

R&D and Innovation for Gas Operations at PG&E

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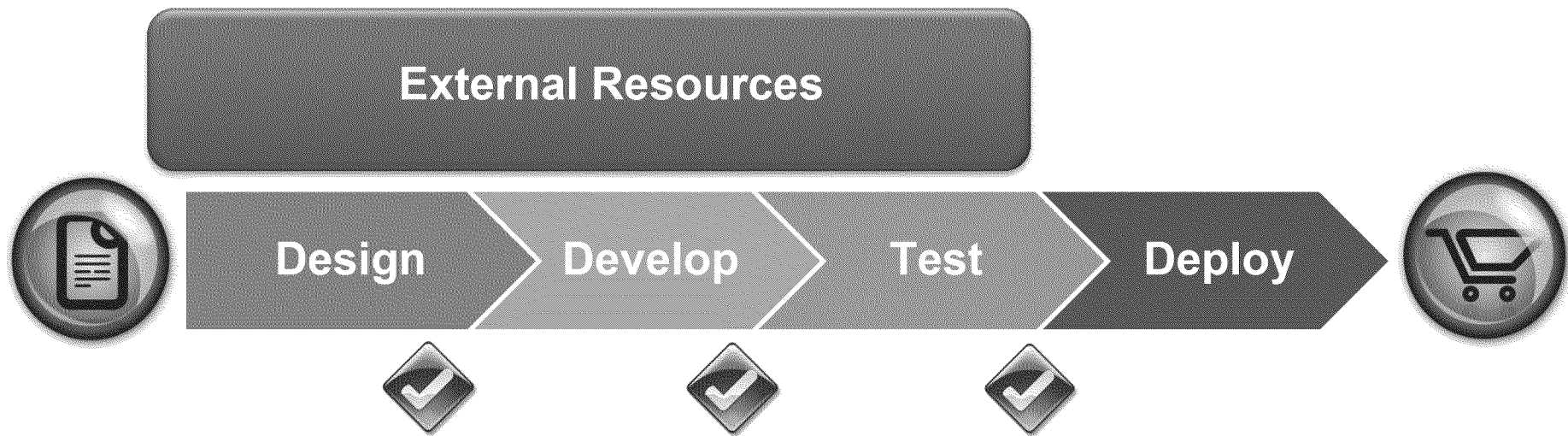
CPUC, June 4th, 2013





Mission Statement

R&D and Innovation detects, adapts, qualifies and implements innovative solutions in the Gas Operations business to improve its performance measured in public and work safety, customer satisfaction, cost effectiveness, environmental impact, regulatory compliance, and communication.



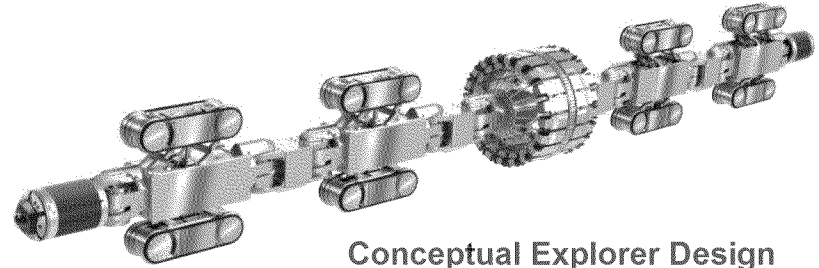


Some Examples

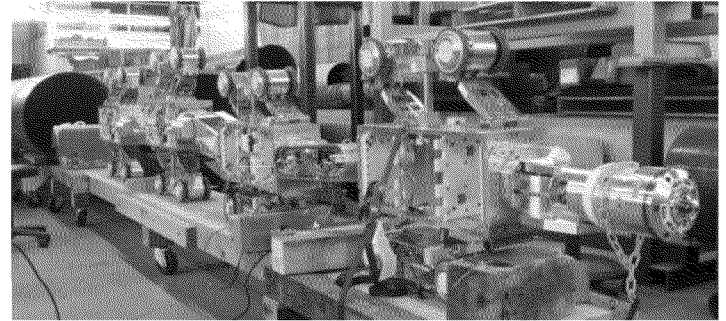


Explorer 30-36" Development and First Field Demonstration

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Conceptual Explorer Design



Manufacturing Status as of 4/25/2013

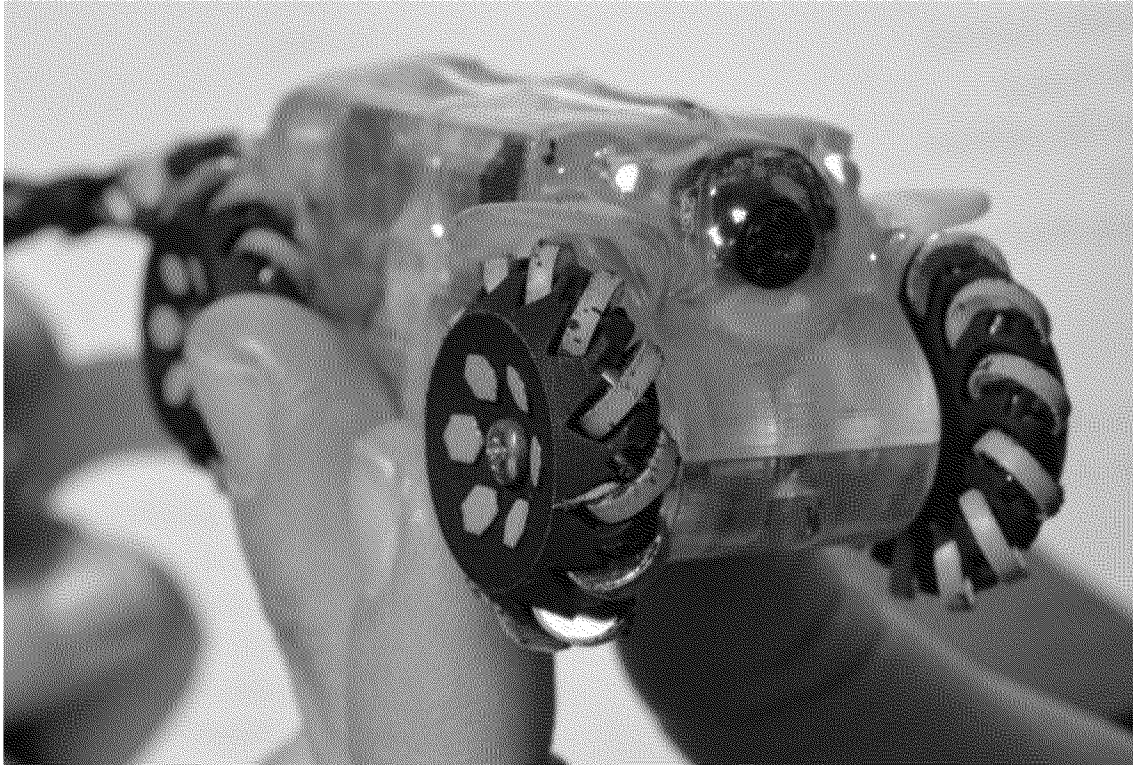
- Partnership with NYSEARCH and Invodane Engineering on developing untethered inspection robot for “un-piggable” transmission pipelines 30-36” diameter
- Currently machining magnet bars for MFL sensor, and testing module firmware integration

**Demonstration:
Line-153 at Irvington Station in Fremont**





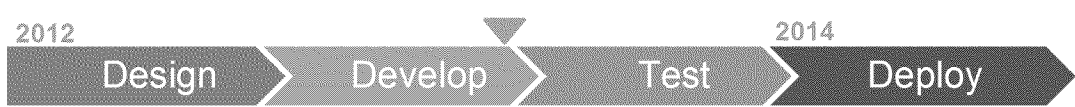
Robot for Visual Inspection of Pipe Casing through Vents



Prototype of Robot for Visual Inspection of Pipe Casing through Vents

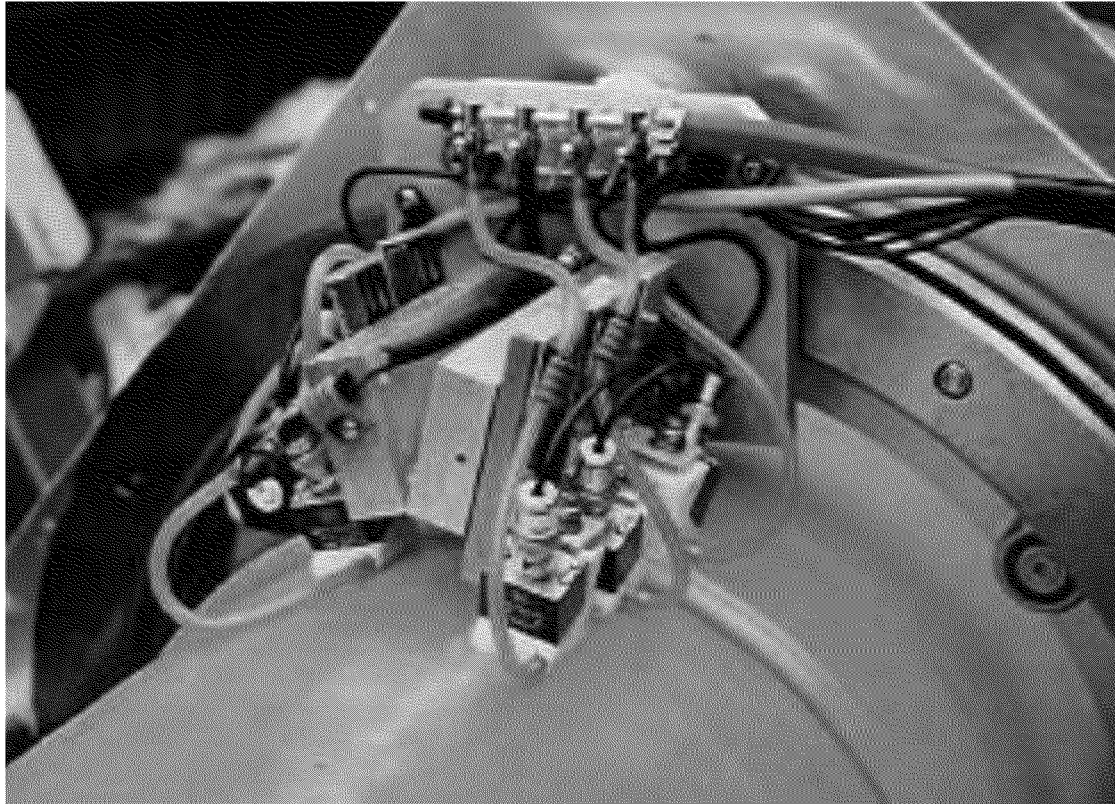
- NYSEARCH project with Honeybee Robotics initiated in 2012
- Quick visual inspection of pipe casing without digging
- Prioritization of ILI inspection and digs
- First functional prototype tested by National Grid in February 2013
- Development of a refined prototype to be tested in August 2013

We are looking for a demonstration site!





NDE for Polyethylene Butt Fusion Joints



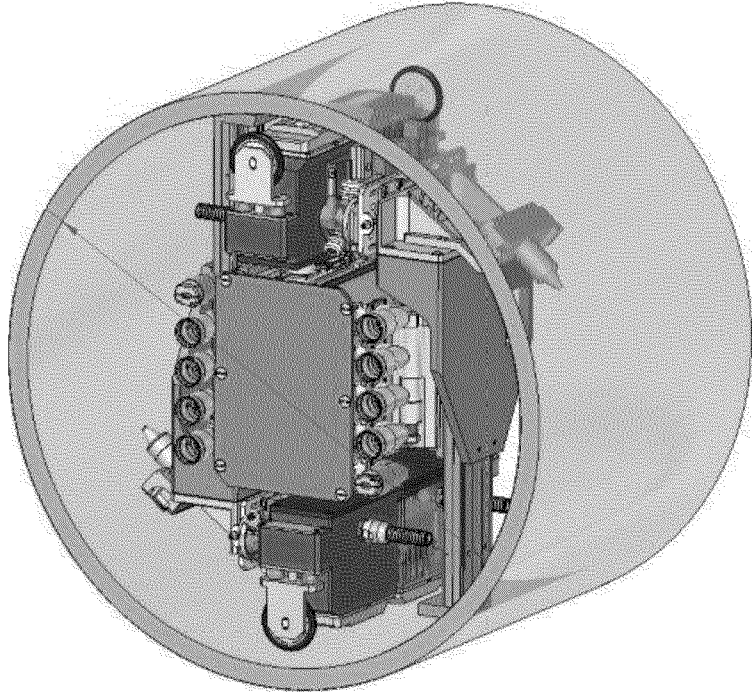
Prototype NDE system for Butt Fusion welds in PE pipes
(Ref.: TWI WINDEPP Program)

- NYSEARCH project on developing automated NDE (Phased Array UT) system for inspection of butt fusion joints of polyethylene distribution pipelines
- Current validation method is visual inspection
- Automated NDE tool increases reliability
- Will be used for Integrity Management, Training, and Quality Control
- Currently developing PAUT recognition signatures in preparation for field-ready configuration





Diakont Multiple Channel EMAT

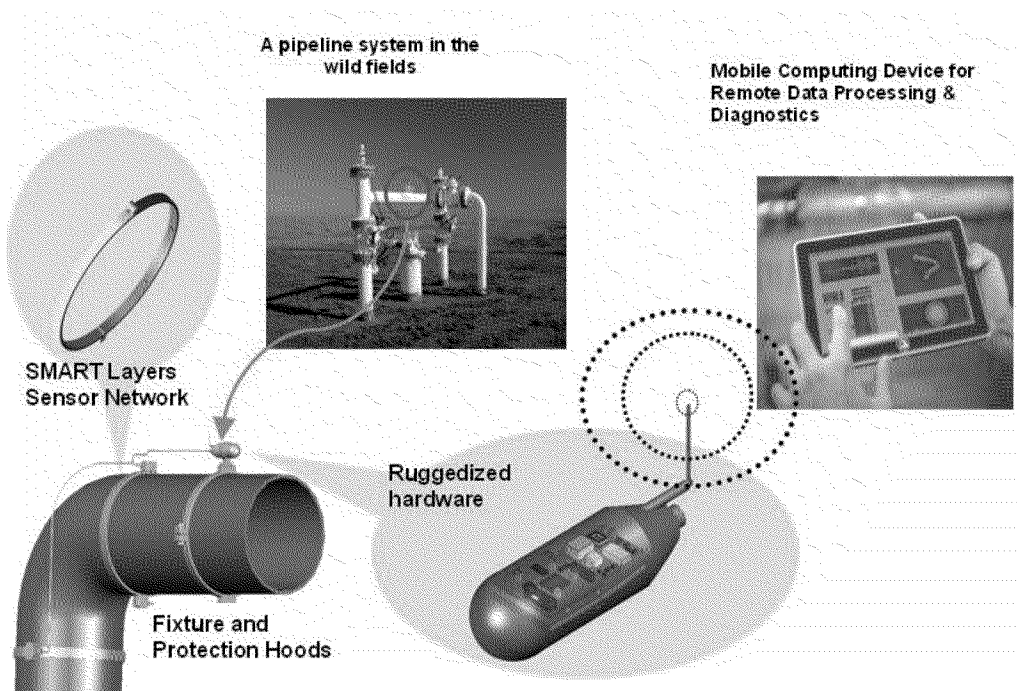


Rendering of Multi-Channel EMAT on Diakont's RODIS Crawler
(Ref: Diakont MS-EMAT Proposal)

- Demonstration of technology by developed by Diakont, funded through CEC-PIER.
- Multi-channel EMAT sensor to allow inspection, characterization, and measurement of girth welds.
- Sensor integrated onto Diakont's tethered crawler to inspect pipelines 30"-56" diameter.
 - Allows for inspection of girth welds as part of ILI inspection, compared to traditional in-the-ditch inspections using hand-held piezoelectric transducers
- Coordinating demonstration of test unit on PG&E territory in 1Q 2014
- Commercial availability in ~ 2Q 2014.



Accellent RAPID System



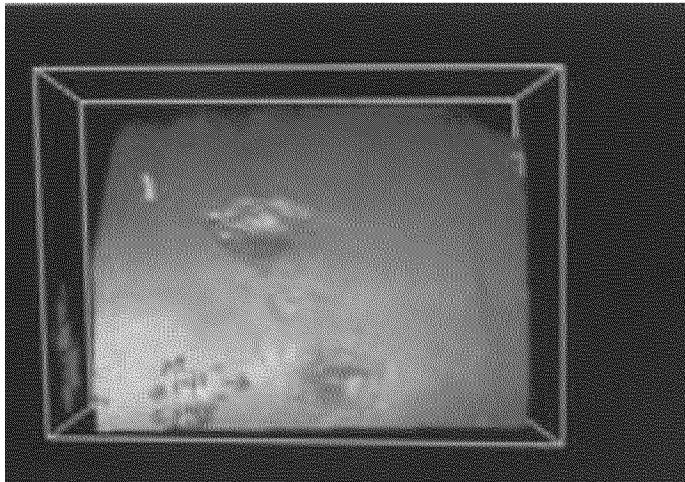
Accellent's RAPID System for In-Situ SHM
(Ref: Accellent, R. Banerjee)

- Demonstration of technology by developed by Accellent, funded through CEC-PIER.
- In-situ Structural Health Monitoring system aims to not only detect structural failure of pipelines, but to provide early indication of physical damage.
- Real-time Active Pipeline Integrity Detection (RAPID) system is a distributed sensor network integrated on above-ground pipelines.
- Piezoelectric sensors and actuators are embedded on a thin dielectric Kapton film (SMART layer)
- Remote monitoring provides diagnostic information on pipeline health
- Coordinating demonstration of test unit on PG&E territory in 1Q 2014





Stereoscopic Camera to capture 3-D Images of Features

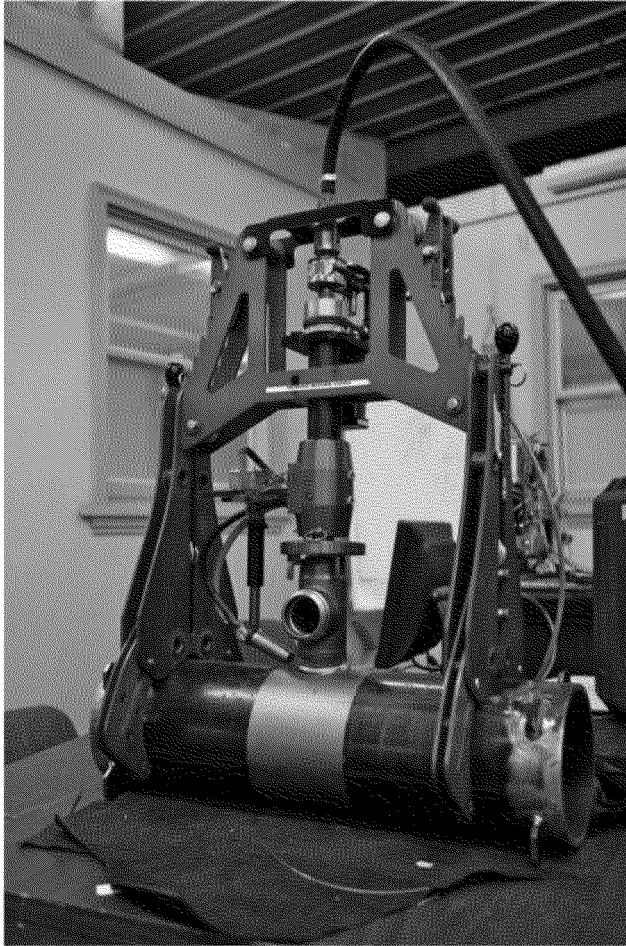


Demonstration of the Seikowave system at
ATS on April 18th, 2013

- PRCI detected the technology through the NASA Techfusion program
- Spin-off of University of Kentucky
- Projector and receiver integrated in the camera
- Projects about 600 frames on the object to measure the volume in one picture
- Automatically creates data for calculations in ASME B31G and RSTRENG
- Analysis is provided in real time with minimal skills required from the operator.
- Cost: \$15k



Automated Welder for Laterals



Prototype of Automated Welding Unit
(Ref: GTI, Dennis Jarnecke)

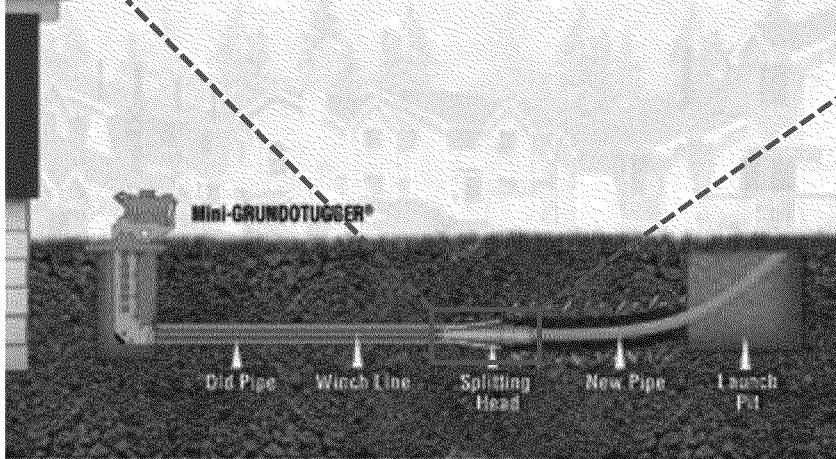
- GTI project on development of an automated welding unit for installation of service laterals
- RDI is partnering with GTI in Phase 2, which will focus on commercialization of prototype developed in Phase 1.
- Automated welding:
 - Improves weld integrity and repeatability
 - Reduces dependency on highly experienced welder, who are short in supply
 - Promotes safer operation by removing operator from the excavation during the welding operation



In Evaluation



Polyethylene Pipe Splitting Tool Development



Mini-GRUNDOTUGGER from TT Technologies

- Certain older vintages of polyethylene (PE) pipes require replacement due to brittle material behavior
- Pipe splitting technique involves splitting vintage Aldyl-A pipe and simultaneously inserting new PE pipe in existing path
- Methodology is “trenchless” and lower in cost compared to excavation
- Many pipe splitting tools are not standardized, often requiring custom builds and training
- GTI project on development of standardized PE pipe splitting toolkits and as well as guidelines and training for the industry





Light Weight Methane Detector to rapidly Locate Leaks



Prototype of Methane Detector by JPL (March 2013)

- Jet Propulsion Laboratory of Nasa in Pasadena has developed a miniaturized methane detector to be mounted on a UAV to locate methane sources on Mars
- Precision of 10 ppb with an open path of 20 cm by using 3.3 μm absorption band.
- Allows to go from Picarro methane indication to leak by tracking the plume.
- Can be mounted on a UAV for rough terrain pipeline survey. Senior project at UC MERCED.
- Proposed partnership with JPL to complete development and adaptation to our needs.





Stationary Methane Laser Sensor



Installed Remote Methane Leak Detector at PG&E
Livermore Training Center (February 2013)

- Continuously monitor pipelines and provide rapid warning of potentially explosive leaks.
- System is set up in area where leaks can be created and controlled for testing purposes.
- Testing of this system consists of
 - Demonstration of sensor efficacy
 - Evaluate sensor response to leaks in typical operating scenarios and weather conditions
 - Verify sensor freedom from sensitivity to other ambient gases
- Currently collecting data from the facility's scheduled of leak training classes and from planned leaks from the team.
- System consists of sensor, weather station, camera and computer ops station.
- Project funded by the CEC (Small Grants)

Design

Develop

Test

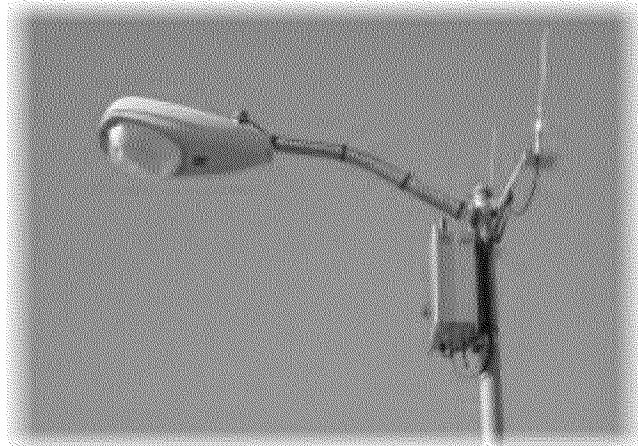
Deploy

2013

2014



Using Smart Meter Infrastructure to transport Monitoring Data



- Demonstrated that in adequate locations latency is less than few seconds
- Install Silverspring Networks modem on ERX to collect and transport local pressure and flow information towards the Control Room
- Cost effective alternative to cellular service or dedicated wireless network.

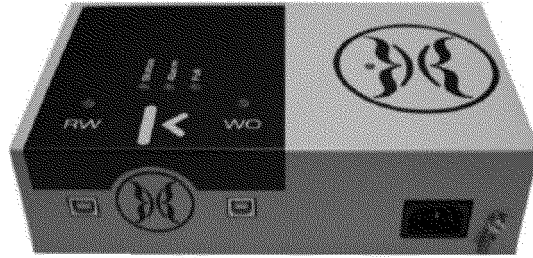


ERX Unit and Data Collector Unit

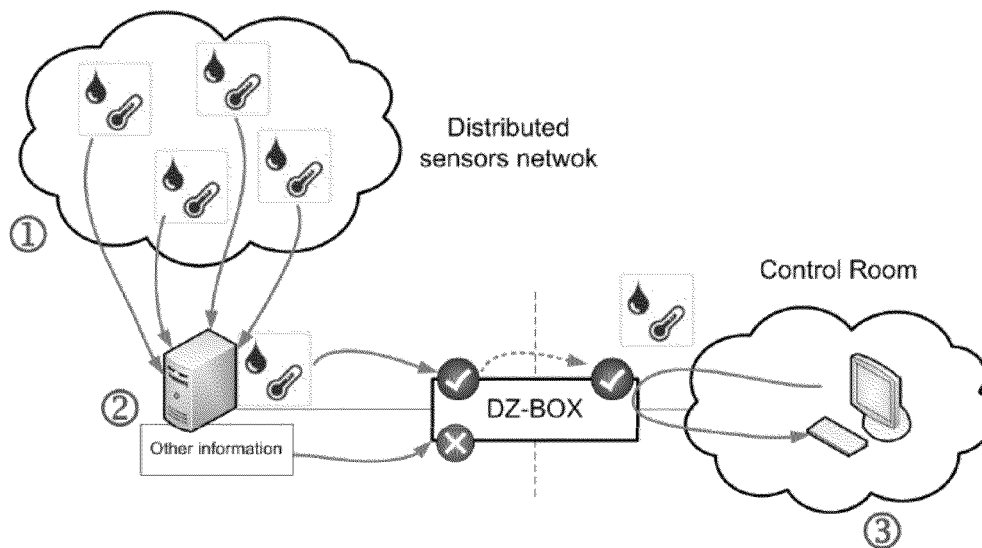




Separating our Control Room from Public Networks



- Assure physical separation of the control room from the external network
- Controls and authorizes transfer of information from the public network to the Control Room
- Hardware-based (“security in silicon”), not subject to software flaws and configuration errors.
- Does not require any administration.



ERX Unit and Data Collector Unit



In Evaluation



Portfolio

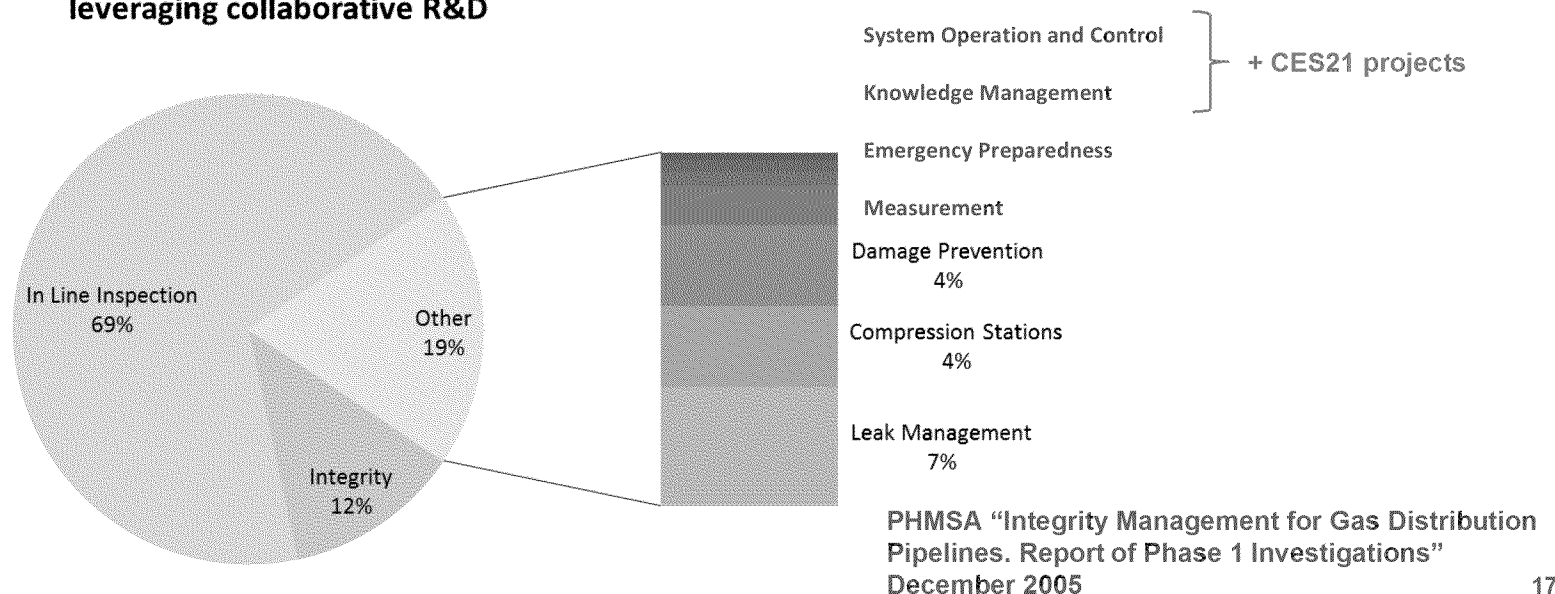


Focus on Integrity Management

■ Prevent low probability high consequence events:

- Know its infrastructure
- Identify threats, both existing and of potential future importance
- Assess and prioritize risks
- Identify and implement appropriate measures to mitigate risks
- Measure performance, monitor results, and evaluate the effectiveness of its programs, making changes where needed¹

**Current R&D and Innovation Portfolio
leveraging collaborative R&D**





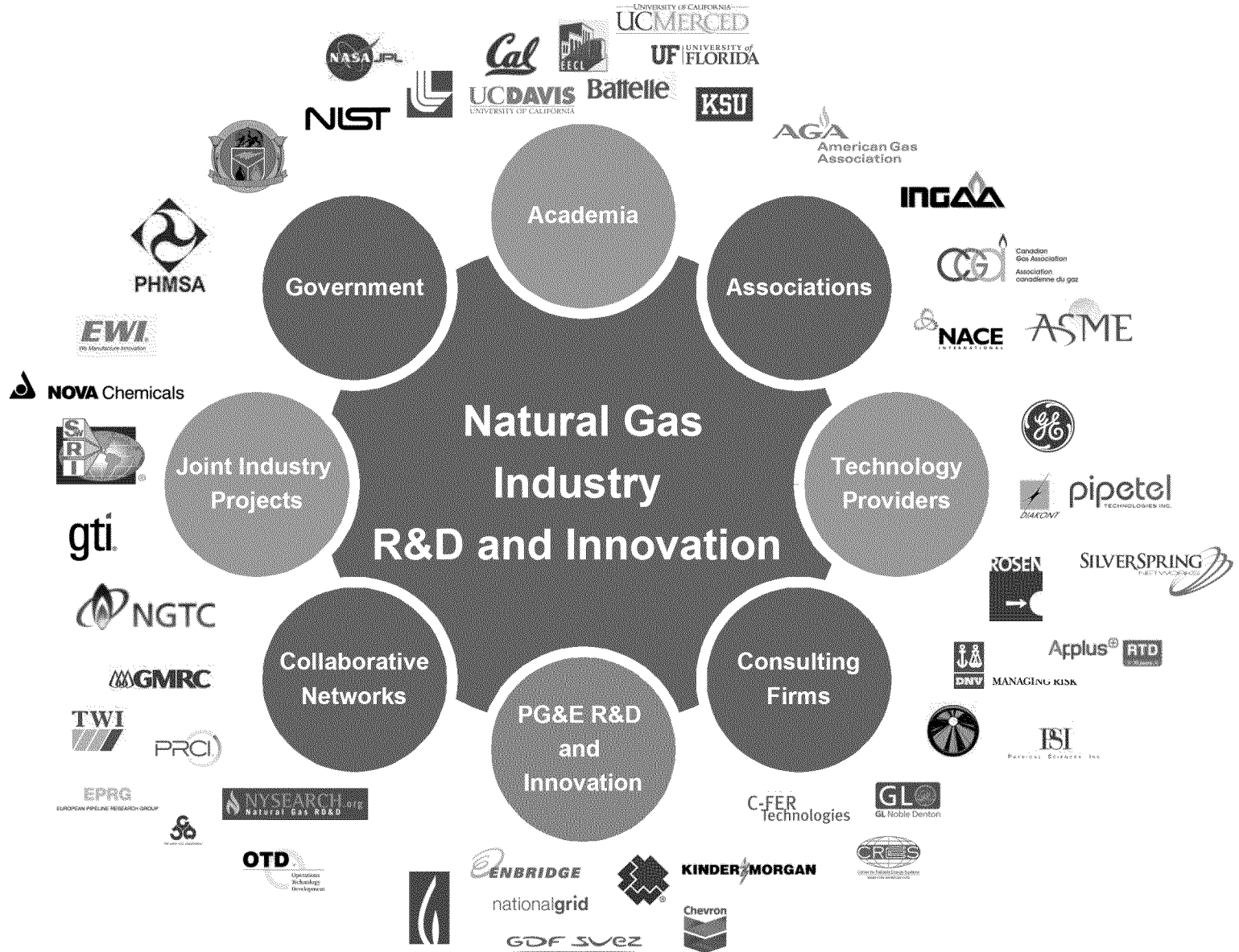
Mapping on Major Threats

17 Hazards That Impact Public Safety (CPUC - March 2012)

1. Susceptibility of older plastic pipe to premature brittle-like cracking.	0%
2. Grandfathering provisions in 49 CFR Part 192.	3%
3. Excavation damage by third-parties (dig-ins).	5%
4. Operators unaware of the location and specification of the pipe in the ground.	0%
5. Unmonitored class location change.	
6. Aging infrastructure and interacting threats.	1%
7. Infrastructure, maintenance, and parts.	3%
8. Utility resource management and workforce development	
9. Ineffective or inadequate gas leak identification and response.	3%
10. Pipe with mechanical/strength characteristics susceptible to failure.	22%
11. Lack of protection redundancy.	
12. Lines unable to accommodate in-line inspection tools, such as smart pigs.	54%
13. Utility management deficiencies.	
14. Remote-controlled and automatic shutoff valves.	0%
15. Customer-owned or operated lines.	
16. Master-metered systems not in mobilehome parks.	
17. Inadequate regulation.	
TOTAL	92%



Leveraging of a large network of Partners





Road Maps

Objectives

Needs and Gaps

R&D Projects and Technologies

Time line

<2012

2012

2013

2014

2015

>2015

Detect Construction Equipment/Activity

Eliminate False Alarms

Locate Construction Equipment

Control HDD

Locate Pipelines

Improve Communication

Satellite Observation

Aerial Surveys - Drones

Image Analysis

Optic Fiber (Cost Reduction)

Ground Acoustic Sensors

Signal Analysis

Video Surveillance

Electronic Fence

Multiple Signal Analysis

GPS Localization

Best Practices

Ground Penetrating Radar

Acoustic detectors

XYZ localization sensor

GIS location validation

Pipeline ROW markers

Smart Phone Solutions

Standardization

PRCI

PRCI

PRCI

NYSEARCH 018
Natural Gas RD&D

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PRCI

OTD
Operational Technology Development

PRCI

OTD
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NYSEARCH 018
Natural Gas RD&D

OTD
Operational Technology Development

OTD
Operational Technology Development

Prevent 3rd Party Damage

● PG&E participating

Deploy

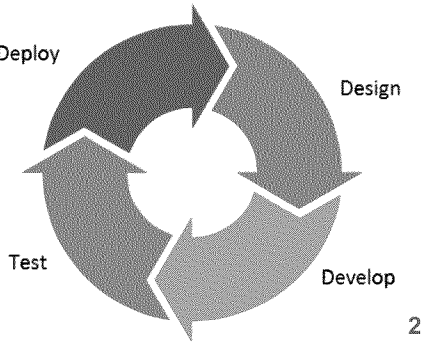
Design

Deploy

Design

Test

Develop

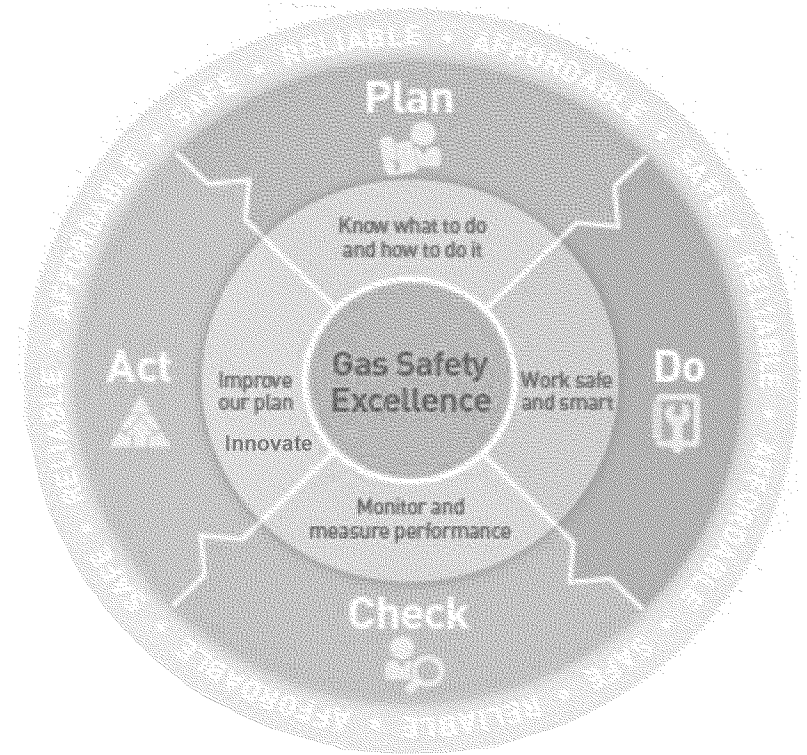




R&D and Innovation for Gas Safety Excellence

■ R&D and Innovation is part of the Continuous Improvement Framework introduced at PG&E following the principles of PAS 55.

- Sustainable best practice processes for all aspects of operations, clearly documented
- Continuously understanding and managing risks
- Requires independent evaluation to achieve accreditation, and continuous improvement and evaluation to maintain accreditation





- **53 Active Projects, 17 in Evaluation** (as April 30th, 2013), **more to come:**

Thank You!

- **Contacts:**

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