Installation of Remote Control Valve (RCV) in Gas Transmission Pipelines

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Outline

- Pipeline Failures & Risk Management
- Regulatory Drivers for RCV or ASV
- Evolution of RCV Program at DTE Gas
- RCV Design, Installation and Operational Considerations
- Complexity of RCV Installations
- Recent Event (Rouge Incident)
- Status of DTE Gas RCV Program
- Acknowledgement
Pipeline Failure Modes

Transmission Pipelines
- Failures of transmission lines operating above 30% of Specified Minimum Yield Strength (SMYS) of pipe usually result in ruptures

Common Thread
- Ignition, explosion, huge flames
- Property damage and/or loss
- Loss of life in some cases

Distribution Pipelines
- Failures of distribution pipelines operating < 20% SYMS typically result in leaks

Edison, NJ, 1994, 36" line, 0 fatalities, $25 MM property damage

Carlsbad, NM, 2000, 30" line, 12 fatalities, $1 MM property damage

San Bruno, CA, 2010, 30" line, 8 fatalities, several injuries, 37 homes destroyed, 88 damaged

Melvindale, MI, 2016, 30" line, 0 fatalities, 1 injury, property damage cost TBD
Routine O & M and Pipeline Integrity Management activities are structured to mitigate pipeline risk.

Risk = **Likelihood** of an Event × **Consequence** of the Event

**Likelihood** addressed through measures such as:
- Threat Identification
- Risk Assessment
- Periodic Pipeline Assessments
- Defect Remediation
- Routine O&M activities (patrol, periodic inspections/tests, leak surveys, damage prevention etc.)

ASV or RCV lowers risk of an Event by reducing the **Consequence** of the Event
- Limits volume of gas release
- Extent of Damages
- Limits of evacuation
- Duration of Event
Isolation of pipeline segments by valves can be done by one of three methods

Remote Control Valve (RCV)
- Remote Control, activated through human intervention
- Delayed activation
- Less susceptible to false trips
- Pressure and rate of drop trending capability
- Power
- Communication

Automatic Shut Off Valve (ASV)
- Self contained local control, activated without human intervention
- Faster activation
- Susceptible to false trip
- No power or remote communication (in the simplest form)

Manual Isolation Valve
- No automation, operated locally by pipeline technicians
Regulatory Drivers for ASV or RCV

• 192.935 (c) – Additional Preventive and Mitigative Measures (Dec. 15, 2003):
  “If an operator determines, based on risk analysis, that an ASV or RCV would be an efficient means of adding protection to a high consequence area in the event of a gas release, an operator must install the ASV or RCV”.................

• National Transportation Safety Board (NTSB) Recommendations (Sept 26, 2011)
  Amend Title 49 CFR, section 192.935 (c) to directly require that automatic shut-off valves or remote control valves in high consequence areas and in class 3 and 4 locations be installed and spaced at intervals that consider population factors listed in the regulations

• Legislation by Congress (Jan 3, 2012)
  The Pipeline Safety, Regulatory Certainty and Job Creation Act of 2011 required PHMSA to issue regulations on the use of automatic or remotely controlled shut-off valves, or equivalent technology, where economically, technically and operationally feasible on newly constructed or entirely replaced transmission pipelines. Further, the Act required the Comptroller General of the US to conduct a study on the ability of transmission pipeline facility operators to respond to a hazardous liquid or gas release from a pipeline segment located in HCA

• PHMSA Notice of Proposed Rule Making (NPRM) - April 7, 2016:
  Separate rulemaking will be considered based on the result of the study by the Comptroller General
Evolution of DTE Gas ASV/RCV Program focused on five key areas

- Risk Assessment
- Program Coverage
- Control method
- Activation protocol
- Transient Study
A relative risk evaluation was used to determine coverage of RCV/ASV program

- Criteria considered is a mix of operational, physical installation and pipe attribute:
  - Existence of ASV or RCV
  - Failure mechanism – rupture vs leak
  - Probability of ignition (calculated based on GRI reports 97/0245 and 00/0232)
  - Isolation time (time for technician to respond and isolate segment)
  - Blowdown time
  - Pipe Diameter

- Each of the criteria was assigned a weight ($W_i$)
  - For existing RCV or ASV, $W = 10$
  - Isolation time, $W = 5$

- Each of the criteria was assigned numerical risk value ($R_i$) based on the value of the criteria for each pipe segment
  - Existing RCV or ASV, $R = 0$
  - Isolation time of 30 minutes, $R = 2.5$
  - No RCV or ASV, $R = 10$
  - Isolation time of 90 minutes, $R = 7.5$

- Segment Risk Value = $\sum (W_i * R_i) / \sum (W_i)$
Clustering of risk scores in risk ranking did not lend to a distinctive cut-off point for RCV/ASV benefit

<table>
<thead>
<tr>
<th>ASV or RCV</th>
<th>Failure Mode</th>
<th>Probability of Ignition (Rupture)</th>
<th>Probability of Ignition (Leaks)</th>
<th>Isolation Time</th>
<th>Blowdown Time</th>
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Risk Score for highest risk segment post RCV/ASV installation

| AustDetC2 | 0.00 | 9.66 | 3.20 | 0.00 | 2.50 | 7.11 | 7.50 | 4.28 |
Transient hydraulic analysis guided selection of rate of pressure drop set point

Pipeline System Diagram
January Average Day

- All pipelines common at Milford Junction
- L-line isolated from K-line south of Milford Station

Legend
- Main Line Valve Block
- Main Line Valve
- Compressor
- Flow Direction
- Simulated Rupture Location
- Michigan Facilities
- *RCV installed

Not to Scale
## Summary of transient hydraulic analysis

<table>
<thead>
<tr>
<th>Pipeline</th>
<th>Peak rate of pressure drop (psi/min)</th>
<th>Duration (min) rate of pressure drop exceeds:</th>
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</thead>
<tbody>
<tr>
<td>Rupture</td>
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<td>30 psi/min</td>
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<tr>
<td>24” A Line</td>
<td>136</td>
<td>1.75</td>
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<tr>
<td>36” E line</td>
<td>217</td>
<td>1.37</td>
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<tr>
<td>36” L line</td>
<td>318</td>
<td>5.93</td>
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<tr>
<td>Supply Disruption</td>
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<td>Case 1 (East)</td>
<td>18</td>
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<tr>
<td>Case 2 (South)</td>
<td>15</td>
<td>0</td>
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</table>

- 30 psi/min selected as set point for rate of pressure drop
  - greater than transient pressure drops associated with normal supply disruptions
  - duration was greater than 1 min
  - over 5X lower than peak rate, therefore will detect ruptures at minimum day flows

- Peak rate of pressure drop at a MLV increased as distance of rupture from MLV decreased
- Response (delay) time to rupture at a MLV increased with distance of rupture from MLV
Key Decisions of DTE Gas Program

- Coverage expanded beyond riskiest locations to cover all valves in HCA
- RCV adopted as control method due to ability to control valve closure and avoid unnecessary customer outages
- 30 psi/min selected as rate of pressure drop set point
- Retrofits to be completed over 10 years (2011 - 2020)
- Security of communication to/from SCADA
- Gas Control management on recommendation from Gas Controllers has final call on valve closure
Design & Installation Considerations

- Valve type (Ball, Plug or Gate; Existing or New)
- Valve Operator type (Electric, Pneumatic, Gas/Hydraulic)
- Valve / Operator mating (physical; motion – rotary or linear)
- Torque requirements plus allowance for cold weather operation
- Failure triggers (power, communication, signal)
- Failure mode (FC, FLP)

- Transient hydraulic analysis
- NEC Area Classification
- Power and Communication
- Security (physical and cyber)
- Cost
Operational & Maintenance Considerations

Functionality Tests (at prescribed frequencies)

- Trip (set) points
- Instrument calibration
- Valve Travel (Open/Close limits)
- Communications
  - Remote Command
  - Pressure and pressure drop signals
- Back-up power
  (Generator, UPS)

Training

- Operations personnel
- Gas Controllers (Activation Protocol)
  - Confirmation of incident
  - Recommendation to management
  - Management approval
Components of a typical RCV Installation
### Number of new components drive complexity, schedule and cost of RCV Installations

<table>
<thead>
<tr>
<th>Basic (common) cost components</th>
<th>Variable cost components</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmitters</td>
<td>Valve (new or existing)</td>
</tr>
<tr>
<td>Modification kits</td>
<td>Automatic valve operator (new or existing)</td>
</tr>
<tr>
<td>Control panel</td>
<td>Size of valve and operator</td>
</tr>
<tr>
<td>Conduit/Wiring</td>
<td>Power supply</td>
</tr>
<tr>
<td>Instrument taps</td>
<td>Communication</td>
</tr>
<tr>
<td>SCADA Screen</td>
<td>Land</td>
</tr>
<tr>
<td></td>
<td>Installation cost</td>
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</tbody>
</table>

Complexity of installations can drive installed cost from a few tens of thousand dollars to several hundred thousand dollars
54% of planned RCV installations completed, on track to complete all installations in HCA by 2020

Considering accelerating program based on demonstrated effectiveness in limiting the impact of the Melvindale incident

Reviewing potential expansion of program to Moderate Consequence Areas (MCA) based on risk assessment
Acknowledgements

DTE Gas RCV Program is a continuing collaboration of the following cross-functional teams whose efforts are gratefully acknowledged:

- Integrity Management
- Transmission & Distribution Engineering
- Gas Control
- Control Maintenance
- Transmission & Storage Operations
- Transmission Construction
- System Planning
- Distribution (Pressure) Operations
- Supply Chain

Senior management of DTE Gas is also acknowledged for continued support of the RCV Program