Canada Energy Regulator | Régie de l'énergie du Canada

National Academies of Sciences-Engineering -Medicine

Criteria for Installing Automatic and Remote-Controlled Shutoff Valves on Existing Gas and Hazardous Liquid Transmission Pipelines

Session:

Canada Energy Regulator Perspective on Automatic and Remote-Controlled Shutoff

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Canada

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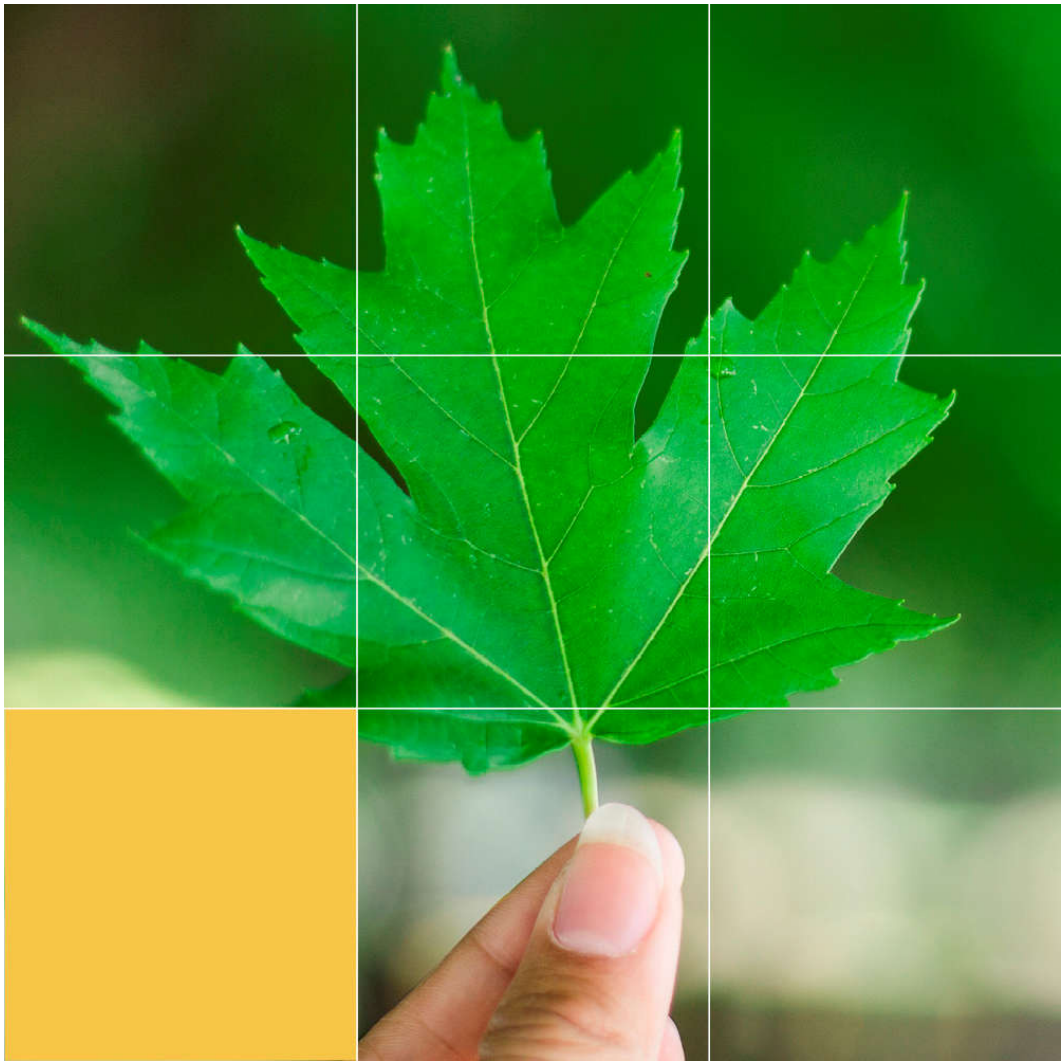

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Today's Discussion

- **Background on Canada Energy Regulator**
- **Type of regulatory regime**
- **CER Regulations Referencing CSA with respect to valving**
- **Do remote valves and blowdown valves make a difference?**
- **Conclusion**

Canada Energy Regulator (CER)

- The CER regulates approximately 73,000 kilometres of pipeline.
  - approximately 75% is Gas/ High Vapor Pressure
- CER regulated pipelines safely transport over 1.25 billion barrels of liquid products and almost 5.8 trillion cubic feet of natural gas annually.
- CER regulated pipelines transported over $134 billion worth of energy products.

Regulatory Policy Development

- Canada Energy Regulator (formerly known as the National Energy Board) created in 1959 for construction of cross-Canada oil and gas pipelines.
  - Responsibilities established under the CER Act.

- Independent agency
  - Public safety
  - Environmental protection
  - Financial regulation of pipelines

Evolution of Regulatory Philosophy

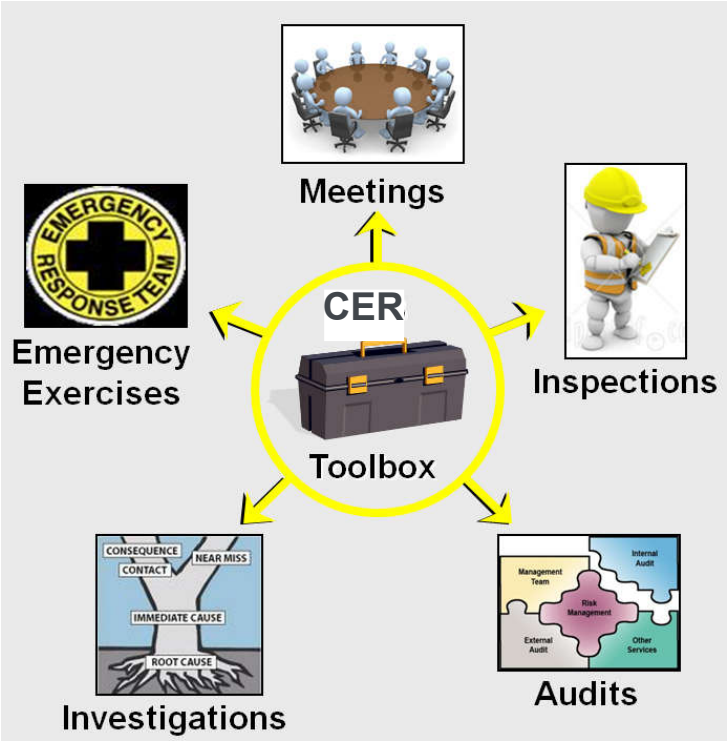
- "strong regulator supported by strong technical standards"
  - CSA Z662 "Oil and Gas Pipeline Systems" incorporated by reference

- Pre -1999 – prescriptive regulations.

courtesy http://shop.csa.ca

- Shift towards performance-based regulation

Regulation of Existing Pipelines



Compliance Verification & Enforcement

- Compliance meetings with regulated companies.
- Audits of company's management systems.
- Facility inspections to assess compliance with requirements.
- Review and approve key documents (e.g., Integrity Management Plans)

Canadian regulators incorporate standards by reference

- In Canada all oil and gas regulators incorporate Canadian Standards Association (CSA) Z662 Oil and Gas Pipeline Systems by reference
  - CSA Z662 is a comprehensive full lifecycle standard – design, construction, operation, maintenance and abandonment and includes management system and integrity management program requirements
  - The 2019 version of CSA Z662 is a 922 page document that includes 12 focus area Annexes and a 210 page Commentary (guidance).
  - Follows Standards Council of Canada (SCC) requirements, necessitating a consensus document with a matrix of stakeholder representation, public review and regular review and maintenance
  - All Canadian Regulators incorporate all of CSA Z662 with a small number of exemptions or exceedance of the CSA Z662 requirements within their Regulations

Participation enables the influence of standards

- Substantial active and coordinated CER participation and leadership in the various strategic steering committees, chairmanship of technical committees and task forces and technical expertise allows the CER exert a significant amount of influence

- Recent examples of CER influence by initiating, leading and participation:
  - Damage Prevention Standard (CSA Z247)
  - Security Management (CSA Z246.1)
  - Emergency Preparedness and Response (CSA Z246.2)
  - Fugitive Emissions (CSA Z620.1)
  - Significant changes to CSA Z662:
    - management system and integrity management program requirements
    - Class Location designation and requirements
    - Quality assurance requirements for the manufacturing of pipe and components

What is the perceived issue?

- **Is there a relationship between consequences and isolation valve spacing, and location and sizing of blow down/vent stacks?**

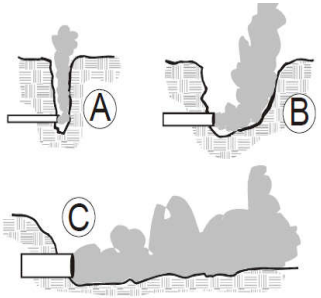
September 9, 2010
San Bruno, California
- **8 Fatalities**
- **58 inured**
- **38 houses destroyed**
- **70 houses damaged**
- **Fire burned for more than 2 hours**

Examining proposed consequence reduction associated with valves and blowdown/vents

- Proponents, such as landowners, advocate that regulations and standards must be changed to reduce the gas available at a failure site
- Proposed solutions to reduce the amount of gas available in elevated consequence areas, such as higher class location areas, include:
  - Mandating isolation valves
  - Mandating automatic and/or remotely operated valves
  - Reducing the spacing of isolation valves
  - Sizing blowdown valves appropriately to rapidly reduce pressure and available gas at the location of the leak
  - Siting blow down valves so they do not pose an additional hazard when activated

Sequence of events during a failure - detection, closure of valves, blowdown

- Natural gas pipeline release events have three distinct sequential phases:
  - Failure Detection Phase,
  - Isolation Valve Closure Phase,
  - Blowdown/venting Phase.
- Total discharge volume equals the sum of the volumes released during each phase.
- Worst case is a guillotine break with immediate ignition due to largest volume of release of gas in the shortest time period.



Schematic of a pipeline rupture for (A) small size/pressure (B) medium size/pressure, and (C) large size/pressure

Considerations related to detection, closure of valves, and blowdowns

- During detection phase Isolation valves have no influence on the volume of natural gas released because
  - valves are open
  - compressors are still discharging; however, some benefit form suction side of compressor
- Isolation phase and Blowdown/venting phase:
  - Reduces the total volume of natural gas released
  - Reduces the consequences associated with thermal radiation after the initial ignition
  - Dependent on detection on the failure and time required to implement isolation
  - The longer the time to isolation the less effective the mitigation.

Understanding North American Isolation Valve Requirements

- Currently in Canadian regulations there is no mandatory requirement for remotely operated or automatic shut off isolation valves
- Companies are to determine if remotely operated or automatic shut off valves would reduce consequences

Isolation Valve Requirements - Canadian CSA Z662

- Isolating valves shall be installed for the purpose of isolating the pipeline for maintenance and for response to operating emergencies.
- In determining the number and spacing of sectionalizing valves to be installed, if any, the company shall perform an engineering assessment that gives consideration to relevant factors, such as:
  - the nature and amount of service fluid released due to repair and maintenance blowdowns, leaks, or ruptures; and
  - the time to blow down or drain down an isolated section.

Note. In assessing drain-down volumes, the CER's expectation is that the effects of terrain be accounted for, and consideration given to the use of check valves.

Analysis of whether isolation valve spacing significantly reduce consequences

- An assessment titled "Review of Safety Considerations for Natural Gas Pipeline Block Valve Spacing of Past Incidents" was conducted by Eiber et al in September 2012 to evaluate the safety considerations associated with block valve spacing.

- The review was comprehensive and is consistent with past assessments and determined that:
  - "all of the prior research studies, the examination of the PHMSA incident database and the examination of NTSB gas transmission pipeline incidents indicate that main line block valve spacing on natural gas transmission pipelines is not related to public safety."

Analysis of whether isolation valve spacing significantly reduce consequences

- The assessment also concluded:
  - Valves are useful for maintenance and line modification but they do not control or affect public safety
  - The injuries and fatalities on gas transmission pipelines generally occur during the first 30 seconds
  - For some incidents it took at least an hour after the rupture for the natural gas to decompress and exhaust from the pipeline
  - Based on calculations smaller diameter pipelines required longer decompression times due to wall friction effects
  - If the gas ignites it will stay ignited for the time that it takes to blowdown the gas

Analysis of whether automatic or remote operated valve significantly reduce consequences

- The refenced reports and studies conclude:
  - The vast majority of injuries, fatalities, and property damage associated with a catastrophic pipeline incident occur within the first few minutes of the event,
  - Automatic and remotely operated valves do not have time to activate to significantly reduce the consequences that occur during the initial blast
- However, companies must focus on ensuring valves are operable and accessible in a reasonable time
- The length of time to obtain isolation may contribute to unnecessary secondary consequences associated with:
  - Continual thermal radiation
  - Hindering first responders

Understanding North American Blowdown/vent Stack Requirements

- U.S. and Canadian blowdown/vent stack requirements are similar
- Blowdowns can be used to reduce outflow at a rupture site more quickly
- The blowdown/vent stack is designed
  - to relieve pressure in the main piping as rapidly as practical
  - in a controlled manner at a safe location

Summary – Do blowdown/vent stacks significantly reduce consequences?

- The amount of time for a section of transmission pipeline to depressurize once isolated is based on numerous variables such as:
  - diameter of pipeline, distance between isolation valves
  - internal pipeline restrictions, operating pressure of the line at the time of valve closure
  - physical dimensions of the opening at the point of pipeline failure.
- Based on the applicable parameters it may take a considerable amount of time to reach atmospheric pressure -ranging from tens of minutes to several hours.
- Most damage occurs within 30 seconds of ignition
- May reduce secondary consequences

Concluding Remarks

❑ Automatic and Remotely operated Valves

- Automatic and remotely operated valves do not have time to activate to significantly reduce the consequences that occur during an ignited gas rupture
- Length of time to closure and volume released may impact secondary consequences due to inability to access the location
- Companies to determine if automatic or remotely operated valves would reduce consequences
- Standards and regulations related to blow down and vent stacks are not prescriptive but performance-based. Requires companies to size and consider capacities so under emergency conditions, the sections can be “rapidly blown down”
- Onus is on the company to perform the analysis and design to meet the goal

Concluding Remarks (continued)

- Industry standards are the minimum requirements, and do not cover every possible situation
- Through the use of a Management System and Integrity Management Programs, Companies will perform risk assessments that consider all of the consequences to determine the appropriate spacing for isolation valves, the need for rapid closure, and appropriate sizing and locations of blowdowns/vents
- The risk assessment might drive the need for additional sectioning valves or the need for automatic or remote operated valves, as might a class location change

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