



# Natural Gas Pipeline Safety and Integrity Management Research – An Overview

Avtar Bining, Ph.D.  
Energy Systems Research Office  
Energy Research and Development Division

Staff Workshop  
on  
Potential Effects of Land Subsidence to Natural Gas and Oil Infrastructure

California Energy Commission  
Imbrecht Hearing Room  
November 10, 2015



# Goals

- Conduct research in natural gas infrastructure not covered by the regulatory and competitive markets
- Provide research that results in tangible benefits to utility customers
  - Focus is on projects that have the potential to increase safety and enhance transmission and distribution capabilities of the natural gas system



# Past Research and Accomplishments

## Natural Gas Pipeline Research - Best Practices in Monitoring Technology - Gas Technology Institute

**Purpose:** To develop a baseline assessment of technologies currently used nationwide and in California to manage natural gas (NG) pipeline integrity and safety, Identify emerging technologies, and develop an implementation plan to bring emerging technologies to California.

### Results:

- Successfully completed a baseline assessment of technologies.
- Identified emerging technologies.
- Developed an implementation plan to advance emerging technologies.
- Published Final Report (CEC-500-2014-024)

<http://www.energy.ca.gov/2014publications/CEC-500-2014-024/CEC-500-2014-024.pdf>

- Presented results at public workshops.
- Used results to develop FY14-15 and FY15-16 NG pipeline integrity research initiatives, develop solicitations and fund research projects.



# Recent Research and Highlights

Project	Description	Status and Highlights
<p><b>Contractor:</b> The Regents of the University of California – UC Berkeley – CITRIS/CIEE</p>	<p><b>Purpose:</b> To explore innovative sensor and communication technologies and approaches for inspecting and monitoring natural gas pipelines, and develop a testbed for testing sensors under simulated field conditions in the lab.</p>	<p><b>Highlights</b></p> <ul style="list-style-type: none"> <li>Designed, developed and tested an <u>innovative low-cost</u>, <u>miniature</u> Micro Electro-Mechanical Sensor system prototype to inspect, monitor and report on the operating condition of natural gas pipelines. Final Report published.</li> </ul> <p><a href="http://www.energy.ca.gov/2014publications/CEC-500-2014-104/index.html">http://www.energy.ca.gov/2014publications/CEC-500-2014-104/index.html</a></p>
<p><b>Contractor:</b> Diakont Advanced Technologies, Inc., San Diego, CA</p>	<p><b>Purpose:</b> To demonstrate a multi-channel electromagnetic acoustic transducer sensor module for pipeline (in-line) inspection crawler for accurately detecting, locating, and measuring pipeline girth weld defects.</p>	<p><b>Highlights</b></p> <ul style="list-style-type: none"> <li>Demonstrated sensor hardware and software integrated with Diakont’s Robotic Operational Defect Inspection System on PG&amp;E pipeline. Final Report in published.</li> </ul> <p><a href="http://www.energy.ca.gov/publications/displayOneReport.php?pubNum=CEC-500-2015-028">http://www.energy.ca.gov/publications/displayOneReport.php?pubNum=CEC-500-2015-028</a></p>
<p><b>Contractor:</b> Acellent Technologies, Inc, Sunnyvale, CA.</p>	<p><b>Purpose:</b> To develop and demonstrate a continuous integrity monitoring system for natural gas pipeline for providing operators with increased information on the current status of the pipeline networks.</p>	<p><b>Highlights</b></p> <ul style="list-style-type: none"> <li>Developed and tested a prototype pipeline corrosion monitoring system at PG&amp;E test lab with complete remote monitoring capability and active 24X7 ongoing testing. Final Report in publication.</li> </ul>



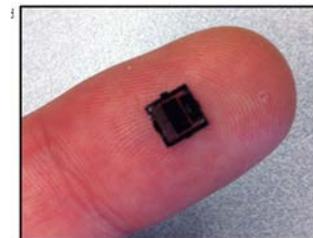
# Major Accomplishment

## Natural Gas Pipeline Research - Innovative Monitoring

- **Contractor:** The Regents of the University of California – UC Berkeley – CITRIS/CIEE
- **PIER Funds:** \$855,835
- **Description:** This project explored innovative sensor and communication technologies and approaches for inspecting and monitoring natural gas pipelines, and developed a testbed for testing sensors under simulated field conditions in the lab.
- **Results:** Designed, fabricated, and tested the micro-electro-mechanical system pressure sensor and flow sensor, and the testbed for testing sensors.
- The pressure sensor showed good sensitivity and accuracy up to 200 pounds per square inch pressure but the flow sensor did not work in the test bed, as iron particles in the test bed—just like gas pipelines—interfered with the tiny sensor mechanism.
- **Ratepayer Benefits:** This project will benefit the ratepayers by improving the safety of natural gas pipelines.



Natural gas pipeline sensors testbed at UC Berkeley



Miniaturized sensor



# Major Accomplishment

## Commercialization of In-line Technology which Accurately Detects, Locates, and Measures Pipeline Girth Weld Defects

- **Contractor:** Diakont Advanced Technologies, Inc., San Diego
- **PIER Funds:** \$1,000,000
- **Description:** This project demonstrated a multi-channel electromagnetic acoustic transducer sensor module on an in-line inspection robotic crawler for accurately detecting, locating, and measuring natural gas pipeline girth weld defects on PG&E pipeline in San Francisco.
- **Results:** Results indicated reduced cost and faster inspections.
- **Ratepayer Benefits:** Reduced cost and improved safety.



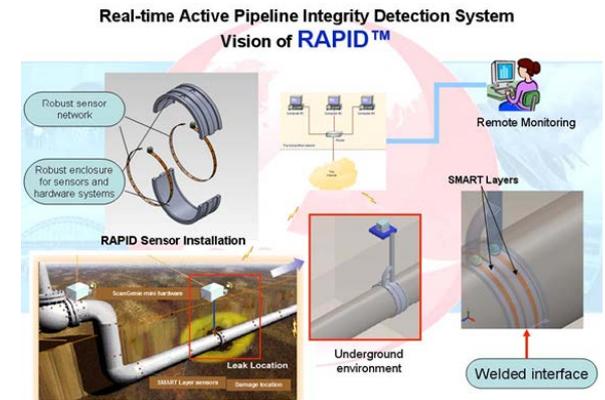
Diakont's Robotic Operational Defect Inspection System at the pipeline entry



# Major Accomplishment

## Real-time Active Pipeline Integrity Detection

- **Contractor:** Acellent Technologies, Inc., Sunnyvale, CA
- **PIER Funds:** \$622,622
- **Description:** Developed a prototype pipeline corrosion monitoring system per PG&E specifications and tested at PG&E test lab with complete remote monitoring capability and active 24X7 ongoing testing.
- **Results:** The system, in blind tests, detected accurately and consistently multiple corrosion damages induced by PG&E and showed capability for corrosion damage detection accuracy for both location and size.
- **Ratepayer Benefits:** This project will benefit ratepayers and pipeline operators by providing a cost-effective real-time pipeline monitoring system for improving pipeline safety and integrity management.



Acellent's RAPID system using piezoelectric transducers/sensors



# Recently Started Projects and Status

Name of Initiative*	Description	Status
<p><b>Natural Gas Pipeline Safety and Damage Prevention</b></p> <p><b>Group 1:</b> Technologies to Monitor and Report Encroachments on the Pipeline Right of Way</p>	<p><b>PON:</b> PON-14-503</p> <p><b>Release Date:</b> 12/12/2014  <b>Applications Due:</b> 2/2/2015 by 3:00 p.m.</p> <p><b>Notice of Proposed Award:</b> 2/24/2015</p> <p><b>R&amp;D Funds:</b> Up to \$4,600,000 (FY13/14 &amp; FY14/15)</p> <p><b>Purpose:</b>            To demonstrate natural gas pipeline right-of-way (ROW) monitoring technologies that are past the “proof-of-concept” stage in a utility setting, and to develop programs that promote knowledge regarding pipeline safety for both the public and non-industry workers.</p>	<p><b>Status</b></p> <ul style="list-style-type: none"> <li>Two Grant Agreements approved and executed effective from June 30, 2015..</li> <li><b>GAS TECHNOLOGY INSTITUTE - PIR 14-014 - \$1,049,978</b> grant to demonstrate a Pipeline Right of Way Monitoring and Notification System. Work in progress.</li> <li><b>ACELLENT TECHNOLOGIES, INC. - PIR-14-015 - \$1,633,093</b> grant to deploy and field test a Real-time Active Pipeline Integrity Detection (RAPID+) System for natural gas pipeline integrity management and ROW monitoring and notifications. Work in progress.</li> </ul>

\*Initiatives refer to the Natural Gas RD&D Program Plan and Funding Request



# Future Research

Name of Initiative*	Plan Description	Status
<p><b>Natural Gas Pipeline Safety and Integrity Assessment</b></p> <p><b>Group 1:</b> Technologies that Improve Situational Information. (FY2014/15)</p> <p><b>Group 2:</b> Technologies that Enhance Integrity Management Practices through Risk Analysis. (FY 2014/15), and</p> <p><b>Group 3:</b> Natural Gas Pipeline Safety Integrity Monitoring Technologies Assessment. (FY 2015/16)</p>	<p><b>Staff Workshop:</b> July 16, 2015, Rosenfeld Hearing Room</p> <p>Held workshop to solicit input from stakeholders on future research plan and Grant Funding Opportunity (GFO)</p>	<p>In progress.</p>

\*Initiatives refer to the Natural Gas RD&D Program Plan and Funding Request



# Contact Information

Avtar Bining, Ph.D.

Energy Systems Research Office  
Energy Research and Development Division  
California Energy Commission

[Avtar.Bining@energy.ca.gov](mailto:Avtar.Bining@energy.ca.gov)

916-327-1411