Methods and Advances in Actuation of Remote Control Valves and Automatic Control Valves on Natural Gas Transmission Pipelines

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Enormity of the Situation

- The Pipeline and Hazardous Material Safety Administration – Estimate
- Pipeline network in the USA – more than 2 million miles of pipe
- 400,000 miles of large diameter transmission pipelines
- 60% of these pipelines are 40 years old or older
### Significant Pipeline Incidents – Gas Transmission

Average more than 50 Significant Pipeline Incidents per year
Heightened Public Awareness
Multiple Press Releases
National Transportation Safety Board

- Investigates pipeline accidents
- Makes official safety recommendations
Basis Of This Presentation

• February, 2012, we were summoned by the NTSB to discuss automated valve technology for gas transmission pipelines

• Seeking actuator control function technology versus a product presentation

• Topics
  – Human intervention vs automatic controls
  – False valve closures
Automated Valves Can Help Mitigate Consequences If An Incident Occurs

• Most fatalities and damage occur in the first few minutes following a rupture.

Incident response time can impact property and environmental damage and possibly injuries and fatalities.
Current NTSB Recommendations

• Develop standards for rapid shutdown of failed natural gas pipelines
• Install automatic or remote operated mainline valves in high consequence areas
Control Options General Overview

• Remote Control Valves (RCV)
  – Remote 2-Way Electric
    • Actuator receives a signal from gas control
  – Electric Fail Safe
    • Actuator reacts upon loss of a signal
  – Pneumatic 2-Way Control
  – Pneumatic ESD loss of pilot signal
General Overview

- **Automatic Control Valves (ACV)**
  - **Low Pressure Shutoff**
    - Actuator reacts automatically to a single pressure setpoint
    - Need to consider transient pressure drops
    - Need to consider the reset dead band
  
  - **Automatic Linebreak (Pneumatic or Mechanical)**
    - Actuator reacts to an excessive rate of pressure drop
    - Need to account for transient pressure drops
    - Need to consider valve location
General Overview

• Combination Control Functions
  – Automatic linebreak and low pressure shutoff
  – Two way remote control and low pressure shutoff
  – Two way electric and electric failsafe
  – Low pressure shutoff and high pressure shutoff
Pneumatic LineBreak Schematic
Pneumatic LineBreak
Normal Intact Pipeline

PIPELINE

ORIFICE

REFERENCE TANK

DIAPHRAM
Pipeline Ruptures
The Control Reacts To A Rapid Drop In Pressure
Under Normal Operating Conditions

• Major Concern
• False Closure
  – Compressor station coming on/off line
  – Transient pressure changes
  – Pigging operation
Shortcomings Of The Pneumatic Linebreak Control Systems

- The tiny orifice may clog or freeze-off
- R-O-D set points drift as pipeline pressure changes
- There is no adjustable time delay
  - Leads to false valve closures
- There is no memory or stored data
- There is no method to communicate with the actuator
Latest Technology
Microprocessor Based Linebreak Controls

• Guard the pipeline in three ways:
  – Rate of pressure drop
  – Low pressure shutdown
  – High pressure shutdown
Electronic LineBreak Solutions

- The small orifice can clog or freeze off
- Set points drift as pipeline pressure changes

Pressure transducers replace orifices

Set points are stable
Electronic Linebreak Solutions

• Pneumatic Control Problem:
  There is no adjustable time delay

• Solution:
  Electronic linebreak controls have adjustable time delays for all set points
Electronic Linebreak Solutions

• Pneumatic Control Problem: There is no record if an event occurs

• Solution:
  Two memory modes:
  – Data Collect Mode (unarmed)
  – Valve Control Mode (armed)
Additional Performance Features

• Remote communication capability
  – Alarm call out

• These products are generally expandable
  – Additional configurable I/O ports are available

• The control logic can be changed if required
SCADA Systems Aren’t Perfect

• Failure to isolate the rupture
  – Location of sensors and sampling times
• Failure of SCADA system’s communication signal
• Human error
• Security issues
  – Cyber attack
  – Unauthorized access
Questions

Thank You!