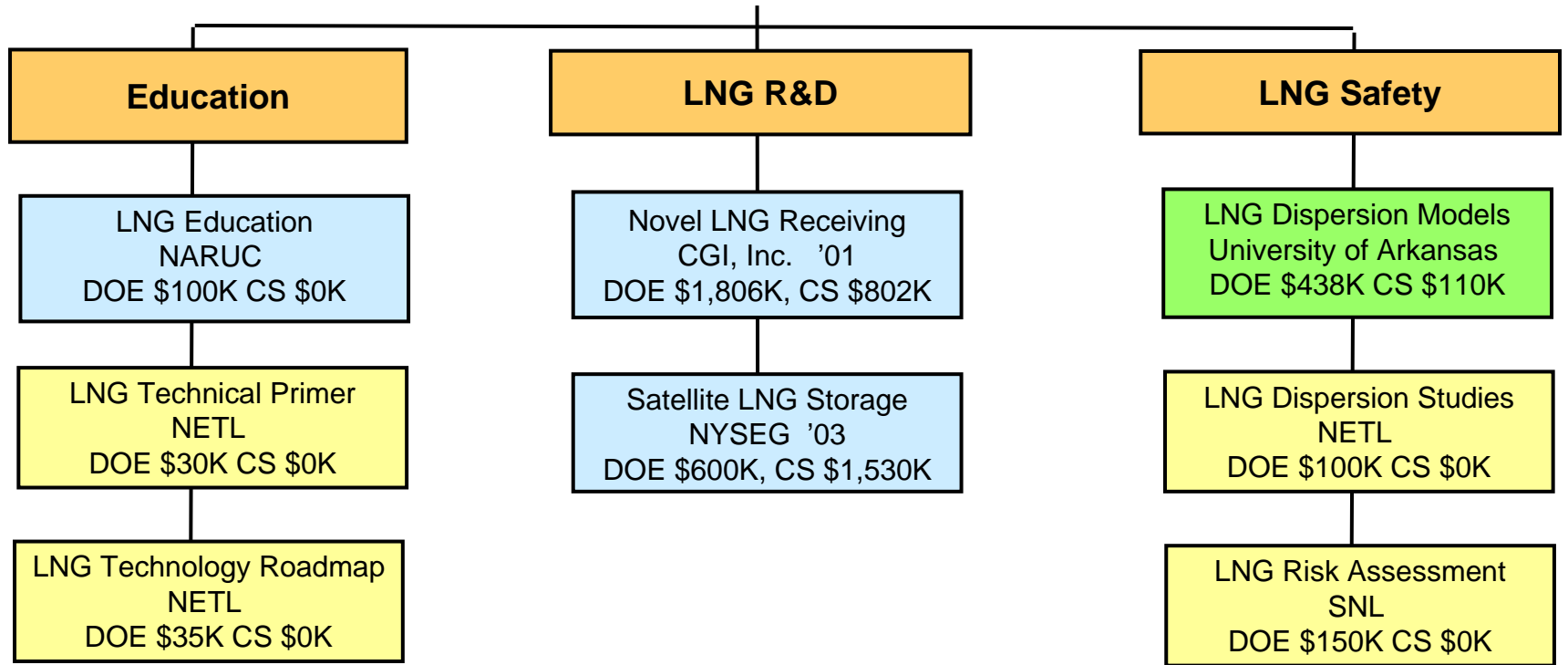
Schedule/Status:

- Start Date: 9/29/02
- End Date: 9/30/05

Partners: Gas Machinery Research Council,
Pipeline Research Council International



Current LNG Projects



Note: 01, 02 & 03 refer to fiscal year of award



FY04 Planned Activities

- **Update Natural Gas Infrastructure Roadmap (February 2004)**
- **Broad-based solicitations (February)**
 - Portfolio gaps and innovation
- **Develop LNG Technology Roadmap (spring)**
- **Gas hydrate storage demonstration (winter)**
- **Robotic platform demonstration (winter/spring)**
- **Inspection/remote sensing field demos (summer)**
- **LNG Heat exchanger field tests (spring)**
- **Continue collaboration with DOT/OPS – joint technical conference**
- **No new targeted solicitations scheduled in FY 2004**





April 18, 2002

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The Strategic Center for Natural Gas

Integrating All Elements of DOE's Natural Gas Research From Borehole to Burner Tip

Natural Gas Infrastructure Reliability Industry Forums

The Strategic Center for Natural Gas (SCNG) at the NETL will conduct a series of Natural Gas Infrastructure Reliability Industry Forums in September 2002. [Read More!](#)

Natural Gas Technology – Investment in a Healthy U. S. Energy Future

Time is running short to register for the "Natural Gas Technology – Investment in a Healthy U.S. Energy Future" conference. [Read More!](#)

DOE Kicks Off "Deep Trek" to Develop Deeper, Smarter Drilling Technology

To develop a new high-tech "smart" drilling system that can tap into deep reservoirs, the DOE is beginning "Deep Trek." [Read More!](#)

- Strategic Planning & Policy Support
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