R&D Program – Main Line Valves

Operations Technology Development (OTD)

PHMSA

March 28, 2012

Dennis Jarnecke

R&D Manager

Gas Technology Institute (GTI)

gti

Topics for Discussion

- History and application of automatic shut-off valves
- Research funding
- Research related to automatic shut-off valves
- Future focus

History of Automatic Shut-off Valves

- Concept of early valve closures to reduce the effects of pipeline ruptures dates back to 1940's
  - Development of pneumatically operated automated control valves.
  - More recently, with advances in communications and automation, remote-controlled mainline valves have been developed and deployed.
    - Provide early valve closure
    - Minimize false closure
- Automated shut-off valves do not prevent leaks from occurring.
- They will not minimize the consequence from the initial rupture.
- Role of a ASV or RCV on pipelines is to mitigate the risk of additional consequences by quicker shut down times.

gti

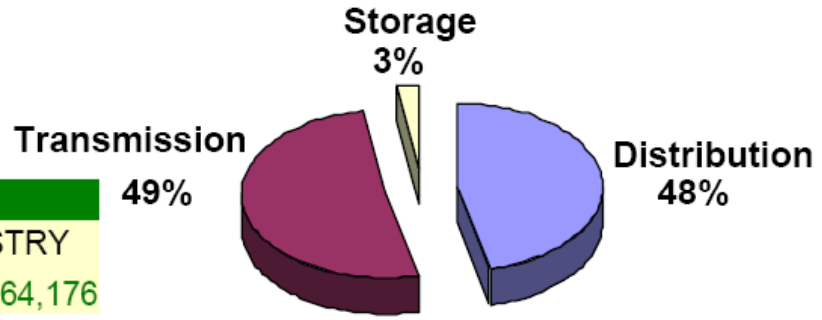
Research Funding

- Research Funding:
  - Over $1 billion in R&D funding has been spent on energy related projects by industry and government.
  - Funding peaked in the 1990's
  - Funding has been on the decline.
- Gas Research Institute (GRI) and Operations Technology Development (OTD) organizations have funded several projects related to main line valve research.
  - Over $100 million in R&D funding directed towards transmission and storage related projects.

gti

Research Funding

> 2006 research funding for natural gas totals $54 million:
  - Distribution……..$26.1 million
  - Transmission…..$26.8 million
  - Storage……$1.3 million.



TRANSMISSION R&D				
			GOV'T	INDUSTRY
TOTALS	%	$26,753,133	$9,688,957	$17,064,176
Remote Sensing	1%	$355,109	$355,109	$0
Inspection	22%	$5,818,960	$1,646,066	$4,172,894
Boring/HDD	2%	$421,424	$171,424	$250,000
Repair / Construction	0%	$0	$0	$0
Materials / Design	54%	$14,322,847	$5,780,000	$8,542,847
Compressors	2%	$655,116	$0	$655,116
Automat / GPS / GIS	1%	$365,000	$0	$365,000
Measurement / Press Control	2%	$468,108	$0	$468,108
General Studies	4%	$1,051,432	$716,984	$334,448
Modeling	0%	$0	$0	$0
Environmental	4%	$1,085,784	$0	$1,085,784
Knowledge-Base	0%	$0	$0	$0
Quality / Interchangeability	0%	$0	$0	$0
Codes / Standards	0%	$0	$0	$0
Regulatory Compliance	0%	$0	$0	$0
Basic Research	8%	$2,209,353	$1,019,374	$1,189,979

Research of Automatic Shut-off Valves

- Research included:
  - Assessment of remote and automatic shut-off valve technology through:
    - Field experience
    - Simulation studies

  Results indicated that the major source of unreliability with ASV's and RCV's lies with the inability to accurately detect a rupture event (false closures).

Research of Automatic Shut-off Valves

- Research: (continued)
  - Additional efforts focused on the use of computer simulation modeling for the improved application of line break control systems.
    - Results indicated that simulation data agreed well with field shut downs.
    - Field tests validated the use of acoustic wave detectors in detecting the simulated pipeline breaks.

gti

Research of Automatic Shut-off Valves

- Research: (continued)
  - A project to investigate the challenges associated with installing ASV's or RCV's. These challenges include:
    - Lack of above/underground space for valve placement, especially in urban environments.
    - Costs to install ASV's or RCV's on new and existing transmission pipelines. Costs can be greater than $1,000,000 per valve installed.
  - Studies were also conducted to evaluate the potential benefit of ASV's and RCV's to reduce injuries and fatalities associated with pipeline ruptures.

gti

Research of Automatic Shut-off Valves

- Research: (continued)
  - Modeling for Rupture Response (computational fluid dynamics)
    - Evaluate the effects of added valves and valve modifications (i.e., ASV and RCV's)
    - Takes into consideration various inputs such as:
      - Valve types
      - Closure times
      - Pressures
      - Ambient temperatures and gas loads
      - High consequence areas
      - Etc.

gti

Research of Automatic Shut-off Valves

- Research (Modeling continued)
  - Modeling for Rupture Response
    - Various scenarios are then modeled using randomly generated and selected rupture locations (based on risk and consequences of a pipeline rupture).
  - Results of model runs will provide determining factors that have the greatest influence on rupture blow down times. Which allows for:
    - Number and type of valves required
    - Placement of valves
    - Number and placement of sensors and flow measurement points
    - Etc.

gti

Research of Automatic Shut-off Valves

- Research (continued)
  - Design and development of an in-situ installation valve.
    - The goal of this project is to develop a valve that can be installed on existing natural gas pipelines without shutting off the flow of gas.
    - Issues with installing valves on an existing pipeline are:
      - High cost
      - Large excavations
      - Installation of several fittings to allow for flow stopping
      - By-pass of pipeline is often required
      - Space requirements
      - Etc.

gti

Research of Automatic Shut-off Valves

- Research (in-situ valve continued)
  - Various lab and field evaluations performed to evaluate an in-situ valve on distribution natural gas piping systems.

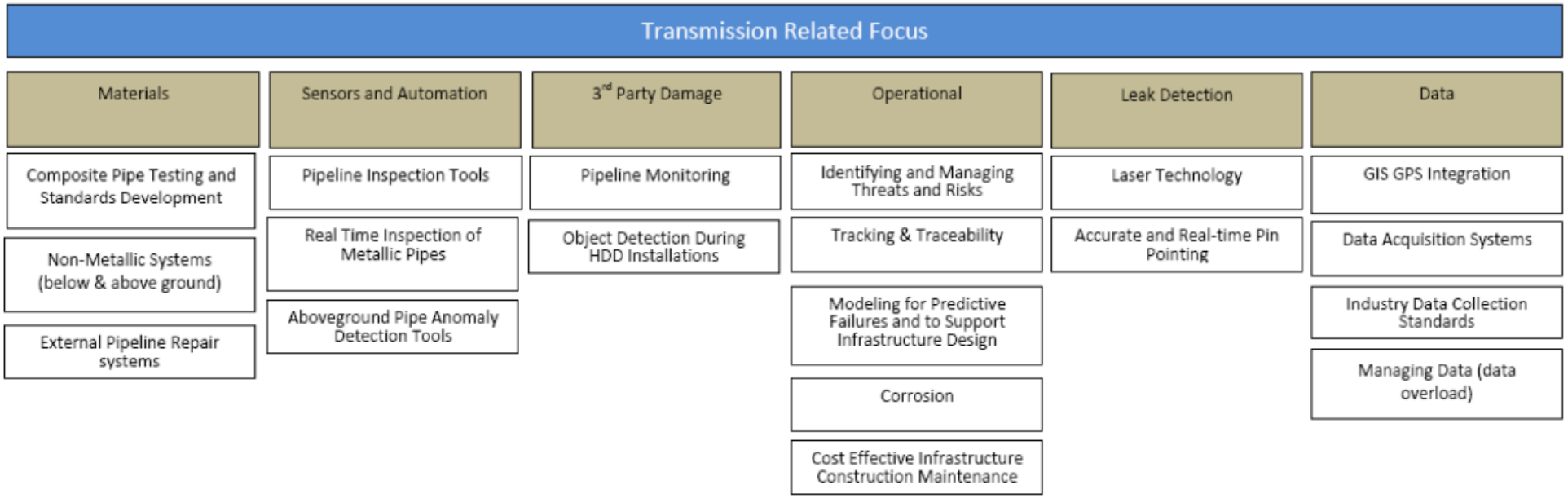
gti

Needs of ASV's and RCV's

- Based on research and current operator experience with ASV's and RCV's, additional needs exist for:
  - More accurate pipeline sensing systems to minimize unintended valve closures.
  - Additional options for conversion of existing manual valves to ASV and RCV.
  - Computer modeling to assess pipeline rupture response and placement of valves and associated sensors.
  - More cost effective installation of valves.
  - New valve designs for various types of installation scenarios.

gti

Pipeline Roadmap



Solving important *problems* facing the energy industry and its consumers …

Dennis Jarnecke
Gas Technology Institute
847-768-0943
Dennis.jarnecke@gastechnology.org