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**Ratemaking Issues Relating to Pacific Gas and  
Electric Company's Pipeline Safety  
Enhancement Plan: Attachments REDACTED**

**Prepared testimony of  
William B. Marcus**

**JBS Energy, Inc.  
311 D Street  
West Sacramento  
California, USA 95605  
916.372.0534**

**on behalf of  
The Utility Reform Network**

**California Public Utilities Commission  
Rulemaking 11-02-019**

**January 31, 2012**

## **List of Attachments**

**Attachment 1: Qualifications of William B. Marcus**

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**Attachment 4: TURN DR 13-01 Attachment 1 (general cost information on pipeline replacement)**

**CONFIDENTIAL Attachment 5: TURN DR 13-01 Attachment 13 (unit labor and material cost information on pipeline replacement).**

**Attachment 6: Information on EXPLORER and TIGRE robots for unpiggable pipelines**

**Attachment 1**

**Qualifications of William B. Marcus**

## **William B. Marcus**

Principal Economist,  
JBS Energy, Inc.

William B. Marcus has 30 years of experience in analyzing electric and gas utilities.

Mr. Marcus graduated from Harvard College with an A.B. magna cum laude in economics in 1974 and was elected to Phi Beta Kappa. In 1975, he received an M.A. in economics from the University of Toronto.

In July, 1984, Mr. Marcus became Principal Economist for JBS Energy, Inc. In this position, he is the company's lead economist for utility issues.

Mr. Marcus is the co-author of a book on electric restructuring prepared for the National Association of Regulatory Utility Commissioners. He wrote a major report on Performance Based Ratemaking for the Energy Foundation.

Mr. Marcus has prepared testimony and formal comments submitted to the Federal Energy Regulatory Commission, the National Energy Board of Canada, the Bonneville Power Administration, the U.S. Bureau of Indian Affairs, U.S. District Court in San Diego, Nevada County Municipal Court; committees of the Nevada, Ontario and California legislatures and the Los Angeles City Council; the California Energy Commission (CEC), the Sacramento Municipal Utility District (SMUD), the Transmission Agency of Northern California, the State of Nevada's Colorado River Commission, a hearing panel of the Alberta Beverage Container Management Board; two arbitration cases, environmental boards in Ontario, Manitoba, and Nova Scotia; and regulatory commissions in Alberta, Arizona, Arkansas, British Columbia, California, Colorado, Connecticut, District of Columbia, Hawaii, Manitoba, Maryland, Massachusetts, Nevada, New Jersey, New Mexico, North Carolina, Northwest Territories, Nova Scotia, Ohio, Oklahoma, Ontario, Oregon, South Carolina, Texas, Utah, Vermont, Virginia, Washington, Wisconsin, and Yukon. He testified on issues including utility restructuring, stranded costs, Performance-Based Ratemaking, resource planning, load forecasts, need for powerplants and transmission lines, environmental effects of electricity production, evaluation of conservation potential and programs, utility affiliate transactions, mergers, utility revenue requirements, avoided cost, and electric and gas cost of service and rate design.

From 1975 to 1978, Mr. Marcus was a research analyst at the Kennedy School of Government, Harvard University. He prepared public policy case studies on environmental and transportation issues, benefit-cost analysis, and urban policy and finance for use in classes and publication in the Kennedy School Case Series.

From July, 1978 through April, 1982, Mr. Marcus was an economist at the CEC, first in the energy development division and later as a senior economist in the CEC's Executive Office. He prepared testimony on purchased power pricing and economic studies of transmission projects, renewable resources, and conservation programs, and managed interventions in utility rate cases.

From April, 1982, through June, 1984, he was principal economist at California Hydro Systems, Inc., an alternative energy consulting and development company. He prepared

financial analyses of projects, negotiated utility contracts, and provided consulting services on utility economics.

Mr. Marcus is currently the Chair of the Manufactured Home Fair Practices Commission for the City of Woodland, California. This Commission regulates space rents in the City's mobile home parks. He has served on several other local government advisory committees, including a 1991-92 SMUD Rate Advisory Committee, which recommended cost allocation and rate design changes to the SMUD Board.

**Attachment 2**

**TURN DR 2-76 in PG&E TY 2011 General Rate Case (A. 09-12-020)  
on Short-Term Incentive Compensation**

**PACIFIC GAS AND ELECTRIC COMPANY  
General Rate Case 2011 Phase I  
Division of Ratepayer Advocates  
Data Response**

PG&E Data Request No.:	TURN_002-76		
PG&E File Name:	GRC2011-Ph-I_DR_TURN_002-Q76		
Request Date:	November 10, 2009	Requester DR No.:	TURN_PG&E_2
Date Sent:	November 24, 2009	Requesting Party:	TURN
PG&E Witness:	Karen Crowley/Barbara Vietor	Requester:	Hayley Goodson

**SUBJECT: COMPENSATION**

**QUESTION 76**

Regarding short-term bonuses, please identify the base year total amount expensed, the forecast test year total amount expensed, and the amount requested for recovery of short-term bonuses from ratepayers. If any costs are excluded for reasons other than allocation between regulated and unregulated affiliates, please explain.

**ANSWER 76**

The information below provides the requested response:

**Short Term Incentive Plan (STIP) <sup>[1], [2]</sup>  
Nominal (\$000)**

**Utility STIP:** Reference - workpapers supporting Exhibit (PG&E -2), WP 7-8 and 7-15

Line	Cost	FERC	2008*	2008RA	2009	2010	2011
1	Utility STIP	920	90,496	97,558	110,838	114,994	119,307
2	Capitalization	922	(24,868)	(26,809)	(30,458)	(31,600)	(29,349)
3	<b>Total Utility STIP</b>		<b>65,628</b>	<b>70,749</b>	<b>80,380</b>	<b>83,394</b>	<b>89,957</b>

**PG&E Corporation STIP** - Reference - workpapers supporting Exhibit (PG&E-2), WP 7-19

Line	Cost	FERC	2008*	2008RA	2009	2010	2011
4	PG&E Corp.	923	6,805	4,462	5,126	5,318	5,517
5	Affiliate Exclusion	923	-	(1,172)	(1,346)	(1,396)	(1,449)
6	<b>Total PG&amp;E Corp STIP</b>		<b>6,805</b>	<b>3,290</b>	<b>3,780</b>	<b>3,922</b>	<b>4,069</b>
7	<b>Total STIP</b>		<b>72,433</b>	<b>74,039</b>	<b>84,159</b>	<b>87,315</b>	<b>94,026</b>

[1] 2008 Recorded amount includes the 2008 accrued expense plus true up for prior years payout.

[2] 2008 Recorded adjusted is the amount paid in 2009 based on 2008 performance. The forecast expense similarly represents the amounts expected to be earned in that year and paid in the next calendar year.



**Attachment 3**

**U.S. Census Data Regarding Oil and Gas Pipeline Construction**



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Construction: Summary Series: General Summary: Value of Construction Work for Establishments by Location of Construction Work: 2007

2007 Economic Census

Data based on the 2007 Economic Census. For information on confidentiality protection, sampling error, nonsampling error, and definitions, see Survey Methodology [pdf]. Data in this file represent those available when this file was created; data may not be available for all NAICS industries or geographies. Data in this table may be subject to employment- and/or sales-size minimums that vary by industry. Comparability to 2002 Summary Series: General Summary Series data files [pdf]

Geographic area name	2007 North American Industry Classification System (NAICS) code	Meaning of 2007 North American Industry Classification System (NAICS) code	Meaning of Location of construction work by state code code	Year code	Value of construction work (\$1,000)	Relative standard error of estimate for value of construction work (%)
United States	237120	Oil and gas pipeline and related structures construction	Total	2007	30,457,507	3
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Alabama	2007	592,152	2
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Alaska	2007	453,714	1
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Arizona	2007	224,208	8
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Arkansas	2007	243,147	23
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in California	2007	2,249,572	3
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Colorado	2007	535,967	6
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Connecticut	2007	34,684	10
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Delaware	2007	46,828	0
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in District of Columbia	2007	20,446	0
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Florida	2007	323,549	4
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Georgia	2007	D	S

Geographic area name	2007 North American Industry Classification System (NAICS) code	Meaning of 2007 North American Industry Classification System (NAICS) code	Meaning of Location of construction work by state code	Year code	Value of construction work (\$1,000)	Relative standard error of estimate for value of construction work (%)
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Hawaii	2007	D	S
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Idaho	2007	25,377	2
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Illinois	2007	382,752	2
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Indiana	2007	267,434	4
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Iowa	2007	134,665	4
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Kansas	2007	238,070	3
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Kentucky	2007	251,762	1
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Louisiana	2007	3,325,910	9
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Maine	2007	1,102	0
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Maryland	2007	142,943	20
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Massachusetts	2007	98,226	19
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Michigan	2007	D	S
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Minnesota	2007	2,405,076	0
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Mississippi	2007	453,911	0
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Missouri	2007	323,660	2
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Montana	2007	84,580	2
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Nebraska	2007	63,644	3
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Nevada	2007	D	S

Geographic area name	2007 North American Industry Classification System (NAICS) code	Meaning of 2007 North American Industry Classification System (NAICS) code	Meaning of Location of construction work by state code	Year code	Value of construction work (\$1,000)	Relative standard error of estimate for value of construction work (%)
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in New Hampshire	2007	17,353	36
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in New Jersey	2007	264,923	2
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in New Mexico	2007	262,665	3
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in New York	2007	485,763	9
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in North Carolina	2007	156,929	2
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in North Dakota	2007	D	S
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Ohio	2007	765,096	2
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Oklahoma	2007	986,520	2
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Oregon	2007	D	S
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Pennsylvania	2007	361,422	6
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Rhode Island	2007	D	S
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in South Carolina	2007	112,627	0
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in South Dakota	2007	D	S
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Tennessee	2007	95,533	8
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Texas	2007	10,729,878	6
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Utah	2007	358,765	0
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Vermont	2007	D	S
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Virginia	2007	339,274	7

Geographic area name	2007 North American Industry Classification System (NAICS) code	Meaning of 2007 North American Industry Classification System (NAICS) code	Meaning of Location of construction work by state code	Year code	Value of construction work (\$1,000)	Relative standard error of estimate for value of construction work (%)
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Washington	2007	486,310	7
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in West Virginia	2007	210,634	1
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Wisconsin	2007	382,978	0
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Wyoming	2007	609,347	1
Arizona	237120	Oil and gas pipeline and related structures construction	Total	2007	208,297	11
Arizona	237120	Oil and gas pipeline and related structures construction	Construction work done in Arizona	2007	186,260	9
Arizona	237120	Oil and gas pipeline and related structures construction	Construction work done in California	2007	6,424	69
Arizona	237120	Oil and gas pipeline and related structures construction	Construction work done in Nevada	2007	D	S
Arizona	237120	Oil and gas pipeline and related structures construction	Construction work done in New Mexico	2007	D	S
Arizona	237120	Oil and gas pipeline and related structures construction	Construction work done in Texas	2007	D	S
Arizona	237120	Oil and gas pipeline and related structures construction	Construction work done in Utah	2007	D	S
Arkansas	237120	Oil and gas pipeline and related structures construction	Total	2007	257,123	21
Arkansas	237120	Oil and gas pipeline and related structures construction	Construction work done in Arkansas	2007	193,928	28
Arkansas	237120	Oil and gas pipeline and related structures construction	Construction work done in Kansas	2007	D	S
Arkansas	237120	Oil and gas pipeline and related structures construction	Construction work done in Louisiana	2007	D	S
Arkansas	237120	Oil and gas pipeline and related structures construction	Construction work done in Missouri	2007	D	S
Arkansas	237120	Oil and gas pipeline and related structures construction	Construction work done in Oklahoma	2007	D	S
Arkansas	237120	Oil and gas pipeline and related structures construction	Construction work done in Texas	2007	D	S



Geographic area name	2007 North American Industry Classification System (NAICS) code	Meaning of 2007 North American Industry Classification System (NAICS) code	Meaning of Location of construction work by state code	Year code	Value of construction work (\$1,000)	Relative standard error of estimate for value of construction work (%)
California	237120	Oil and gas pipeline and related structures construction	Total	2007	D	S
California	237120	Oil and gas pipeline and related structures construction	Construction work done in Arizona	2007	D	S
California	237120	Oil and gas pipeline and related structures construction	Construction work done in California	2007	1,892,091	4
California	237120	Oil and gas pipeline and related structures construction	Construction work done in Hawaii	2007	D	S
California	237120	Oil and gas pipeline and related structures construction	Construction work done in Nevada	2007	D	S
California	237120	Oil and gas pipeline and related structures construction	Construction work done in Texas	2007	D	S
California	237120	Oil and gas pipeline and related structures construction	Construction work done in Utah	2007	D	S
California	237120	Oil and gas pipeline and related structures construction	Construction work done in Washington	2007	D	S
Louisiana	237120	Oil and gas pipeline and related structures construction	Total	2007	3,978,445	23
Louisiana	237120	Oil and gas pipeline and related structures construction	Construction work done in Alabama	2007	85,591	0
Louisiana	237120	Oil and gas pipeline and related structures construction	Construction work done in Arkansas	2007	D	S
Louisiana	237120	Oil and gas pipeline and related structures construction	Construction work done in Florida	2007	D	S
Louisiana	237120	Oil and gas pipeline and related structures construction	Construction work done in Georgia	2007	D	S
Louisiana	237120	Oil and gas pipeline and related structures construction	Construction work done in Louisiana	2007	2,731,677	11
Louisiana	237120	Oil and gas pipeline and related structures construction	Construction work done in Mississippi	2007	D	S
Louisiana	237120	Oil and gas pipeline and related structures construction	Construction work done in Tennessee	2007	D	S
Louisiana	237120	Oil and gas pipeline and related structures construction	Construction work done in Texas	2007	975,310	63
Mississippi	237120	Oil and gas pipeline and related structures construction	Total	2007	D	S

Geographic area name	2007 North American Industry Classification System (NAICS) code	Meaning of 2007 North American Industry Classification System (NAICS) code	Meaning of Location of construction work by state code	Year code	Value of construction work (\$1,000)	Relative standard error of estimate for value of construction work (%)
Mississippi	237120	Oil and gas pipeline and related structures construction	Construction work done in Alabama	2007	D	S
Mississippi	237120	Oil and gas pipeline and related structures construction	Construction work done in Arkansas	2007	D	S
Mississippi	237120	Oil and gas pipeline and related structures construction	Construction work done in Florida	2007	D	S
Mississippi	237120	Oil and gas pipeline and related structures construction	Construction work done in Georgia	2007	D	S
Mississippi	237120	Oil and gas pipeline and related structures construction	Construction work done in Louisiana	2007	3,095	4
Mississippi	237120	Oil and gas pipeline and related structures construction	Construction work done in Mississippi	2007	D	S
Mississippi	237120	Oil and gas pipeline and related structures construction	Construction work done in Tennessee	2007	D	S
Mississippi	237120	Oil and gas pipeline and related structures construction	Construction work done in Texas	2007	20,067	9
Missouri	237120	Oil and gas pipeline and related structures construction	Total	2007	549,822	2
Missouri	237120	Oil and gas pipeline and related structures construction	Construction work done in Arkansas	2007	D	S
Missouri	237120	Oil and gas pipeline and related structures construction	Construction work done in California	2007	D	S
Missouri	237120	Oil and gas pipeline and related structures construction	Construction work done in Colorado	2007	D	S
Missouri	237120	Oil and gas pipeline and related structures construction	Construction work done in Illinois	2007	D	S
Missouri	237120	Oil and gas pipeline and related structures construction	Construction work done in Indiana	2007	D	S
Missouri	237120	Oil and gas pipeline and related structures construction	Construction work done in Iowa	2007	D	S
Missouri	237120	Oil and gas pipeline and related structures construction	Construction work done in Kansas	2007	D	S
Missouri	237120	Oil and gas pipeline and related structures construction	Construction work done in Kentucky	2007	D	S
Missouri	237120	Oil and gas pipeline and related structures construction	Construction work done in Mississippi	2007	D	S

Geographic area name	2007 North American Industry Classification System (NAICS) code	Meaning of 2007 North American Industry Classification System (NAICS) code	Meaning of Location of construction work by state code	Year code	Value of construction work (\$1,000)	Relative standard error of estimate for value of construction work (%)
Missouri	237120	Oil and gas pipeline and related structures construction	Construction work done in Missouri	2007	297,962	2
Missouri	237120	Oil and gas pipeline and related structures construction	Construction work done in Nebraska	2007	D	S
Missouri	237120	Oil and gas pipeline and related structures construction	Construction work done in Ohio	2007	D	S
Missouri	237120	Oil and gas pipeline and related structures construction	Construction work done in Oklahoma	2007	D	S
Missouri	237120	Oil and gas pipeline and related structures construction	Construction work done in Tennessee	2007	D	S
Missouri	237120	Oil and gas pipeline and related structures construction	Construction work done in Texas	2007	D	S
Texas	237120	Oil and gas pipeline and related structures construction	Total	2007	10,479,795	2
Texas	237120	Oil and gas pipeline and related structures construction	Construction work done in Alabama	2007	D	S
Texas	237120	Oil and gas pipeline and related structures construction	Construction work done in Arizona	2007	D	S
Texas	237120	Oil and gas pipeline and related structures construction	Construction work done in Arkansas	2007	28,768	45
Texas	237120	Oil and gas pipeline and related structures construction	Construction work done in California	2007	73,745	2
Texas	237120	Oil and gas pipeline and related structures construction	Construction work done in Colorado	2007	D	S
Texas	237120	Oil and gas pipeline and related structures construction	Construction work done in Florida	2007	24,762	0
Texas	237120	Oil and gas pipeline and related structures construction	Construction work done in Georgia	2007	4,484	0
Texas	237120	Oil and gas pipeline and related structures construction	Construction work done in Illinois	2007	D	S
Texas	237120	Oil and gas pipeline and related structures construction	Construction work done in Kansas	2007	42,730	0
Texas	237120	Oil and gas pipeline and related structures construction	Construction work done in Louisiana	2007	415,919	5
Texas	237120	Oil and gas pipeline and related structures construction	Construction work done in Mississippi	2007	126,713	0



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Texas	237120	Oil and gas pipeline and related structures construction	Construction work done in Missouri	2007	4,874	37
Texas	237120	Oil and gas pipeline and related structures construction	Construction work done in New Mexico	2007	D	S
Texas	237120	Oil and gas pipeline and related structures construction	Construction work done in Oklahoma	2007	87,448	10
Texas	237120	Oil and gas pipeline and related structures construction	Construction work done in Tennessee	2007	3,817	0
Texas	237120	Oil and gas pipeline and related structures construction	Construction work done in Texas	2007	9,345,032	2

D Withheld to avoid disclosing data for individual companies; data are included in higher level totals

S Withheld because estimate did not meet publication standards

(s) Sampling error exceeds 40 percent

#### UNIVERSE DESCRIPTION

The universe of this file is all employer establishments (establishments with payroll) in the construction of buildings or engineering projects (e.g., highways and utility systems). Also included are establishments primarily engaged in the preparation of sites for new construction and establishments primarily engaged in subdividing land for sale as building sites. This universe includes all establishments classified in the Construction sector (sector 23) in 2007.

#### DATA ITEMS

This file contains data on:

- Value of construction work (\$1,000)
- Relative standard error of value of construction work (%)

#### GEOGRAPHIC COVERAGE

Data are shown at the U.S. and state level.

#### INDUSTRY DETAIL

Data are shown at the two, three, and six-digit North American Industry Classification System (NAICS) levels.

#### OTHER VARIABLES IDENTIFYING RECORDS

Data are also identified by Location of Construction

#### RELEASE SCHEDULE

Data in this file are scheduled for release in March 2010.

#### RELATED DATA FILES

Data supercede those released in the Industry Series reports.

#### DATA LIMITATIONS

There are no special limitations to these data.

#### FILE SEQUENCE

None.

#### ESTIMATED FILE SIZE

Approximately 20 KB



EC0723SG0  
4

Construction: Summary Series: General Summary: Value of Construction Work for Establishments by Location of Construction Work: 2007

2007 Economic Census

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United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Alaska	2007	453,714	1
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Arizona	2007	224,208	8
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Arkansas	2007	243,147	23
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in California	2007	2,249,572	3
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Colorado	2007	535,967	6
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Connecticut	2007	34,684	10
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Delaware	2007	46,828	0
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United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Idaho	2007	25,377	2
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Illinois	2007	382,752	2
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Indiana	2007	267,434	4
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Iowa	2007	134,665	4
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Kansas	2007	238,070	3
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Kentucky	2007	251,762	1
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Louisiana	2007	3,325,910	9
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Maine	2007	1,102	0
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Maryland	2007	142,943	20
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Massachusetts	2007	98,226	19
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Michigan	2007	D	S
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Minnesota	2007	2,405,076	0
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Mississippi	2007	453,911	0
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Missouri	2007	323,660	2
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Montana	2007	84,580	2
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Nebraska	2007	63,644	3
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Nevada	2007	D	S

Geographic area name	2007 North American Industry Classification System (NAICS) code	Meaning of 2007 North American Industry Classification System (NAICS) code	Meaning of Location of construction work by state code	Year code	Value of construction work (\$1,000)	Relative standard error of estimate for value of construction work (%)
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in New Hampshire	2007	17,353	36
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in New Jersey	2007	264,923	2
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in New Mexico	2007	262,665	3
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in New York	2007	485,763	9
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in North Carolina	2007	156,929	2
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in North Dakota	2007	D	S
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Ohio	2007	765,096	2
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Oklahoma	2007	986,520	2
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Oregon	2007	D	S
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Pennsylvania	2007	361,422	6
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Rhode Island	2007	D	S
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in South Carolina	2007	112,627	0
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in South Dakota	2007	D	S
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Tennessee	2007	95,533	8
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Texas	2007	10,729,878	6
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Utah	2007	358,765	0
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Vermont	2007	D	S
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Virginia	2007	339,274	7



Geographic area name	2007 North American Industry Classification System (NAICS) code	Meaning of 2007 North American Industry Classification System (NAICS) code	Meaning of Location of construction work by state code	Year code	Value of construction work (\$1,000)	Relative standard error of estimate for value of construction work (%)
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Washington	2007	486,310	7
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in West Virginia	2007	210,634	1
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Wisconsin	2007	382,978	0
United States	237120	Oil and gas pipeline and related structures construction	Construction work done in Wyoming	2007	609,347	1
Arizona	237120	Oil and gas pipeline and related structures construction	Total	2007	208,297	11
Arizona	237120	Oil and gas pipeline and related structures construction	Construction work done in Arizona	2007	186,260	9
Arizona	237120	Oil and gas pipeline and related structures construction	Construction work done in California	2007	6,424	69
Arizona	237120	Oil and gas pipeline and related structures construction	Construction work done in Nevada	2007	D	S
Arizona	237120	Oil and gas pipeline and related structures construction	Construction work done in New Mexico	2007	D	S
Arizona	237120	Oil and gas pipeline and related structures construction	Construction work done in Texas	2007	D	S
Arizona	237120	Oil and gas pipeline and related structures construction	Construction work done in Utah	2007	D	S
Arkansas	237120	Oil and gas pipeline and related structures construction	Total	2007	257,123	21
Arkansas	237120	Oil and gas pipeline and related structures construction	Construction work done in Arkansas	2007	193,928	28
Arkansas	237120	Oil and gas pipeline and related structures construction	Construction work done in Kansas	2007	D	S
Arkansas	237120	Oil and gas pipeline and related structures construction	Construction work done in Louisiana	2007	D	S
Arkansas	237120	Oil and gas pipeline and related structures construction	Construction work done in Missouri	2007	D	S
Arkansas	237120	Oil and gas pipeline and related structures construction	Construction work done in Oklahoma	2007	D	S
Arkansas	237120	Oil and gas pipeline and related structures construction	Construction work done in Texas	2007	D	S

Geographic area name	2007 North American Industry Classification System (NAICS) code	Meaning of 2007 North American Industry Classification System (NAICS) code	Meaning of Location of construction work by state code	Year code	Value of construction work (\$1,000)	Relative standard error of estimate for value of construction work (%)
California	237120	Oil and gas pipeline and related structures construction	Total	2007	D	S
California	237120	Oil and gas pipeline and related structures construction	Construction work done in Arizona	2007	D	S
California	237120	Oil and gas pipeline and related structures construction	Construction work done in California	2007	1,892,091	4
California	237120	Oil and gas pipeline and related structures construction	Construction work done in Hawaii	2007	D	S
California	237120	Oil and gas pipeline and related structures construction	Construction work done in Nevada	2007	D	S
California	237120	Oil and gas pipeline and related structures construction	Construction work done in Texas	2007	D	S
California	237120	Oil and gas pipeline and related structures construction	Construction work done in Utah	2007	D	S
California	237120	Oil and gas pipeline and related structures construction	Construction work done in Washington	2007	D	S
Louisiana	237120	Oil and gas pipeline and related structures construction	Total	2007	3,978,445	23
Louisiana	237120	Oil and gas pipeline and related structures construction	Construction work done in Alabama	2007	85,591	0
Louisiana	237120	Oil and gas pipeline and related structures construction	Construction work done in Arkansas	2007	D	S
Louisiana	237120	Oil and gas pipeline and related structures construction	Construction work done in Florida	2007	D	S
Louisiana	237120	Oil and gas pipeline and related structures construction	Construction work done in Georgia	2007	D	S
Louisiana	237120	Oil and gas pipeline and related structures construction	Construction work done in Louisiana	2007	2,731,677	11
Louisiana	237120	Oil and gas pipeline and related structures construction	Construction work done in Mississippi	2007	D	S
Louisiana	237120	Oil and gas pipeline and related structures construction	Construction work done in Tennessee	2007	D	S
Louisiana	237120	Oil and gas pipeline and related structures construction	Construction work done in Texas	2007	975,310	63
Mississippi	237120	Oil and gas pipeline and related structures construction	Total	2007	D	S

Geographic area name	2007 North American Industry Classification System (NAICS) code	Meaning of 2007 North American Industry Classification System (NAICS) code	Meaning of Location of construction work by state code	Year code	Value of construction work (\$1,000)	Relative standard error of estimate for value of construction work (%)
Mississippi	237120	Oil and gas pipeline and related structures construction	Construction work done in Alabama	2007	D	S
Mississippi	237120	Oil and gas pipeline and related structures construction	Construction work done in Arkansas	2007	D	S
Mississippi	237120	Oil and gas pipeline and related structures construction	Construction work done in Florida	2007	D	S
Mississippi	237120	Oil and gas pipeline and related structures construction	Construction work done in Georgia	2007	D	S
Mississippi	237120	Oil and gas pipeline and related structures construction	Construction work done in Louisiana	2007	3,095	4
Mississippi	237120	Oil and gas pipeline and related structures construction	Construction work done in Mississippi	2007	D	S
Mississippi	237120	Oil and gas pipeline and related structures construction	Construction work done in Tennessee	2007	D	S
Mississippi	237120	Oil and gas pipeline and related structures construction	Construction work done in Texas	2007	20,067	9
Missouri	237120	Oil and gas pipeline and related structures construction	Total	2007	549,822	2
Missouri	237120	Oil and gas pipeline and related structures construction	Construction work done in Arkansas	2007	D	S
Missouri	237120	Oil and gas pipeline and related structures construction	Construction work done in California	2007	D	S
Missouri	237120	Oil and gas pipeline and related structures construction	Construction work done in Colorado	2007	D	S
Missouri	237120	Oil and gas pipeline and related structures construction	Construction work done in Illinois	2007	D	S
Missouri	237120	Oil and gas pipeline and related structures construction	Construction work done in Indiana	2007	D	S
Missouri	237120	Oil and gas pipeline and related structures construction	Construction work done in Iowa	2007	D	S
Missouri	237120	Oil and gas pipeline and related structures construction	Construction work done in Kansas	2007	D	S
Missouri	237120	Oil and gas pipeline and related structures construction	Construction work done in Kentucky	2007	D	S
Missouri	237120	Oil and gas pipeline and related structures construction	Construction work done in Mississippi	2007	D	S

Geographic area name	2007 North American Industry Classification System (NAICS) code	Meaning of 2007 North American Industry Classification System (NAICS) code	Meaning of Location of construction work by state code	Year code	Value of construction work (\$1,000)	Relative standard error of estimate for value of construction work (%)
Missouri	237120	Oil and gas pipeline and related structures construction	Construction work done in Missouri	2007	297,962	2
Missouri	237120	Oil and gas pipeline and related structures construction	Construction work done in Nebraska	2007	D	S
Missouri	237120	Oil and gas pipeline and related structures construction	Construction work done in Ohio	2007	D	S
Missouri	237120	Oil and gas pipeline and related structures construction	Construction work done in Oklahoma	2007	D	S
Missouri	237120	Oil and gas pipeline and related structures construction	Construction work done in Tennessee	2007	D	S
Missouri	237120	Oil and gas pipeline and related structures construction	Construction work done in Texas	2007	D	S
Texas	237120	Oil and gas pipeline and related structures construction	Total	2007	10,479,795	2
Texas	237120	Oil and gas pipeline and related structures construction	Construction work done in Alabama	2007	D	S
Texas	237120	Oil and gas pipeline and related structures construction	Construction work done in Arizona	2007	D	S
Texas	237120	Oil and gas pipeline and related structures construction	Construction work done in Arkansas	2007	28,768	45
Texas	237120	Oil and gas pipeline and related structures construction	Construction work done in California	2007	73,745	2
Texas	237120	Oil and gas pipeline and related structures construction	Construction work done in Colorado	2007	D	S
Texas	237120	Oil and gas pipeline and related structures construction	Construction work done in Florida	2007	24,762	0
Texas	237120	Oil and gas pipeline and related structures construction	Construction work done in Georgia	2007	4,484	0
Texas	237120	Oil and gas pipeline and related structures construction	Construction work done in Illinois	2007	D	S
Texas	237120	Oil and gas pipeline and related structures construction	Construction work done in Kansas	2007	42,730	0
Texas	237120	Oil and gas pipeline and related structures construction	Construction work done in Louisiana	2007	415,919	5
Texas	237120	Oil and gas pipeline and related structures construction	Construction work done in Mississippi	2007	126,713	0



Geographic area name	2007 North American Industry Classification System (NAICS) code	Meaning of 2007 North American Industry Classification System (NAICS) code	Meaning of Location of construction work by state code	Year code	Value of construction work (\$1,000)	Relative standard error of estimate for value of construction work (%)
Texas	237120	Oil and gas pipeline and related structures construction	Construction work done in Missouri	2007	4,874	37
Texas	237120	Oil and gas pipeline and related structures construction	Construction work done in New Mexico	2007	D	S
Texas	237120	Oil and gas pipeline and related structures construction	Construction work done in Oklahoma	2007	87,448	10
Texas	237120	Oil and gas pipeline and related structures construction	Construction work done in Tennessee	2007	3,817	0
Texas	237120	Oil and gas pipeline and related structures construction	Construction work done in Texas	2007	9,345,032	2

D Withheld to avoid disclosing data for individual companies; data are included in higher level totals

S Withheld because estimate did not meet publication standards

(s) Sampling error exceeds 40 percent

#### UNIVERSE DESCRIPTION

The universe of this file is all employer establishments (establishments with payroll) in the construction of buildings or engineering projects (e.g., highways and utility systems). Also included are establishments primarily engaged in the preparation of sites for new construction and establishments primarily engaged in subdividing land for sale as building sites. This universe includes all establishments classified in the Construction sector (sector 23) in 2007.

#### DATA ITEMS

This file contains data on:

- Value of construction work (\$1,000)
- Relative standard error of value of construction work (%)

#### GEOGRAPHIC COVERAGE

Data are shown at the U.S. and state level.

#### INDUSTRY DETAIL

Data are shown at the two, three, and six-digit North American Industry Classification System (NAICS) levels.

#### OTHER VARIABLES IDENTIFYING RECORDS

Data are also identified by Location of Construction

#### RELEASE SCHEDULE

Data in this file are scheduled for release in March 2010.

#### RELATED DATA FILES

Data supercede those released in the Industry Series reports.

#### DATA LIMITATIONS

There are no special limitations to these data.

#### FILE SEQUENCE


None.

#### ESTIMATED FILE SIZE

Approximately 20 KB

**Attachment 4**

**TURN DR 13-01 Attachment 1 (general cost information on pipeline replacement)**

 <b>GULF INTERSTATE ENGINEERING</b>	<b>PG&amp;E's Pipeline Modernization Implementation Plan</b>	<b>Highly-Congested 12" &amp; Under Pipeline Model</b>
		<b>Total Amount</b>
<b>Highly-Congested 12" &amp; Under Pipeline Model</b>		
<b>DIRECT COSTS</b>		
<b>1.0 Total Material &amp; Equipment</b>		<b>\$ 845,542</b>
<b>2.0 Total Construction</b>		<b>\$ 1,910,168</b>
<b>3.0 Total Commissioning</b>		<b>\$ 27,557</b>
<b>4.0 Duties, Freight, &amp; Taxes</b>		<b>\$ 175,548</b>
<b>SUBTOTAL DIRECT COSTS</b>		<b>\$ 2,959,000</b>
<b>INDIRECT COSTS</b>		
<b>5.0 Engineering, Design, and Survey</b>		<b>\$ 88,770</b>
<b>6.0 Land and Right of Way Acquisition</b>		<b>\$ 527,540</b>
<b>7.0 Regulatory Permits</b>		<b>\$ 88,770</b>
<b>8.0 Construction Management &amp; QA/QC</b>		<b>\$ 147,950</b>
<b>9.0 Owners Overheads</b>		<b>\$ 356,695</b>
<b>SUBTOTAL INDIRECT COSTS</b>		<b>\$ 1,210,000</b>
<b>SUBTOTAL DIRECT &amp; INDIRECT COSTS</b>		<b>\$ 4,169,000</b>
<b>10.0 Contingency (TBD)</b>		<b>\$ -</b>
<b>PIPELINE TOTAL</b>		<b>\$ 4,169,000</b>
<b>\$/ft</b>		<b>\$ 790</b>

Description	Takeoff Quantity	Unit	Cost/Unit	Extended Cost/Unit	Subcontract	Total Amount	Notes
<b>Highly-Congested 12" &amp; Under Pipeline Model</b>							
<b>DIRECT COSTS</b>							
<b>1.0 Materials &amp; Equipment</b>							
<b>1.1 Materials - Line Pipe</b>							
10.750" O.D. X .250" W.T., APL 5L X52, ERW Pipe, FBE Coated, 14- 18 mils	5,280	lf	\$ 25	\$ 132,000	\$ -	\$ 132,000	Client Provided
<b>1.1 Subtotal Materials - Line Pipe</b>				<b>\$ 132,000</b>	<b>\$ -</b>	<b>\$ 132,000</b>	
<b>1.2 Materials - Pipeline ROW</b>							
Aerial Markers - 2 per mile	2	ea	\$ 97	\$ 194	\$ -	\$ 194	Material Cost based on Recent Vendor Inquiry
Mile Post Markers -2 per mile	2	ea	\$ 12	\$ 24	\$ -	\$ 24	Material Cost based on Recent Vendor Inquiry
Line Markers -8 per mile	8	ea	\$ 23	\$ 184	\$ -	\$ 184	Material Cost based on Recent Vendor Inquiry
Filter Fence & Silt Barriers	5,280	lf	\$ -	\$ -	\$ 29,040	\$ 29,040	GIE Historical Database
Ditchline Breakers	6	ea	\$ 1,317	\$ 7,320	\$ -	\$ 7,320	GIE Historical Database
Hay/Straw Bales for Erosion	500	ea	\$ 10	\$ 5,000	\$ -	\$ 5,000	GIE Historical Database
<b>1.2 Subtotal Materials - Pipeline ROW</b>				<b>\$ 12,722</b>	<b>\$ 29,040</b>	<b>\$ 41,762</b>	
<b>1.3 Materials - MLV</b>							
N/A	0	ea	\$ -	\$ -	\$ -	\$ -	
<b>1.3 Subtotal Materials - MLV</b>				<b>\$ -</b>	<b>\$ -</b>	<b>\$ -</b>	
<b>1.4 Materials - Tie-ins</b>							
10" Weld Caps, Y70 (Testing)	10	ea	\$ 500	\$ 5,000	\$ -	\$ 5,000	GIE Historical Database
Miscellaneous material small valves, gaskets and fittings	1	ls	\$ 25,000	\$ 25,000	\$ -	\$ 25,000	GIE Historical Database
<b>1.4 Subtotal Materials - Tie-ins</b>				<b>\$ 30,000</b>	<b>\$ -</b>	<b>\$ 30,000</b>	
<b>1.5 Materials - Crossings</b>							
10" O.D. X .500" W.T., APL 5L X52, ERW Pipe, 3-part Coated, 14- 18 mils, ARO Coating (ROAD BORES)	0	lf	\$ -	\$ -	\$ -	\$ -	- Added on a project by project basis
10" O.D. X .500" W.T., APL 5L X52, ERW Pipe, 3-part Coated, 14- 18 mils, ARO Coating (HDD < 1000')	0	lf	\$ -	\$ -	\$ -	\$ -	- Added on a project by project basis
10" O.D. X .500" W.T., APL 5L X52, ERW Pipe, 3-part Coated, 14- 18 mils, ARO Coating (HDD > 3000')	0	lf	\$ -	\$ -	\$ -	\$ -	- Added on a project by project basis
<b>1.5 Subtotal Materials - Crossings</b>				<b>\$ -</b>	<b>\$ -</b>	<b>\$ -</b>	
<b>1.6 Cathodic Protection</b>							
Allowance for Cathodic Protection Repair	5,280	ft	\$ 1.00	\$ 5,280	\$ -	\$ 5,280	Allowance
<b>1.6 Subtotal Cathodic Protection</b>				<b>\$ 5,280</b>	<b>\$ -</b>	<b>\$ 5,280</b>	
<b>1.7 Paving and Asphalt Replacement</b>							
Concrete Paving and Asphalt Replacement (6" x 12')	4,750	lf	\$ 132	\$ 627,000	\$ -	\$ 627,000	Client Provided
Concrete Paving and Asphalt Saw Cuts	4,750	lf	\$ 2	\$ 9,500	\$ -	\$ 9,500	Client Provided
<b>1.7 Subtotal Paving and Asphalt Replacement</b>				<b>\$ 636,500</b>	<b>\$ -</b>	<b>\$ 636,500</b>	

Description	Takeoff Quantity	Unit	Cost/Unit	Extended Cost/Unit	Subcontract	Total Amount	Notes
<b>Highly-Congested 12" &amp; Under Pipeline Model</b>							
<b>1.0 SUBTOTAL MATERIAL &amp; EQUIPMENT</b>				<b>\$ 816,502</b>	<b>\$ 29,040</b>	<b>\$ 845,542</b>	
<b>2.0 Construction</b>							
<b>2.1 Construction - Line Pipe</b>							
Prime Pipeline Contractor	5,280	lf	\$ 318	\$ 1,676,400	\$ -	\$ 1,676,400	Based on Construction Crew Sheets
Mill Inspect 10" Pipe	5,280	lf	\$ 0.75	\$ 3,971	\$ -	\$ 3,971	GIE Historical Database
Pipeline Pigging & Inspection Costs / L.F.	5,280	lf	\$ -	\$ -	\$ -	\$ -	
<b>2.1 Subtotal Construction - Line Pipe</b>				<b>\$ 1,680,371</b>	<b>\$ -</b>	<b>\$ 1,680,371</b>	
<b>2.2 Construction - MLV</b>							
Adder for MLV Replacements - Assume 8 mile spacing	5,280	lf	\$ 7	\$ 36,960	\$ -	\$ 36,960	Based on TIC for 10" MLV = \$300k
<b>2.2 Subtotal Construction - MLV</b>				<b>\$ 36,960</b>	<b>\$ -</b>	<b>\$ 36,960</b>	
<b>2.3 Labor - Pipeline Tie-ins</b>							
10" Weld Caps, Y70 (Testing)	10	ea	\$ 394	\$ 3,938	\$ -	\$ 3,938	GIE Historical Database
Miscellaneous Labor small valves, gaskets and fittings	1	ls	\$ 75,000	\$ 75,000	\$ -	\$ 75,000	GIE Historical Database
<b>2.3 Subtotal Labor - Pipeline Tie-ins</b>				<b>\$ 78,938</b>	<b>\$ -</b>	<b>\$ 78,938</b>	
<b>2.4 Construction - Crossings</b>							
10" O.D. X .500" W.T., APL 5L X52, ERW Pipe, 3-part Coated, 14- 18 mils, ARO Coating (ROAD BORES)	0	lf	\$ -	\$ -	\$ -	\$ -	- Added on a project by project basis
10" O.D. X .500" W.T., APL 5L X52, ERW Pipe, 3-part Coated, 14- 18 mils, ARO Coating (HDD < 1000')	0	lf	\$ -	\$ -	\$ -	\$ -	- Added on a project by project basis
10" O.D. X .500" W.T., APL 5L X52, ERW Pipe, 3-part Coated, 14- 18 mils, ARO Coating (HDD > 3000')	0	lf	\$ -	\$ -	\$ -	\$ -	- Added on a project by project basis
	0	ls	\$ -	\$ -	\$ -	\$ -	
<b>2.4 Subtotal Construction - Crossings</b>				<b>\$ -</b>	<b>\$ -</b>	<b>\$ -</b>	
<b>2.5 Pipeline Storage &amp; Offload Yards</b>							
Pipe Storage Yard Allowance	1	ls	25,000		\$ 25,000	\$ 25,000	GIE Historical Database
<b>2.5 Subtotal Pipeline Storage &amp; Offload Yards</b>				<b>\$ -</b>	<b>\$ 25,000</b>	<b>\$ 25,000</b>	
<b>2.6 Construction - Hydrotesting</b>							
10" Pipeline Hydrotesting	5,280	lf	\$ -	\$ -	\$ -	\$ -	- Costs Included in 2.1 Above
10" Pipeline Hydrotesting / Recycle Disposal Costs / Gallons / Mile	70,700	gal	\$ 1.0	\$ 70,700	\$ -	\$ 70,700	GIE Historical Database
<b>2.6 Subtotal Construction - Hydrotesting</b>				<b>\$ 70,700</b>	<b>\$ -</b>	<b>\$ 70,700</b>	
<b>2.7 Non-Destruction Testing (NDT) &amp; Non-Destructive Examinations (NDE)</b>							
NDT & NDE	14	day	\$ 1,300	\$ -	\$ 18,200	\$ 18,200	Client Provided, 8/hr/dy/ pipeline mile
<b>2.7 Subtotal NDT &amp; NDE</b>				<b>\$ -</b>	<b>\$ 18,200</b>	<b>\$ 18,200</b>	

Description	Takeoff Quantity	Unit	Cost/Unit	Extended Cost/Unit	Subcontract	Total Amount	Notes
<b>Highly-Congested 12" &amp; Under Pipeline Model</b>							
<b>2.8 Construction Contractor - Mob / Demob</b>							
Prime Contractor Mobilization (Included Separately)	1	ls	\$ -	\$ -	\$ -	\$ -	Added on a project by project basis
<b>2.8 Subtotal Construction Contractor - Mob / Demob</b>				\$ -	\$ -	\$ -	
<b>2.0 SUBTOTAL CONSTRUCTION</b>				\$ 1,866,968	\$ 43,200	\$ 1,910,168	
<b>3.0 Commissioning</b>							
<b>3.1 Commissioning</b>							
1% of Labor & Material	1	%		\$ 27,557		\$ 27,557	GIE Historical Database
<b>3.0 SUBTOTAL COMMISSIONING</b>				\$ 27,557	\$ -	\$ 27,557	
<b>4.0 Duties, Freight, &amp; Taxes</b>							
<b>4.1 Customs Duties, Freight &amp; Taxes</b>							
Customs/Import Duties EXCLUDED		0 %		\$ -		\$ -	
Materials Tax (9.5% of Materials)		9.5 %		\$ 77,568		\$ 77,568	
Freight (12% of Materials)		12 %		\$ 97,980		\$ 97,980	GIE Historical Database
<b>4.0 SUBTOTAL DUTIES, FREIGHT, TAXES</b>				\$ 175,548	\$ -	\$ 175,548	
<b>SUBTOTAL DIRECT COSTS</b>				\$ 2,887,000	\$ 72,000	\$ 2,959,000	
<b>INDIRECT COSTS</b>							
<b>5.0 Engineering, Design, &amp; Survey</b>							
<b>5.1 Engineering, Design, &amp; Survey</b>							
Engineering, Design, & Survey	3.0	%		\$ -	\$ 88,770	\$ 88,770	GIE Historical Database
<b>5.0 SUBTOTAL ENGINEERING, DESIGN, &amp; SURVEY</b>				\$ -	\$ 88,770	\$ 88,770	
<b>6.0 Land and Right of Way</b>							
<b>6.1 Land Acquisition &amp; Damages</b>							
ROW Services, Construction Easements & Environmental Mitigation	6.0	%	\$ -	\$ -	\$ 177,540	\$ 177,540	Client Provided
Land Damages Allowance	1	mile	\$ 350,000	\$ 350,000		\$ 350,000	Allowance for damages
<b>6.0 SUBTOTAL LAND AND RIGHT OF WAY ACQUISITION</b>				\$ 350,000	\$ 177,540	\$ 527,540	
<b>7.0 Regulatory Permits</b>							
<b>7.1 Regulatory Permits</b>							
Regulatory Permitting	3.0	%			\$ 88,770	\$ 88,770	
<b>7.0 SUBTOTAL REGULATORY PERMITS</b>				\$ -	\$ 88,770	\$ 88,770	

Description	Takeoff Quantity	Unit	Cost/Unit	Extended Cost/Unit	Subcontract	Total Amount	Notes
<b>Highly-Congested 12" &amp; Under Pipeline Model</b>							
<b>8.0 Construction Management &amp; QA/QC</b>							
<b>8.1 Construction Management &amp; QA/QC</b>							
Construction Management & QA/QC	5.0	%			\$ 147,950	\$ 147,950	
<b>8.0 SUBTOTAL CONSTRUCTION MANAGEMENT</b>				<b>\$ -</b>	<b>\$ 147,950</b>	<b>\$ 147,950</b>	
<b>9.0 Owners Overheads</b>							
<b>9.1 Owners Overheads</b>							
P G & E Labor ( 10% Engineering & Construction Mgmt.)	10	%			\$ 23,672	\$ 23,672	Provided By Client
P G & E Material Burden ( 5% of Material Costs)	5	%			\$ 42,277	\$ 42,277	Provided By Client
AFUDC Costs (7.58% of Total)	7.58	%			\$ 290,746	\$ 290,746	Provided By Client
<b>9.0 SUBTOTAL OWNERS OVERHEADS</b>				<b>\$ -</b>	<b>\$ 356,695</b>	<b>\$ 356,695</b>	
<b>SUBTOTAL INDIRECT COSTS</b>				<b>\$ 350,000</b>	<b>\$ 860,000</b>	<b>\$ 1,210,000</b>	
<b>SUBTOTAL DIRECT &amp; INDIRECT COSTS</b>				<b>\$ 3,237,000</b>	<b>\$ 932,000</b>	<b>\$ 4,169,000</b>	
<b>10.0 Contingency</b>							
<b>10.1 Contingency</b>							
Contingency (TBD)	0	%	\$ -	\$ -	\$ -	\$ -	
<b>10.0 SUBTOTAL CONTINGENCY</b>				<b>\$ -</b>	<b>\$ -</b>	<b>\$ -</b>	
<b>PIPELINE TOTAL</b>				<b>\$ 3,237,000</b>	<b>\$ 932,000</b>	<b>\$ 4,169,000</b>	

**CONFIDENTIAL Attachment 5**

**TURN DR 13-01 Attachment 13 (unit labor and material cost information on pipeline replacement).**

**(NOT INCLUDED WITH PUBLIC TESTIMONY)**



**Attachment 6**

**Information on EXPLORER and TIGRE robots for unpiggable pipelines**

# Update on Commercialization and Advanced Devt of Explorer/TIGRE Robotic Platforms

September 2011

Daphne D'Zurko

Executive Director, NYSEARCH

Vice President, RD & D, NGA

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**NYSEARCH**

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# Robotic Platforms Underwent 500 hours of Laboratory Testing

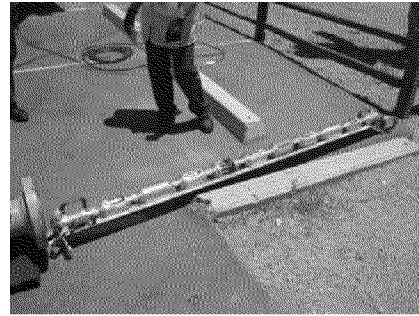
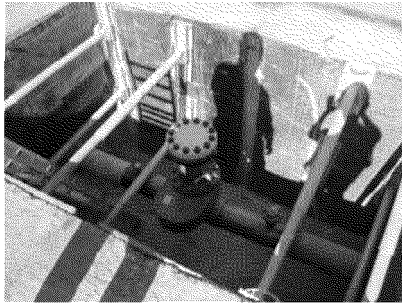


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# NYSEARCH Robotics Program

## Overall Status

- Explorer-II: 6" – 8" system commercially available via Pipetel Technologies Inc.



- TIGRE: 20" – 26" system in late stages of development
- EXP/III – 10 – 14" – accelerated and now near commercial (late '11)
- EXP/TIGRE 16" – 18" and 28"- 36" being carried forward separately

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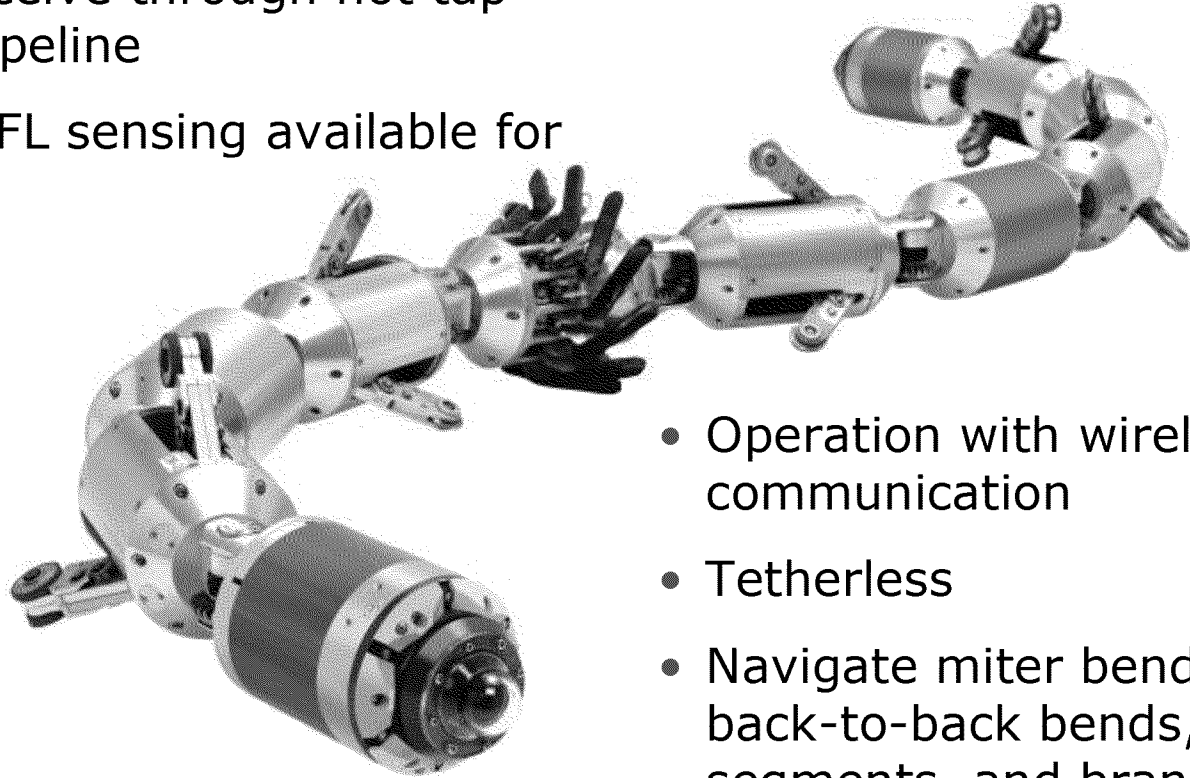
# Explorer 6/8 Live Demonstrations

- NFG – September 2009, Brookville, Pa. 8” line, 145 psi
- SWGas – June 2010, Phoenix AZ, 8” line, 170 psi, 0.25” w.t.
- NGrid – October 2010, Oneida, NY, 6” line, 470 psi, 0.188” w.t.

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# Commercial Explorer PipeTel Technologies Inc.

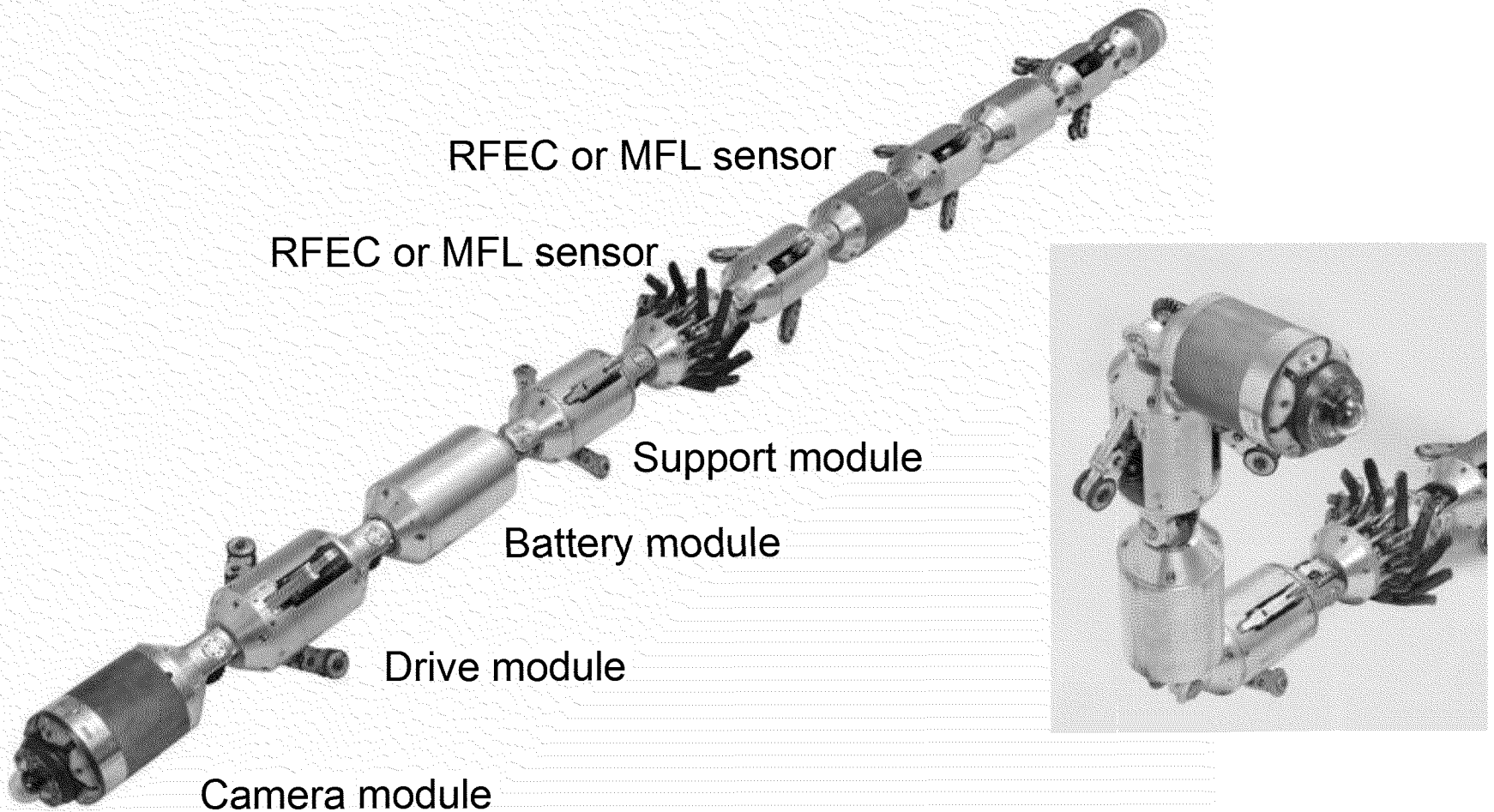
- Natural gas pipelines
- Launch/receive through hot tap into live pipeline
- RFEC or MFL sensing available for metal loss



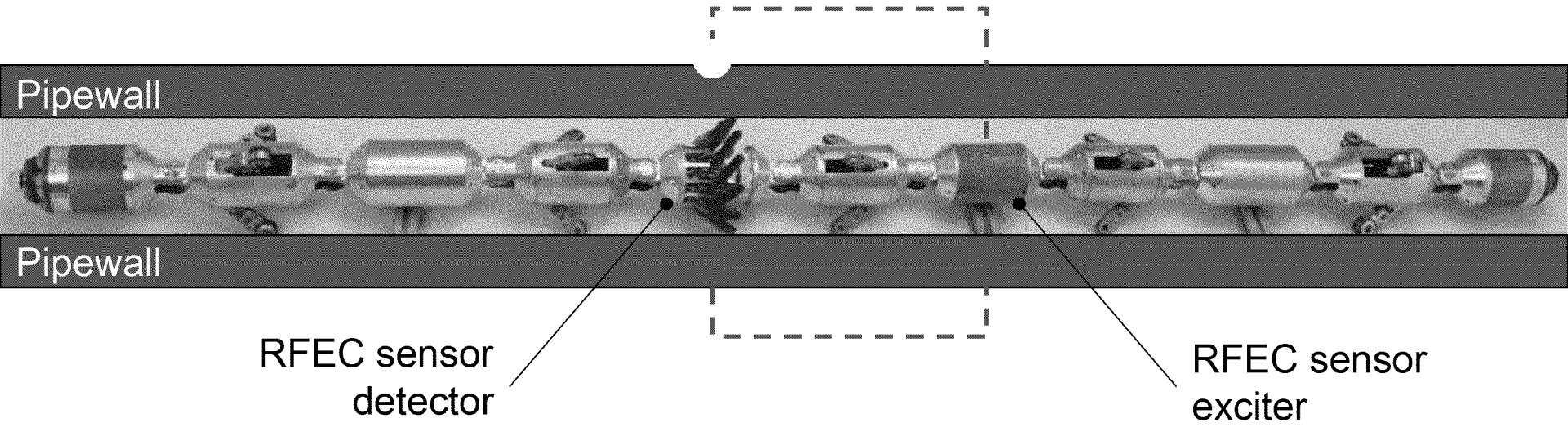
- Operation with wireless communication
- Tetherless
- Navigate miter bends, valves, back-to-back bends, vertical segments, and branch connections

# General Configuration of Explorer

RFEC – Remote Field Eddy Current



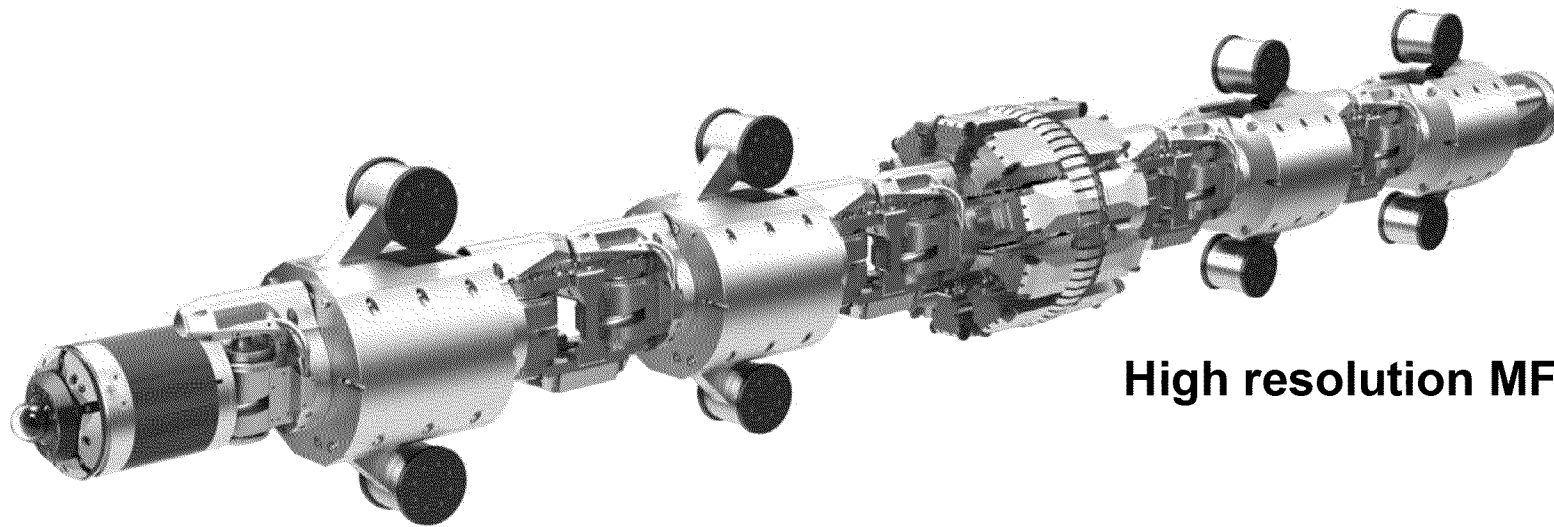
# Sensing – RFEC For 6/8 Sizes



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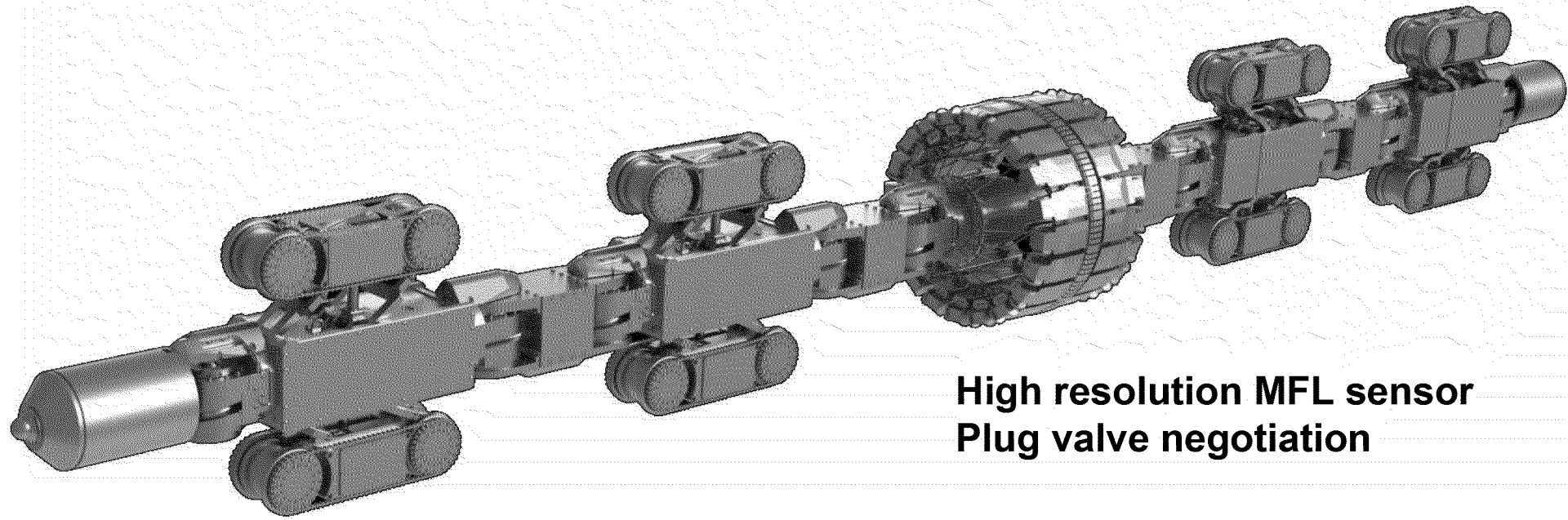
# ***EXPLORER 10/14***



**High resolution MFL sensor**

# ***EXPLORER 20/26***

AKA Tigre



**High resolution MFL sensor  
Plug valve negotiation**

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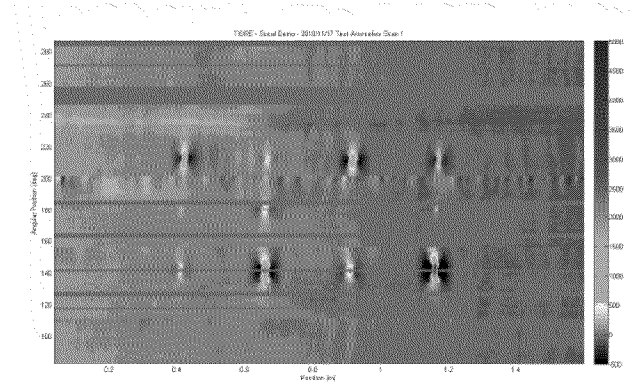
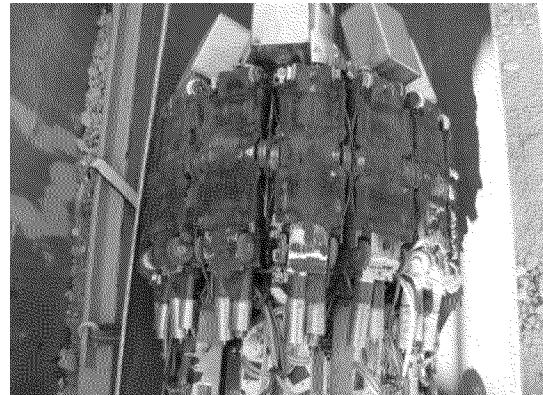
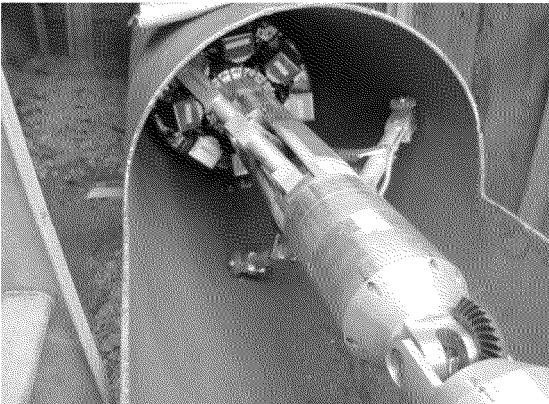
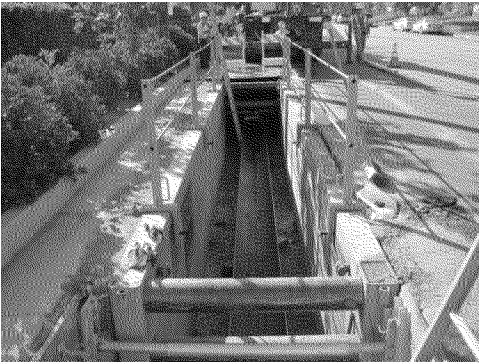
# Unpiggable Inspection Deliverables

- ILI Report
  - Pipe tally with weld location
  - List of features and anomalies found
  - Locations of features (o'clock position & distance)
  - Metal loss histograms
  - Dig sheets
  - QC check lists
  - Videos

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# Intermediate TIGRE Testing

- Tested successfully at SoCal Gas in 11/10
  - New MFL sensor performed as expected



NYSEARCH/NGA

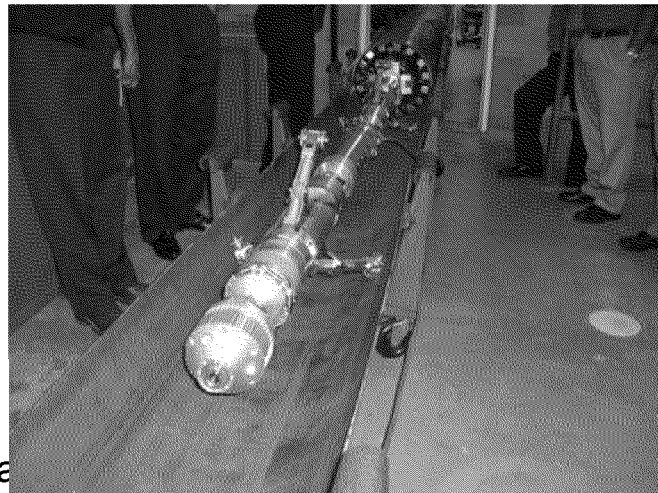
# Advanced Testing of EXP 20/26 (aka TIGRE)

- NYSEARCH Test Bed – 10/11 – 950' of un-pressurized 20" line; numerous defects at known locations; back-to-back 90s, turns etc
- Enbridge Live Test – 24" line – 500 psi; 11/11
- SoCal Gas- 1<sup>st</sup> Qtr 2012
- Con Ed/ NGrid – 1<sup>st</sup>/2<sup>nd</sup> Qtrs 2012

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# EXP20/26 & Greater Commercialization Plan

- Pipetel Technologies to carry out pre-commercial field deployments in 2011 and early 2012
- Commercially available in 2012; 20" – 26"; 16", 28" – 36" deployment acceleration pending



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# Ongoing NYSEARCH/Invodane/PipeTel Projects

- Adding Functionality to Robotics Platform
  - Cleaning debris (ahead of launch tube) and ahead of device while in pipe
  - Mechanical Damage, dents, ovality
  - In-line charging for unlimited range
  - Rescue Tool
  - Crack/Weld Detection
  - High Resolution Camera as alternative to ID ‘San Bruno’ defect (weld problem)

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NYSEARCH

## TIGRE™: A Robotic Platform and MFL Sensor for the Inspection of Unpiggable Pipelines

Description: Sophisticated, self-propelled robotic inspection platform and innovative sensor system for live NDE inspection of 20” to 26” diameter pipes up to 750 psi.

Status: Testing of prototype system ongoing.

### BENEFITS

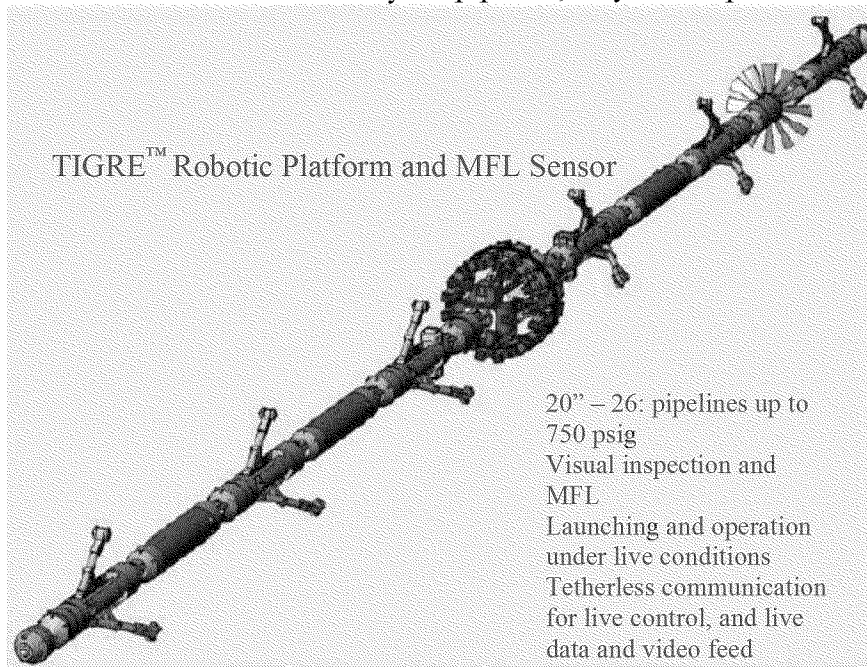
The TIGRE™ program supports the development of a modular, self-propelled robot for the inspection of unpiggable natural gas transmission and distribution pipelines under live conditions.

The robot uses a collapsible MFL sensor that is designed, as the platform, to negotiate all obstacles encountered in such pipelines, including mitered bends, plug valves, and inclined and vertical segments. Unlike other inspection pigs and robots TIGRE™ is not encumbered by

an umbilical cord (tether), due to the use of on-board batteries and wireless communications. As a result, the robot offers a significant potential improvement over existing inspection systems.

The TIGRE™ technology will allow the non-destructive evaluation (NDE) of pipelines currently inspectable only through direct assessment or hydrotesting. While these technologies provide useful information on the condition of a pipeline, they do not provide the

detailed assessment and wealth of information that an MFL sensor can and can be cost-prohibitive. With the 2002 OPS/DoT rule mandating the inspection of all pipelines (piggable and unpiggable) in high consequence areas, TIGRE™ is expected to become an indispensable tool towards meeting these mandates at great savings over alternatives. These savings, for a 100-mile gas transmission system, are expected to amount to more than \$500,000 per year.



TIGRE™ Robotic Platform and MFL Sensor

20” – 26: pipelines up to 750 psig  
Visual inspection and MFL  
Launching and operation under live conditions  
Tetherless communication for live control, and live data and video feed

### BACKGROUND

The TIGRE™ program builds on NYSEARCH’s earlier Explorer™ effort - an articulated, self-propelled, bi-directional, tether-free robot designed to permit in-situ visual inspection of live six and eight-inch gas distribution mains.

The goal of the TIGRE™ program is to develop and test a robotic platform and MFL sensor able to inspect unpiggable transmission and distribution pipelines in the twenty to twenty six inch pipe diameter range.



The requirement that such a system would be able to negotiate all obstacles, including plug valves, resulted in a set of very challenging engineering problems. An early program of evaluating various technological options resulted in the adoption of technologies for wireless communication, onboard battery recharge, locomotive systems, and MFL sensing that meet these specifications.

**TECHNICAL APPROACH**  
NYSEARCH, the research, development, and demonstration organization within the Northeast Gas Association, with co-funding from the Office of Pipeline Safety of the US Department of Transportation and the Operation Technology Development (OTD) Corporation retained Automatika Inc. and InvoDane Engineering Ltd. to develop a long-range, untethered inspection robot system, TIGRE™, using a state-of-the-art Magnetic Flux Leakage (MFL) sensor, for the inspection of transmission and distribution pipelines under live conditions. TIGRE™ has been developed as a live launch and recovery inspection robot that uses widely spaced and minimally sized access holes to launch and operate the robot.

A total of fifteen modules provide the necessary locomotion, power and sensing capabilities to operate the robot. Six locomotor modules provide the necessary driving power to withstand the high aerodynamic and magnetic forces to be encountered as the robot propels itself through high pressure and flow pipelines, and negotiates plug valves. Four battery

modules provide for the necessary power to propel the robot over long distances for efficient and economical deployments. A turbine-based, battery recharge system allows for the extraction of energy from the flow itself to recharge the batteries in-situ, thus further extending the operational range of the robot. A collapsible MFL sensor module provides state-of-the-art defect sizing while able to negotiate through plug valves, mitered bends and back-to-back bends. A magnet shunting mechanism allows the sensor to negotiate obstacles without the danger of getting attached to such elements, thus requiring high levels of force and power to detach itself. Antennas located in the two end modules provide for wireless communication between robot and operator. The available bandwidth allows for the live control of the robot while at the same time transmitting live images from the robot's cameras as well as data from the MFL sensor. The ability to visualize raw data is a unique capability of this technology and allows more accurate and defensible pipeline integrity decisions.

#### PROGRAM STATUS

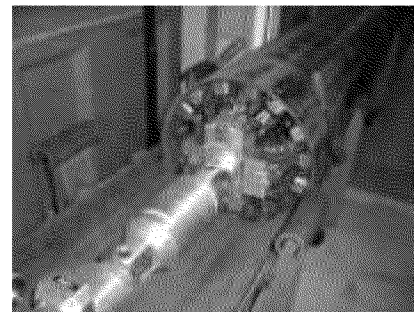
The prototype platform and sensor systems were constructed and tested individually throughout 2006. They were then integrated and extensively tested in the laboratory through 2007. In these tests the system has proven its ability to carry out an inspection of a transmission pipeline and negotiate mitered and short radius bends, back-to-back bends and plug valves. The MFL sensor has shown reliable operation and consistent sizing

of defects at a level of accuracy consistent with that of present day state-of-the-art smart pigs.

The program is now entering the phase of field demonstrations, prior to moving into a live demonstration later this year.

Commercialization of the technology is expected in 2009.

#### FOR ADDITIONAL INFORMATION



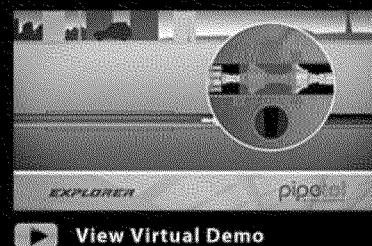
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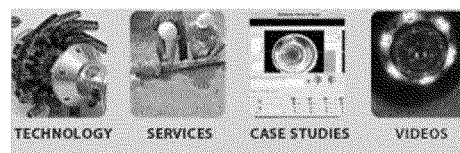
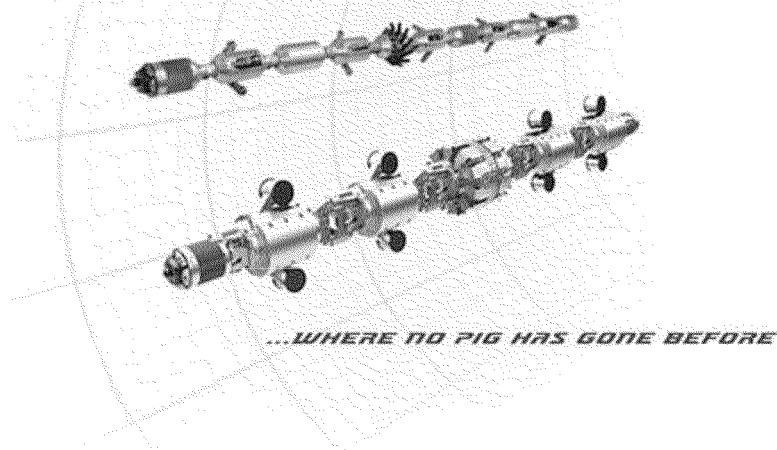


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Unpiggable pipeline asset evaluation has never been more comprehensive with Pipetel's Explorer Series of untethered, remotely controlled, self-powered inspection robots.

## EXPLORER SERIES- 6/8 - 10/14



### Developed for Pipeline Operators by Pipeline Operators

Pipetel Technologies offers a unique service using proprietary robots that deliver data inspecting unpiggable gas pipelines.

These robots were initially developed under the leadership of The Northeast Gas Association and NYSEARCH. In a strategic partnership with NYSEARCH and InvoDane, Pipetel Technologies have commercialized these robots providing a much needed service for gas transmission and distribution operators.

This service provides full deployment and inspection of unpiggable pipelines using an untethered, modular, remotely controllable, self-powered robot for the visual and non-destructive inspection of natural gas transmission and distribution pipelines.

Committed to improving safety and reliability, Pipetel protects your assets by providing data from technology developed for pipeline operators by pipeline operators.

#### Latest News:

Pipetel's Explorer Robotic Inspection Tool Used to Inspect SoCalGas Pipelines...  
([read more](#))



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### Introduction

As carbon steel pipelines age and corrode, leakage of pipelines is a threat that requires active integrity management to maintain their safe operation. Explorer's proprietary technology allows natural gas utilities and distribution companies to implement a proactive pipeline integrity management and maintenance program. This technology allows critical data to be acquired from pipelines so that repairs can be performed at scheduled times, rather than on an emergency basis, thus avoiding the high repair cost of leaking pipelines.

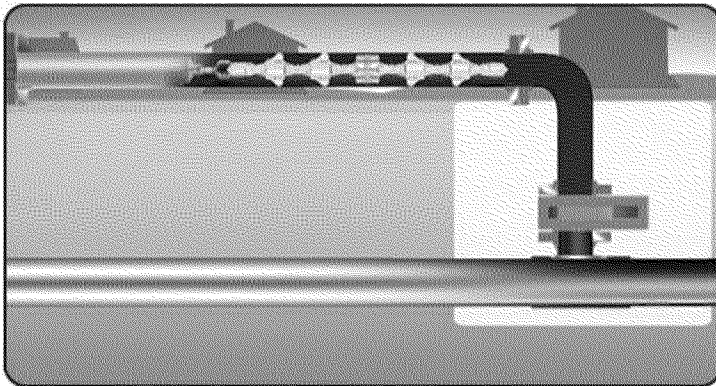
### Applications

Explorer technology has been developed for the inspection of 6 to 36 inch diameter natural gas pipelines that are unpiggable by conventional inline inspection tools. The versatility of Explorer makes it the ideal inline inspection tool for natural gas pipelines with: limited or no flow, short radius or mitered bends, valves, back-to-back bends, and pipelines without pre-built standard to launch and receive equipment for ILI tools. Cased pipelines, and pipelines located at difficult to access locations such as underneath a highway, are also candidates.

### How It Works

Pipetel Technologies provides full inspection of unpiggable pipelines using Explorer – an untethered, modular, remotely controllable, self-powered robot for the visual and non-destructive inspection of natural gas transmission and distribution pipelines.

The illustration below demonstrates how Explorer inspects a pipeline using industry standard fittings and valves which can be done with a 45 degree or 90 degree launch.



> [View details in Pipetel's Videos - click here](#)

The pipeline operator would weld a 45 degree or 90 degree hot tap fitting to the pipeline at a strategic location that maximizes the inspection distance. In some cases, only one hot tap is sufficient but there may be cases where installation of additional hot taps are necessary. The Explorer launch tube is then secured onto an industry standard sandwich valve on top of the hot tap fitting.

The operator of Explorer launches it into the pipeline, inspects the pipeline, and retrieves the robot either through the same hot tap or the second hot tap if one is installed. During the inspection, live video images of the pipeline and integrity data are streamed to the operator of Explorer and the pipeline operator. These functions are performed without the need of a tether and without any interruption to local natural gas services.

Upon retrieving Explorer, the operator downloads the video and integrity data for

Pipetel Technologies has an Operator Qualification Program (OQ) that complies with The Department of Transportation's Operator Qualification Registration 49 CFR 192 Subpart N

Committed to highest standard of service and quality, Pipetel Technologies is implementing other industry standards and quality assurance programs.

Check this section for updates.

analysis. The launch system is removed and the hot tap is left in place for future inspection.

#### Deliverables

Video imagery and integrity data acquired by the Explorer robot is analyzed by Pipetel's experienced team of analysts using our proprietary analysis software. A preliminary report followed by a final report that details the findings and integrity condition of the pipeline form the deliverables. The reporting structure is customized to comply with the specific reporting requirement of the Pipeline Operator.

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**August 2011**

### **Pipetel's Explorer Robotic Inspection Tool Used to Inspect SoCalGas Pipelines**

Pipetel Technologies has inspected 2.5 miles of pipeline operated by Southern California Gas Company (SoCalGas) using a self-propelled robot in place of conventional internal inspection tools sometimes referred to as "smart pigs." The stretch of pipeline had been deemed "unpiggable," due to lack of flow needed to push the inspection tool through the pipeline.

As part of SoCalGas' pipeline integrity management program, Pipetel was contracted to inspect a previously unpiggable pipeline and to provide the inspection results using their customized Datatel analysis software.

Pipetel inspected an eight-inch diameter pipeline with Pipetel's Explorer 6/8 robotic inspection technology without shutting down the pipeline or disrupting service to customers. The Explorer 6/8 is a self-propelled and bi-directional robot. Conventional tools were not an option since the pipeline did not have sufficient flow to propel these tools. A cased segment of this pipeline, underneath a railway track, was also inspected.

Pipetel's Explorer robotic inspection technology was developed under the funding and leadership of NYSEARCH / The Northeast Gas Association with critical financial support from other partners including the Department of Transportation, Pipeline and Hazardous Materials Safety Administration (PHMSA) and Operations Technology Development (OTD) NFP.

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June 2011

**Pipetel announces the Explorer 10/14 as an addition to its growing line of Unpiggable Robots**

Pipetel Technologies Inc. is pleased to introduce the Explorer 10/14, a new unpiggable robot that will inspect 10, 12 and 14 inch natural gas pipelines.

"The industry response to the original Explorer 6/8 has been so positive that the development of the 10/14 has been accelerated to expand our range of inspection robots. In fact we are so enthusiastic that we have moved up the Explorer 20/26 development and we are now working on a Caliper and Dent robot," commented Rod Lee, General Manager of Pipetel Technologies Inc.

The Explorer 10/14 works on the same principle as the 6/8, as an untethered, modular, remotely controllable, self-powered robot for the visual and non-destructive testing of natural gas pipelines.

The Explorer 10/14 offers visual and state-of- the art MFL sensors options with the number of sensors ranging from 120, 144 or 168.

The minimum diameter is 7.5 inches with a maximum pressure of 750 psig that will inspect a pipe wall thickness to 0.45 inches. The unpiggable specifications include vertical segments, mitered bends and tees. For complete application specifications go to [www.pipetelone.com/technology](http://www.pipetelone.com/technology).

Video imagery and integrity data acquired by the Explorer 10/14 robot is analyzed by Pipetel's experienced team of analysts, using exclusive proprietary software. The preliminary and final report details the findings and integrity condition of the pipeline from the deliverables. The reporting structure is customized to comply with the specific reporting requirements of the Pipeline Operator.

As the gas industry sees a greater focus on safety, Pipetel will be there with a range of proprietary robots that will assist pipeline operators in improving safety and reliability by protecting pipeline assets.

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December 2010

### Proven Robotic Pipe Inspection for Unpiggable Pipelines Now Available

Northeast Gas Association/NYSEARCH and InvoDane Engineering Commercialize Robotic Platform and State-of-the-Art Sensors for Inspection of Pipelines through PipeTel Technologies Inc.

Parsippany, NJ and Toronto, ON – December 3, 2010 – The RD & D arm of the Northeast Gas Association known as NYSEARCH (NGA/NYSEARCH) and InvoDane Engineering Ltd. announce the commercialization of a new technology that will help owners inspect unpiggable pipelines. The first PipeTel platform is being released under license from NGA/NYSEARCH to InvoDane Engineering. Starting December 1, PipeTel Technologies Inc. will offer inspection services for small to medium pipe sizes using this platform. PipeTel plans to offer in 2011 and beyond additional robotic platforms arising from this RD & D program that will allow for the inspection of larger diameter pipelines.

Using minimal excavation and under live conditions, this robotic technology can help operators address some pipelines that are unpiggable due to difficult obstructions such as bends, plug valves, vertical sections and other constraints, as well as pipelines with pressure levels below what is needed to propel traditional smart pig technologies. Further, the robotic platform travels long distances from one excavation and does not require a tether for power or communication. Accuracy of the integrated sensor is equivalent to current sensing provided with traditional in-line inspection tools.

Starting with basic research in the early 2000s, members of NYSEARCH, which includes natural gas companies from around North America, identified and then addressed the need for inspection of unpiggable pipelines. Following years of development and laboratory testing with experts in sensing and robotics, NGA/NYSEARCH transferred the state-of-the-art robotic platform and sensing technologies to InvoDane Engineering which has conducted several live field tests with gas companies prior to this commercialization.

"I have seen great strides made in the development of this and other NYSEARCH robotic technologies, not only providing live internal inspection for unpiggable pipelines but also complementing technologies that allow gas companies to be proactive and effective in operating, maintaining, and rehabilitating our gas mains," states Mark Andraka, Sr. Engineer at PECO Energy and current chairman of the NYSEARCH committee.

NYSEARCH has joined with several collaborators throughout this long-term RD & D program. The U.S. Department of Transportation's Pipeline Hazardous Materials Safety Administration (PHMSA) has been and is currently a major funder and supporter of the program. Other current and past collaborators include Operations Technology Development NFP, Department of Energy/NETL and the Pipeline Research Council International (PRCI). Technology providers to the evolution of this program have included SouthWest Research Institute, Carnegie Mellon University, Automatika Inc (dba QinetiQ N.A.), and InvoDane Engineering.

The gas industry's focus on enhancing safety measures was paramount in the effort to develop this technology. Members of NYSEARCH/NGA who supported this work include Central Hudson Gas and Electric, Consolidated Edison, Keyspan Energy Delivery (dba National Grid), National Fuel Gas, New York State Electric and Gas, Niagara Mohawk Power Corp (dba National Grid), Orange and Rockland Utilities, Pacific Gas and Electric Company, PECO Energy, Public Service Electric & Gas, Questar Gas, Rochester Gas & Electric, and The Southern California Gas Company.

**ABOUT NORTHEAST GAS ASSOCIATION**

NGA represents the natural gas industry in the Northeast U.S., which comprises 10 million customers in eight Northeast states. NGA provides education, training, regulatory and operational services to its member companies who transport and distribute natural gas to homes and businesses throughout the Northeast region. NYSEARCH is a sub-organization within NGA, with a separate membership of twenty companies from throughout the United States and Canada. NYSEARCH/NGA conducts cutting-edge research and technology development for its gas members and for other partners to achieve goals that produce viable R & D products with benefits such as increased safety, greater efficiency & reduced costs.

For more information, visit [www.northeastgas.org](http://www.northeastgas.org) and/or [www.nysearch.org](http://www.nysearch.org).

**ABOUT INVODANE ENGINEERING Ltd.**

InvoDane Engineering is a specialized engineering firm based in Toronto, Ontario, Canada intimately connected with the development of specialized tools for the evaluation of pipelines. InvoDane and its staff have designed some of the world's most sophisticated inspection systems for smart pigs. Their expertise lies in integrating multi-disciplinary engineering systems into field-ready inspection equipment. InvoDane personnel have been instrumental in the development of a list of ground-breaking pipeline inspection systems. For more information, visit [www.invodane.com](http://www.invodane.com)

**ABOUT PIPETEL TECHNOLOGIES Inc.**

Pipetel Technologies offers a unique service using NYSEARCH's proprietary robotic platforms that deliver relevant and reliable data inspecting unpiggable gas pipelines. This service provides full deployment and inspection of unpiggable pipelines using robotic platforms that are untethered, modular, remotely controllable, self-powered for the visual and non-destructive inspection of natural gas transmission and distribution pipelines. For more information, visit [www.pipetelone.com](http://www.pipetelone.com)

Contact Information: Daphne D'Zurko, NGA/NYSEARCH, [ddzurko@northeastgas.org](mailto:ddzurko@northeastgas.org),  
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Roderick Lee, [rllee@pipetelone.com](mailto:rllee@pipetelone.com)

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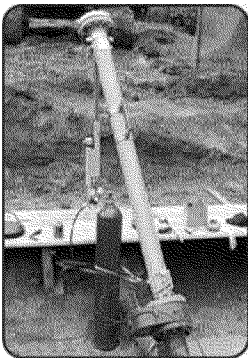




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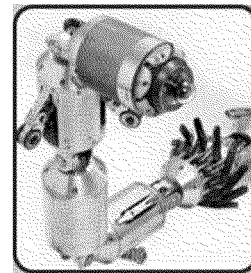
### Deployment into Live Pipelines



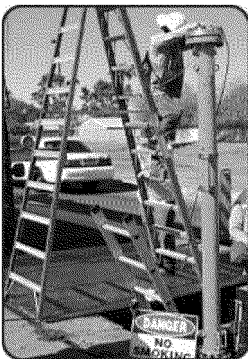
- ⌘ Location: Pennsylvania
- ⌘ Company: National Fuel Gas
- ⌘ Time: Fall 2009
- ⌘ Setting: Rural
- ⌘ Diameter: 8 inch
- ⌘ Age of pipeline: Less than 10 years old
- ⌘ Pressure: 100 to 200 psi
- ⌘ Launch configuration: single launcher at 45 °
- ⌘ Distance: 1,500 ft

### Explorer

Explorer's proprietary technology has been developed for the inspection of unpiggable pipelines using an untethered, modular, remotely controllable, self-powered robot. Its versatility provides full inspection of unpiggable pipelines with limited or no flow, short radius or mitered bends, valves, back-to-back bends, diameter reduction and pipelines without pre-built standard to launch and receive equipment for ILI tools.



### 90° Deployment into Pipelines



- ⌘ Location: Arizona
- ⌘ Company: Southwest Gas
- ⌘ Time: Summer 2010
- ⌘ Setting: Urban
- ⌘ Diameter: 8 inch
- ⌘ Pressure: 100 to 200 psi
- ⌘ Launch configuration: single launcher at 90 °
- ⌘ Distance: 3,500 ft

### Deployment into 6" Pipeline with Casing via Dual Launcher Configuration



- ⌘ Location: New York
- ⌘ Company: National Grid
- ⌘ Time: Fall 2010
- ⌘ Setting: Urban and rural
- ⌘ Diameter: 6 inch
- ⌘ Age of pipeline: Between 10 to 20 years old
- ⌘ Pressure: 400 to 500 psi
- ⌘ Launch configuration: dual launchers at 45 °
- ⌘ Distance: 4,800 ft
- ⌘ Highlight: Deployment scanned cased pipe under a road

NYSEARCH

## TIGRE™: A Robotic Platform and MFL Sensor for the Inspection of Unpiggable Pipelines

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Status: Testing of prototype system ongoing.

### BENEFITS

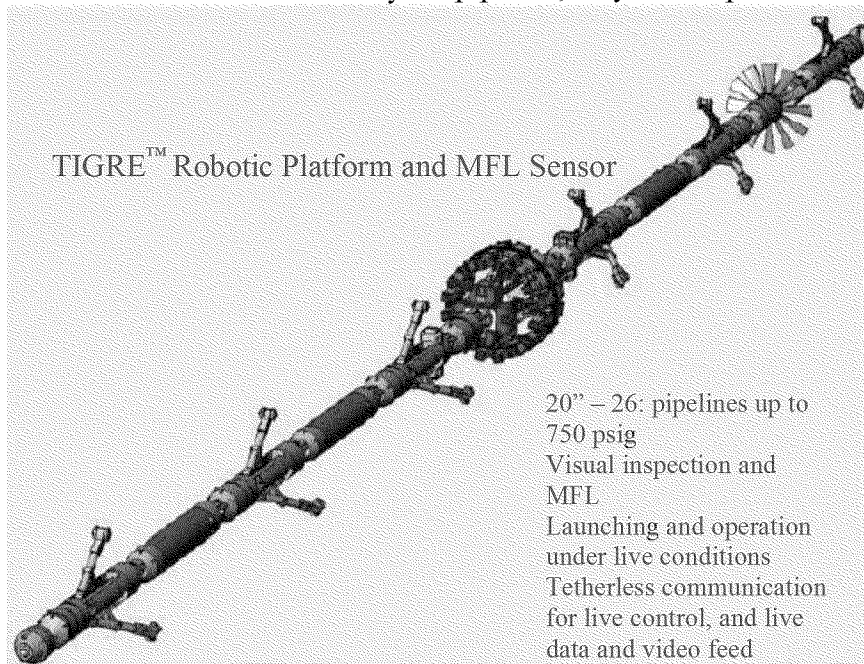
The TIGRE™ program supports the development of a modular, self-propelled robot for the inspection of unpiggable natural gas transmission and distribution pipelines under live conditions.

The robot uses a collapsible MFL sensor that is designed, as the platform, to negotiate all obstacles encountered in such pipelines, including mitered bends, plug valves, and inclined and vertical segments. Unlike other inspection pigs and robots TIGRE™ is not encumbered by

an umbilical cord (tether), due to the use of on-board batteries and wireless communications. As a result, the robot offers a significant potential improvement over existing inspection systems.

The TIGRE™ technology will allow the non-destructive evaluation (NDE) of pipelines currently inspectable only through direct assessment or hydrotesting. While these technologies provide useful information on the condition of a pipeline, they do not provide the

detailed assessment and wealth of information that an MFL sensor can and can be cost-prohibitive. With the 2002 OPS/DoT rule mandating the inspection of all pipelines (piggable and unpiggable) in high consequence areas, TIGRE™ is expected to become an indispensable tool towards meeting these mandates at great savings over alternatives. These savings, for a 100-mile gas transmission system, are expected to amount to more than \$500,000 per year.



TIGRE™ Robotic Platform and MFL Sensor

20” – 26: pipelines up to 750 psig  
Visual inspection and MFL  
Launching and operation under live conditions  
Tetherless communication for live control, and live data and video feed

### BACKGROUND

The TIGRE™ program builds on NYSEARCH’s earlier Explorer™ effort - an articulated, self-propelled, bi-directional, tether-free robot designed to permit in-situ visual inspection of live six and eight-inch gas distribution mains.

The goal of the TIGRE™ program is to develop and test a robotic platform and MFL sensor able to inspect unpiggable transmission and distribution pipelines in the twenty to twenty six inch pipe diameter range.

The requirement that such a system would be able to negotiate all obstacles, including plug valves, resulted in a set of very challenging engineering problems. An early program of evaluating various technological options resulted in the adoption of technologies for wireless communication, onboard battery recharge, locomotive systems, and MFL sensing that meet these specifications.

**TECHNICAL APPROACH**  
NYSEARCH, the research, development, and demonstration organization within the Northeast Gas Association, with co-funding from the Office of Pipeline Safety of the US Department of Transportation and the Operation Technology Development (OTD) Corporation retained Automatika Inc. and InvoDane Engineering Ltd. to develop a long-range, untethered inspection robot system, TIGRE™, using a state-of-the-art Magnetic Flux Leakage (MFL) sensor, for the inspection of transmission and distribution pipelines under live conditions. TIGRE™ has been developed as a live launch and recovery inspection robot that uses widely spaced and minimally sized access holes to launch and operate the robot.

A total of fifteen modules provide the necessary locomotion, power and sensing capabilities to operate the robot. Six locomotor modules provide the necessary driving power to withstand the high aerodynamic and magnetic forces to be encountered as the robot propels itself through high pressure and flow pipelines, and negotiates plug valves. Four battery

modules provide for the necessary power to propel the robot over long distances for efficient and economical deployments. A turbine-based, battery recharge system allows for the extraction of energy from the flow itself to recharge the batteries in-situ, thus further extending the operational range of the robot. A collapsible MFL sensor module provides state-of-the-art defect sizing while able to negotiate through plug valves, mitered bends and back-to-back bends. A magnet shunting mechanism allows the sensor to negotiate obstacles without the danger of getting attached to such elements, thus requiring high levels of force and power to detach itself. Antennas located in the two end modules provide for wireless communication between robot and operator. The available bandwidth allows for the live control of the robot while at the same time transmitting live images from the robot's cameras as well as data from the MFL sensor. The ability to visualize raw data is a unique capability of this technology and allows more accurate and defensible pipeline integrity decisions.

#### PROGRAM STATUS

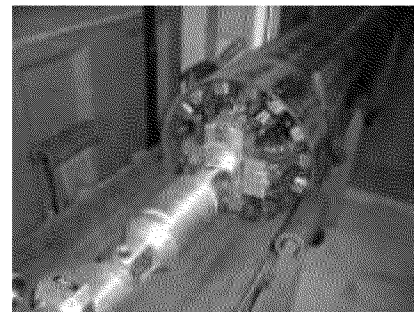
The prototype platform and sensor systems were constructed and tested individually throughout 2006. They were then integrated and extensively tested in the laboratory through 2007. In these tests the system has proven its ability to carry out an inspection of a transmission pipeline and negotiate mitered and short radius bends, back-to-back bends and plug valves. The MFL sensor has shown reliable operation and consistent sizing

of defects at a level of accuracy consistent with that of present day state-of-the-art smart pigs.

The program is now entering the phase of field demonstrations, prior to moving into a live demonstration later this year.

Commercialization of the technology is expected in 2009.

#### FOR ADDITIONAL INFORMATION



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NYSEARCH

## TIGRE™: A Robotic Platform and MFL Sensor for the Inspection of Unpiggable Pipelines

Description: Sophisticated, self-propelled robotic inspection platform and innovative sensor system for live NDE inspection of 20” to 26” diameter pipes up to 750 psi.

Status: Testing of prototype system ongoing.

### BENEFITS

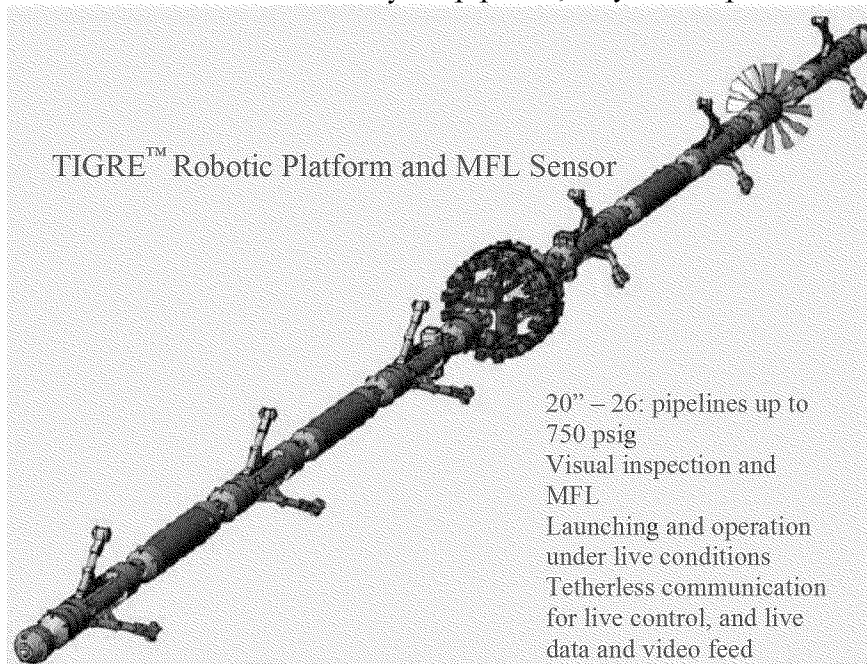
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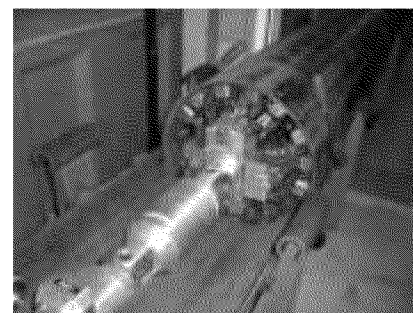
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