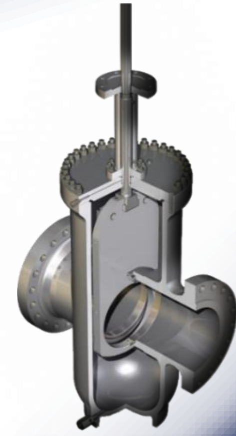

Pipeline and Hazardous Materials Safety Administration

Office of Pipeline Safety

Answers to National Academy of Sciences "Committee" Questions & Information Requests

"Study on Installation of Automatic or Remote-Controlled Shut-Off Valves on Existing Pipelines"

April 26 & 27, 2022

PIPES Act 2020, Sec. 119. National Academy of Sciences (NAS) Study on Automatic (ACV) and Remote-Controlled (RCV) Shut-Off Valves on Existing Pipelines.

a) Study on potential methodologies/standards for installing ACVs and RCVs on existing pipelines.
   1) a high consequence area as defined in Code of Federal Regulations 192.903 for a gas transmission pipeline facility; or
   2) for a hazardous liquid pipeline facility
      A. A commercially navigable waterway, as defined in section CFR 195.450; or
      B. An unusually sensitive area (as defined in section 195.6 of that title (or a successor regulation)).

b) Factors for Consideration. The NAS study shall take the following into consideration:
   1) Methodologies that conform to the recommendations submitted by the NAS Board to PHMSA and Congress regarding ACVs and RCVs;
   2) Compatibility with existing regulations including any regulations promulgated pursuant to docket number PHMSA–2013–0255 **(Amendments to Parts 192 and 195 to Require Valve Installation and Minimum Rupture Detection Standards)**, relating to the installation of ACVs and RCVs;
   3) Methodologies that maximize safety and environmental benefits; and
   4) The economic, technical, and operational feasibility of installing ACVs or RCVs on existing pipelines by employing such methodologies or standards.

(c) Report.

Question 1
Does PHMSA rely on particular guidance document(s) in the development of an RIA for low-frequency-high-consequence events?

PHMSA does not have guidance specific to low-frequency-high-consequence events (also referred to as low-probability, high-consequence (LPHC) events.

- The foundational guidance for PHMSA's regulatory impact analysis (RIA) is OMB Circular A-4.
- LPHC event risks are treated conceptually like other stochastic events. The difference in practice is that LPHC events are present as risks but may not have occurred in the systems PHMSA regulates or might have occurred very few times either in those systems or analogous systems.
- Empirical evaluation of incident history does not provide estimates of frequency and severity of incidents in this long tail of the distribution that would be suitable for quantification of the benefits of avoiding these risks.

Question 1 - Continued

Does PHMSA rely on particular guidance document(s) in the development of an RIA for low-frequency-high-consequence events?

- PHMSA typically qualitatively describes the effect of proposed rules on these events in addition to the effects of the rule that can be quantified.
- PHMSA recognizes that the best quantification of LPHC event risks and the benefits of event reductions is usually in modeling the systems.
- Modeling studies that provide quantitative insight into the regulatory concern are typically long-term projects that are difficult to anticipate the need in time to be incorporated into a rulemaking.
- PHMSA looks at this National Academy of Sciences (NAS) valve study as a potential resource for future rulemaking efforts, including any models developed.

Question 2
How does PHMSA quantify the benefits of incident/accident avoidance? What methods and data inform this analysis?

The foundational guidance for PHMSA RIA's is OMB Circular A-4.

- PHMSA quantifies any consequences of an event that can be avoided by a proposed rule.
  - Consequences typically include evacuations, injuries, deaths, lost product, equipment damages, property damages, and environmental damages.
- Pipeline incident data (https://www.phmsa.dot.gov/data-and-statistics/pipeline/distribution-transmission-gathering-lng-and-liquid-accident-and-incident-data) is a valuable source of empirical evidence of the extent of these consequences of past accidents.
- Consequences are monetized using methods consistent with the USDOT Benefit-Cost Analysis Guidance. A value of a statistical life metric is provided along with fractions of this value for application to injuries.

Question 3

Does PHMSA have a standard figure that it uses, recommends, or could agree to, that estimates a reasonable of personnel density in the vicinity of a pipeline? E.g., a figure that could be compared against a calculated "effect zone" of a release consequence in order to determine the probable loss of life or probable injury resulting from such a consequence?

- PHMSA has no such standard figures.
- The definitions of class location and high consequence area (HCA) provides information about the concentration and types of buildings near a pipeline.
- Gas pipeline incident data (https://www.phmsa.dot.gov/data-and-statistics/pipeline/distribution-transmission-gathering-lng-and-liquid-accident-and-incident-data) provides empirical evidence of the extent of injury and death from past accidents.
- These deaths and injuries are both from typical personnel density, and in the case of excavation damage, includes construction workers who would not have been at the site if they had not been undertaking activities that caused the incident.
- Some relevant information is available in the Oak Ridge National Laboratory (ORNL) study of the impact of more rapid isolation of pipeline ruptures.

Question 3a

If so, can the estimates of personnel density be broken down by type of area that the pipeline is running through (e.g., a different density for the different classes of occupancy - class 1 through 4? HCA?)

- PHMSA has no such standard figures.
- These characteristics are expected to closely correlate to population density in the vicinity of pipelines.
- Models of population density can be refined using explanatory variables that describe area types.

RR

Question 4

Does PHMSA have a standard figure that is uses, recommends, or could agree to, that estimates a reasonable worst-case scenario for environmental cleanup and remediation of land upon which hazardous liquid has been spilled? Potentially including cost of disposal of waste, cost of remediation of damaged soil, and potential third-party liability.

- PHMSA does not have a standard figure.
- PHMSA does require 49 CFR Part 194 Response Plans for Onshore Oil Pipelines that include an estimate of the volume of a worst-case discharge.
- PHMSA’s practice for monetizing the environmental costs of spills for the purpose of benefit cost analysis is to analyze historical hazardous liquid accident data (https://www.phmsa.dot.gov/data-and-statistics/pipeline/distribution-transmission-gathering-lng-and-liquid-accident-and-incident-data).

Question 4 – Continued

Does PHMSA have a standard figure that it uses, recommends, or could agree to, that estimates a reasonable worst-case scenario for environmental cleanup and remediation of land upon which hazardous liquid has been spilled? Potentially including cost of disposal of waste, cost of remediation of damaged soil, and potential third-party liability.

- PHMSA uses reported costs, spill volumes, and spill characteristic data to estimate costs per volume spilled for the class of accident that is relevant to the benefit cost analysis.
- As for the case of LPHC incidents, if little data is available that is relevant to the type of accident, then a modeling exercise might be needed to obtain a reasonable estimate.
- Some relevant information is available in the Oak Ridge National Laboratory study of the impact of more rapid isolation of pipeline ruptures.

Question 4a

If so, can these costs be differentiated by the type of land use that the pipeline is going through?

- PHMSA has no such standard figures.
- Potential damages will depend on land use in the vicinity of the pipeline.
    - Empirical damage models can be refined using explanatory variables that land use.

Question 5

Does PHMSA (or other agencies) have incident records that include incident response times? This includes time to detect the incident, time to close valves, and time to respond to emergency.

- PHMSA requires operators to provide incident reports when accidents meet the reporting thresholds in CFR 191.15 and CFR 195.54 (incident reports are F7100.2 for gas transmission (GT) and F7000.1 for hazardous liquids (HL)).
- Since 2010, PHMSA has received approximately 5,600 reports for GT and HL pipelines. Each report contains information on the time the reportable event occurred, when the operator identified the event, when the operator's resources arrived on the scene, and when the pipeline was shut down.
- In April 2019, PHMSA added GT operator requirements to document upstream and downstream valve closure times to isolate the segment.
- In January 2022, PHMSA added the same requirement for hazardous liquids. PHMSA also conducts investigations at some HL and GT incidents and has more in-depth information related to operator response actions for those.

BK

Question 5a
Do the records also have the reason for the incident?

- Yes, PHMSA incident report forms have 8 categories of failure causes:
  - Corrosion,
  - Natural force damage,
  - Excavation damage,
  - Other outside force damage,
  - Material failure of pipe or weld,
  - Equipment failure,
  - Incorrect operation, and
  - Other.
- Each of these 8 causes have detailed questions that further define the failure cause and specifics unique to that cause. There is also a narrative section that allows the operator to provide additional context to the accident.

Question 6

How likely is it for guillotine-type ruptures to occur and what are the causes?

- Since 2010, there have been roughly 5,600 reported pipeline failures.
  - 283 were ruptures with 57 of those affecting an HCA.
  - PHMSA does not define a guillotine-type of failure, PHMSA does receive accident reports describing the failure type that may be considered guillotine in nature.
  - 77 of the ruptures were classified as circumferential with 12 of those in an HCA.
- Circumferential ruptures are typically due to external forces creating excessive axial or bending stress, or cyclical stress.
- Corrosion and material failures are the two most common causes of ruptures.

BK

Question 7

How many miles of pipelines exist in high-consequence areas and how many of them do not have ASV/RSVs? What are in the pipelines and what are the potential consequences of these materials being released?

	Hazardous Liquid		Gas Transmission	
Calendar Year	**HCA HL Miles**	**HL Total Pipe Miles**	**HCA Trans Miles**	**Total Gas Trans Miles**
2020	96,157	229,281	21,109	301,693
2021			21,092	301,368

2021 HL Annual reports are due on June 15th, 2022.

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Question 7 - Continued

Does PHMSA have, or can it develop, statistics for the frequency of leaks (on an annual basis) for pipelines (e.g., on a per mile basis)?

- **For gas transmission (GT)**, PHMSA collects leak data on the annual report.
- If a leak meets the incident definition in 49 CFR Part 191.3, it is omitted from the GT annual report.
- In the CY 2021 annual report, there were 1,248 GT leaks. The annual report includes the count of leaks in each cause category from ASME B31.8S by location (see Figure 1), but there is no additional data about the leak.

Figure 1

PART M1 – ALL LEAKS ELIMINATED/REPAIRED IN CALENDAR YEAR; FAILURES II

Cause	Transmission Leaks and Failures					
	Leaks					
	Onshore Leaks				Offshore Leaks	
	HCA	MCA	Class 3 & 4 non-HCA & non-MCA	Class 1 & 2 non-HCA & non-MCA	HCA	Non-HCA
External Corrosion						
Internal Corrosion						
Stress Corrosion Cracking						
Manufacturing						
Construction						
Equipment						
Incorrect Operations						
Third Party Damage/Mechanical Damage						
Excavation Damage						
Previous Damage (due to Excavation Activity)						
Vandalism (includes all Intentional Damage)						
Weather Related/Other Outside Force						
Natural Force Damage (all)						
Other Outside Force Damage (excluding Vandalism and all Intentional Damage)						
Other						
Total	Calc	Calc	Calc	Calc	Calc	Calc

Question 7 - Continued

Does PHMSA have, or can it develop, statistics for the frequency of leaks (on an annual basis) for pipelines (e.g., on a per mile basis)?

- **For hazardous liquids (HL)**, the annual report does not include leak data.
- Based on the reporting threshold for HL accidents in 49 CFR 195.50, releases of five (5) gallons or more are reported as accidents.
- PHMSA records **GT incident** and **HL accident** data. The data associated with incidents/accidents is in the response to Q6 – Slide 13.

Question 8

What information does PHMSA have on typical (HCA or non-HCA) releases per mile and damages caused – last 10 years?

- PHMSA does not have any data on "releases," though there is data on GT leaks, GT incidents, and HL accidents. For GT leaks, we cannot characterize "damages caused," though we can for GT incidents and HL accidents.
- Though per mile rates for GT leaks, GT incidents, and HL accidents can easily be calculated, there are challenges in deciding which incidents/accidents should be excluded from per mile calculations because of incidents/accidents that involved pipeline components rather than pipe. For GT leaks, we don't have any data to filter out leaks on pipeline components.

BK

Question 8a

If so, can these statistics be broken down into a distribution of hole sizes, perhaps as a fraction of the diameter of the pipe?

- For GT incidents and HL accidents, PHMSA collects data about the geometry of certain failure mechanisms in part C6 (see Figure 2).
- Pipeline failure geometry is typically ragged rather than circular.

Figure 1

C6. Type of release involved: *(select only one)*

☐ Mechanical Puncture ⇨ Approx. size: /__/__/__/__/./__/in. (axial) by /__/__/__/__/./__/in. (circumferential)

☐ Leak ⇨ Select Type: O Pinhole O Crack O Connection Failure O Seal or Packing O Other

☐ Rupture ⇨ Select Orientation: O Circumferential O Longitudinal O Other ______________________

Approx. size: /__/__/__/__/./__/ in. (widest opening) by /__/__/__/__/__/./__/in. (length circumferentially or axially)

☐ Other ⇨ *Describe: ____

BK

Question 8b

If leak rate data is available, can it be broken down based on service? E.g., perhaps based on metallurgy of piping, and/or operating pressure / approach the MAWP of the piping?

PHMSA does not have leak rate data.

Question 9

Will the same parameters (commodity, size pipe - diameter, spacing, which HCAs or could affect HCAs) in the new valve rule also inform what would be subject to an existing pipeline?

- **Valve Rule is based upon the following parameters:**
  - Commodity: Gas or Hazardous Liquids as defined in Parts 192 and 195
  - Diameter: ≥ 6-inch diameter
  - Spacing: Defined maximum spacing for HCAs
- PHMSA would recommend that the committee use these same parameters for existing pipeline. That is not to say that smaller pipelines may not be considered, but PHMSA determined in the Valve/Rupture rule that based on the current state of technology and considering cost and potential impact, that we should focus on those lines 6-inches and greater in diameter.
- Regarding the scope of the rule (HCA vs non-HCA areas); PHMSA would recommend that the committee consider those areas identified in the statute (i.e., HCA and could affect HCA areas).

Question 10

How should we think of prevention / mitigation of ruptures versus leaks? When does a leak become a rupture? (Not codified, criteria for leak/rupture, decision time in the rule, type pressure loss, operating pressure, pipe properties)

- Federal pipeline regulations do not give definitions for leaks. In general, a leak is a relatively small, stable through-wall defect and a rupture is a larger, fast developing defect and is more dependent on operating pressure and pipe properties.
- The new Valve Rule gives a definition of a rupture as a potential unintentional or uncontrolled release of a large volume of hazardous liquids from a pipeline, which is further defined in the Valve Rule.
- The decision time in the new Valve Rule is largely looking at rupture type situations to make sure that ACVs/RCVs would close relatively quickly. Leaks, on the other hand are often small enough that they will would not activate these valves.

Question 10 – Continued

How should we think of prevention / mitigation of ruptures versus leaks? When does a leak become a rupture?

§ 192.635 Notification of potential rupture

(a) As used in this part, a “notification of potential rupture” refers to the notification of, or observation by, an operator (e.g., by or to its controller(s) in a control room, field personnel, nearby pipeline or utility personnel, the public, local responders, or public authorities) of one or more of the below indicia of a potential unintentional or uncontrolled release of a large volume of gas from a pipeline:

1) <u>An unanticipated or unexplained pressure loss outside of the pipeline’s normal operating pressures</u>, as defined in the operator’s written procedures. The operator must establish in its written procedures that an unanticipated or unplanned pressure loss is outside of the pipeline’s normal operating pressures when there is a pressure loss greater than 10 percent occurring within a time interval of 15 minutes or less, unless the operator has documented in its written procedures the operational need for a greater pressure-change threshold due to pipeline flow dynamics (including changes in operating pressure, flow rate, or volume), that are caused by fluctuations in gas demand, gas receipts, or gas deliveries; or
2) An unanticipated or unexplained flow rate change, pressure change, equipment function, or other pipeline instrumentation indication at the upstream or downstream station that may be representative of an event meeting paragraph (a)(1) of this section; or
3) <u>Any unanticipated or unexplained rapid release of a large volume of gas, a fire, or an explosion</u> in the immediate vicinity of the pipeline.

Question 11

What sort of length of time would it be likely for existing pipe to be binding for the valve rule (effective date/ new pipe and replacement of existing pipe)? Thinking back to the double-hull tanker rule, we could easily envision a time horizon of 25 years.

- PHMSA does not know when or how long it would take for all HCAs to have Rupture Mitigation Valves (RMVs).
- **New Valve Rule**
  - **Existing Pipeline**: Valve spacing based on 2 or more miles, in the aggregate, within any 5 contiguous miles within a 24-month period, a RMV is required.
  - **New Pipeline**: Valve Rule has spacing requirements for GT and HL pipelines

Question 12

Can you outline why Marshall, MI is included in the justification of the final rule? It seems to be unrelated to rupture mitigation valves (RMVs).

- The Marshall, MI accident was due to Enbridge having RCVs installed on its ruptured oil pipeline at the time the spill occurred, but its failure to confirm and respond to the rupture promptly rendered that technology essentially useless.
- Marshall, MI and San Bruno, CA accidents were due to pipe failure due to an anomaly and lack of rupture mitigation:
  - Procedures,
  - Potential rupture and usage of flow modeling,
  - Monitoring and isolation equipment and its location on the pipeline,
  - Emergency plans and emergency response,
  - Maintenance and operations, and
  - Training and drills of personnel, including Controllers.

Question 13

The new final rule talks about control room processes and decision making. How will the Valve Rule improvement this? (Inspections)

- **Rule defines requirements for processes and decision making:**
  - Procedures,
  - Potential rupture and usage of flow modeling,
  - Monitoring and isolation equipment and its location on the pipeline,
  - Emergency plans and emergency response,
  - Maintenance and operations,
  - Training and drills of personnel including Controllers, such as:
    - Overall isolation timing for a segment,
    - Point-to-point verification between supervisory control and data acquisition (SCADA) system displays and the installed valves, sensors, and communications equipment; and
    - Identify corrective actions and lessons learned resulting from the validation and confirmation drills - share and implement them across its entire network of pipeline systems.

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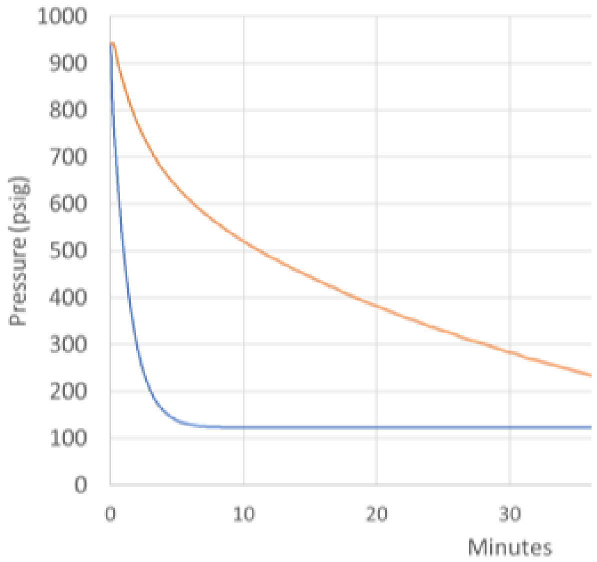
Question 13 – Continued – Background Information

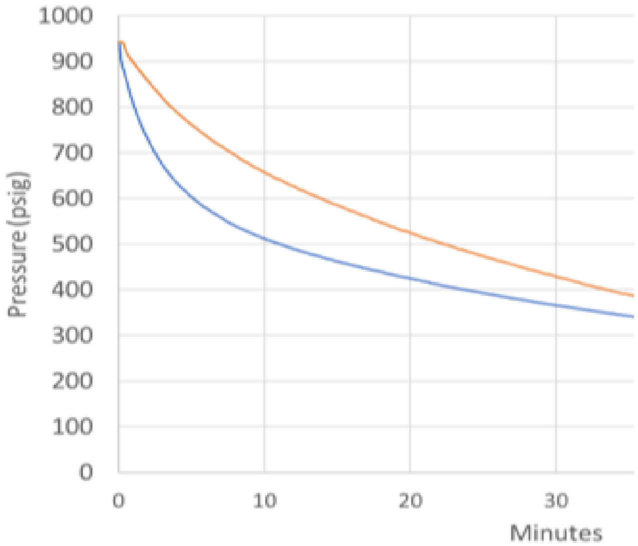
Flow Modeling on a Rupture on a Looped Pipeline

Full Pipe Diameter Rupture



	Low Pressure (500 psig)	Rate of Pressure Change (40 psi/minute)
Valve 1	~ 1 minutes	< 2 minutes
Valve 2	~ 13 minutes	< 2 minutes

50% Area of Pipe Diameter Type Rupture



	Low Pressure (500 psig)	Rate of Pressure Change (40 psi/minute)
Valve 1	~ 12 minutes	< 2 minutes
Valve 2	~ 23 minutes	< 2 minutes

Question 14

Does PHMSA have info on existing mileage in HCAs? The committee report may need to quantify the mileage that would be subject to any rule on existing pipelines. We may be able to use the same criteria as the final rule for new pipelines and then develop an estimate of the number of valves that would have to be installed based on one at the start and at the end of each area with intermediate valves. We would like to enumerate whether these actuators are fitted to existing valves or entirely new valves. Has PHMSA already done this either themselves or by a contractor?

	Hazardous Liquid		Gas Transmission	
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PHMSA Construction Inspections

2018 – early 2020

Facility	Miles	RCVs	ASVs	EFRDs	MOV	Total Valves
Gas Transmission	2,431	200 (86%)	23 (10%)	N/A	9 (4%)	232
Hazardous Liquid	6,674	544 (53%)	136 (13%)	67 (6%)	287 (28%)	1,034

- RCV = Remote Control Valve
- ASV = Automatic Shutoff Valve
- EFRD = Emergency Flow Restricting Device
  (see § 195.450, typically an RCV on new construction)
- MOV = Manually Operated Valve

SN

NAS Committee to Consider

- PHMSA's legal authority for installing valves on existing pipelines in HCAs and non-HCAs.
- Potential cost and benefit considerations and the challenges PHMSA faces in adopting a rule.

Thank You