# A Regulator's View on Approaches to MIC Threat and Failure Assessment

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**Thursday, Feb 7, 2019 from 8:45AM - 11:30AM**

**Forum on Assessment of Microbiologically Influenced Corrosion (MIC) Threats and Failures: Approaches and Challenges**

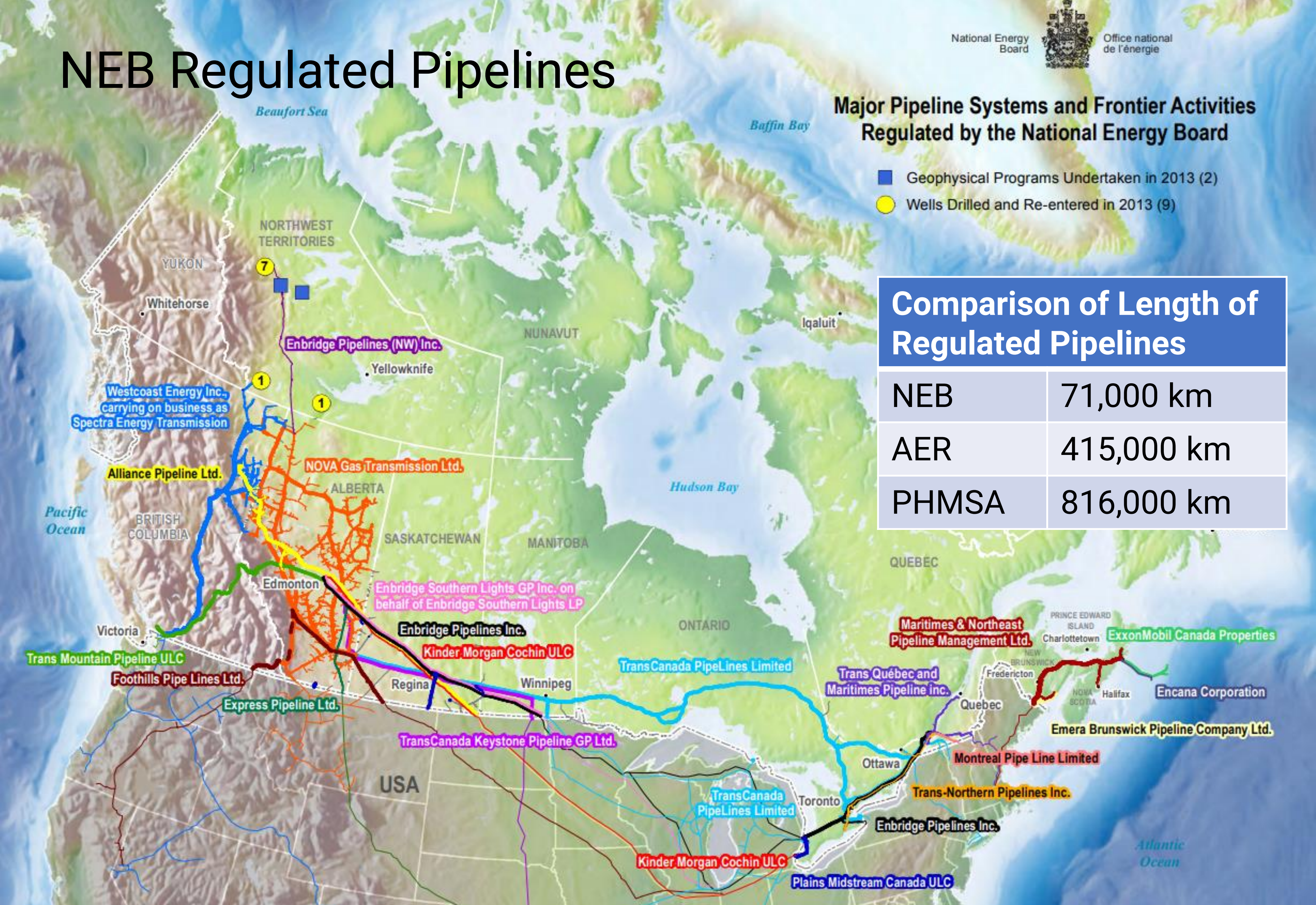
# Disclaimer

*The views, judgments, opinions and recommendations expressed in this session do not necessarily reflect those of the National Energy Board, its Chair or Members, nor is the Board obligated to adopt any of them.*

# A Regulator's View on Approaches to MIC Threat and Failure Assessment

- OPR S40 Integrity Management Program
  - A company shall develop, implement and maintain an integrity management program that anticipates, prevents, manages and mitigates conditions that could adversely affect safety or the environment during the design, construction, operation, maintenance or abandonment of a pipeline.
- The pipeline company is accountable to implement an adequate and effective IMP
  - Follow standards such as CSA Z662
- The regulator must have the confidence in the company's ability and commitment to do so
  - May use Information Requests to clarify, demonstrate, justify, etc.

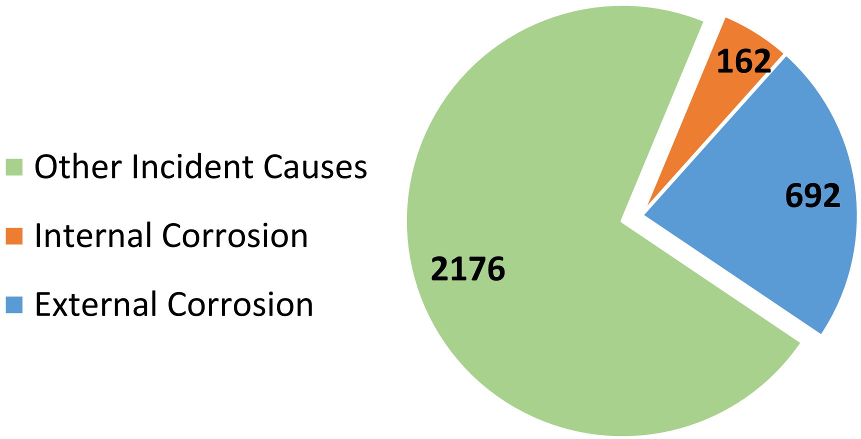
# NEB Regulated Pipelines

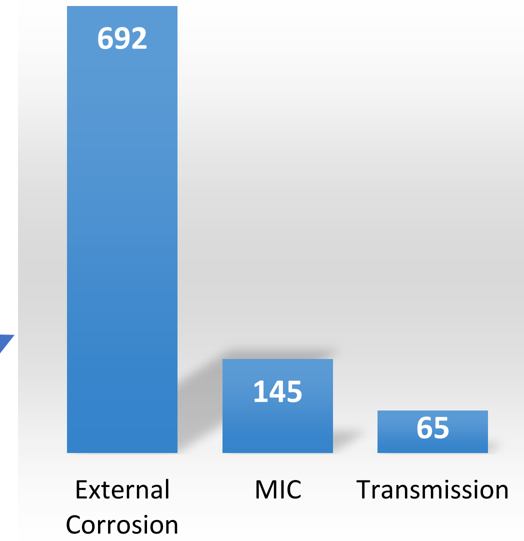



| Comparison of Length of Regulated Pipelines | |
|---|---|
| NEB | 71,000 km |
| AER | 415,000 km |
| PHMSA | 816,000 km |

# PHMSA Incident Data – Hazardous Liquid Pipelines

## 2002 to 2009

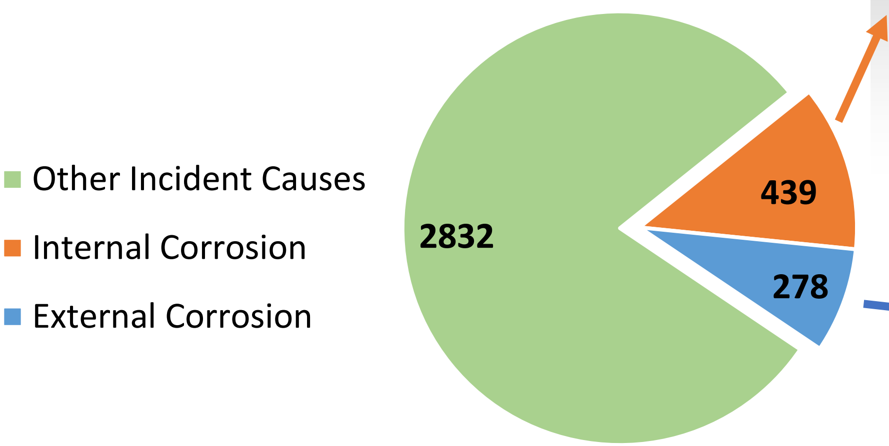


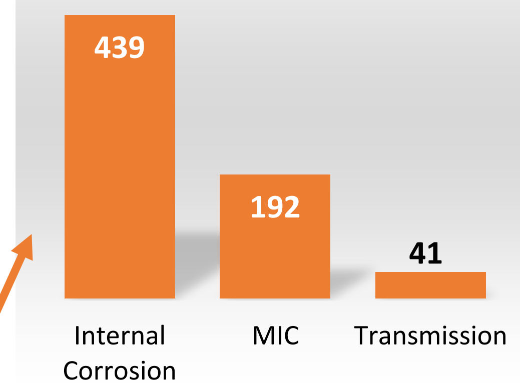




Overall:
4.8% MIC

Transmission:
2.1% MIC

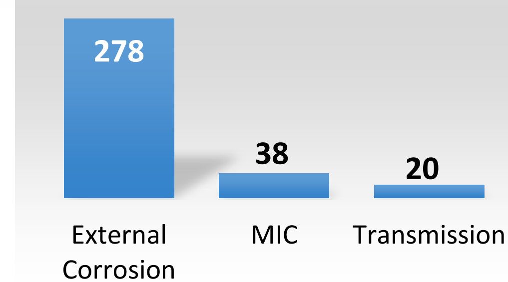
## 2010 to present



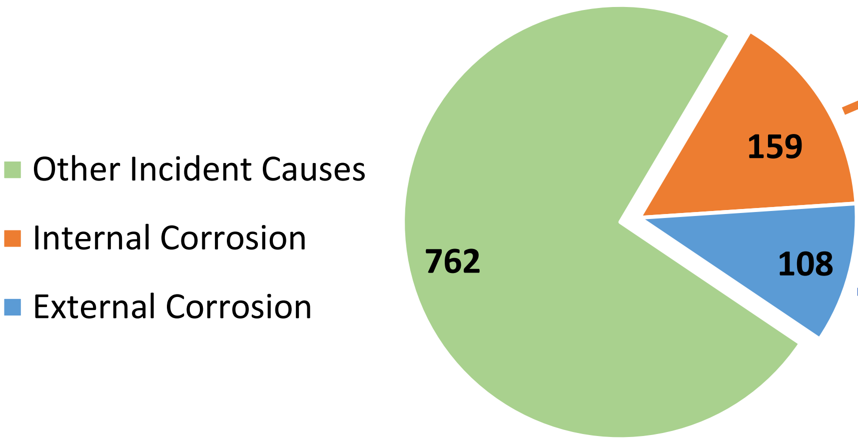

Overall:
6.5% MIC

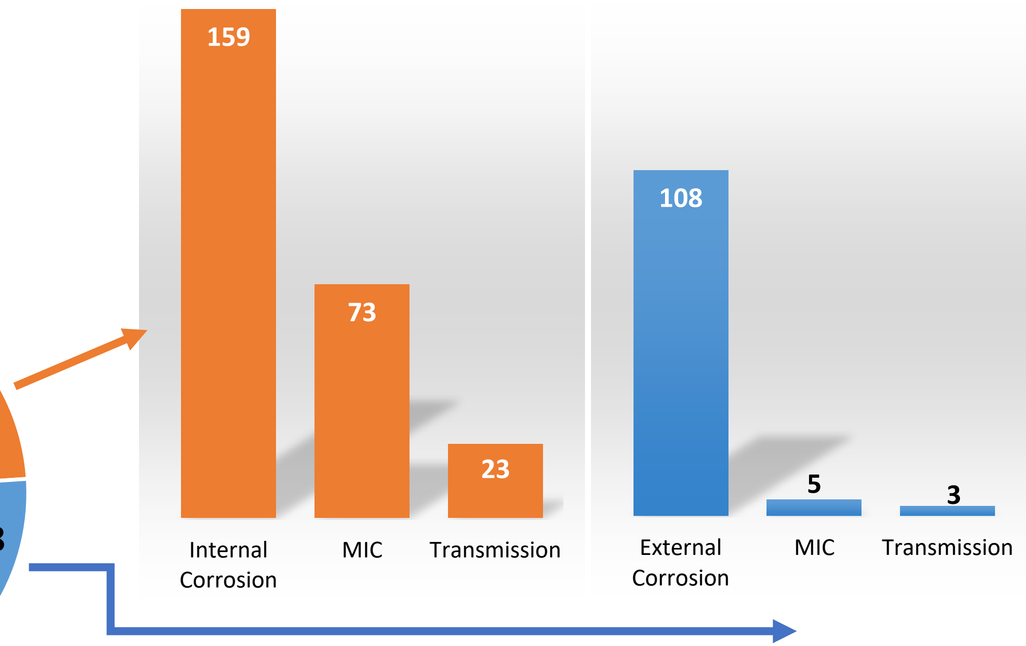
Transmission:
1.7% MIC



# PHMSA Incident Data – Gas Pipelines

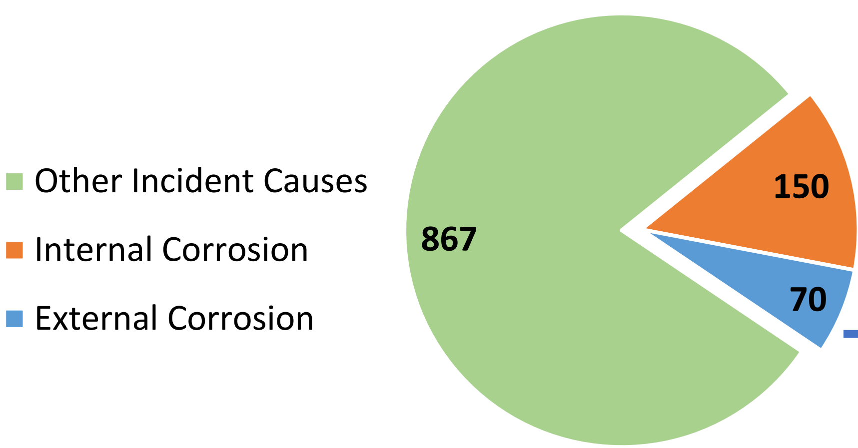
## 2002 to 2009

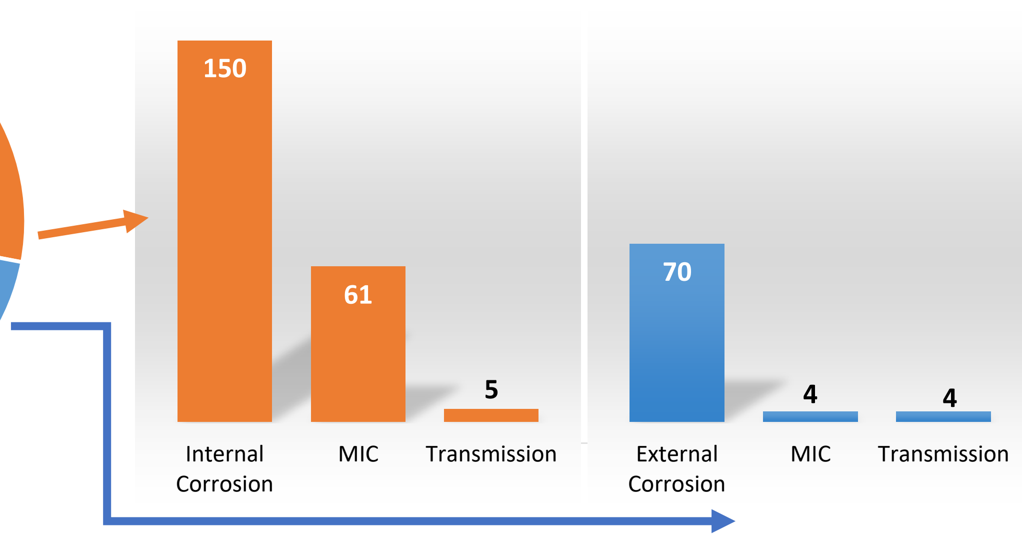



Overall: 7.6% MIC Transmission: 2.5% MIC

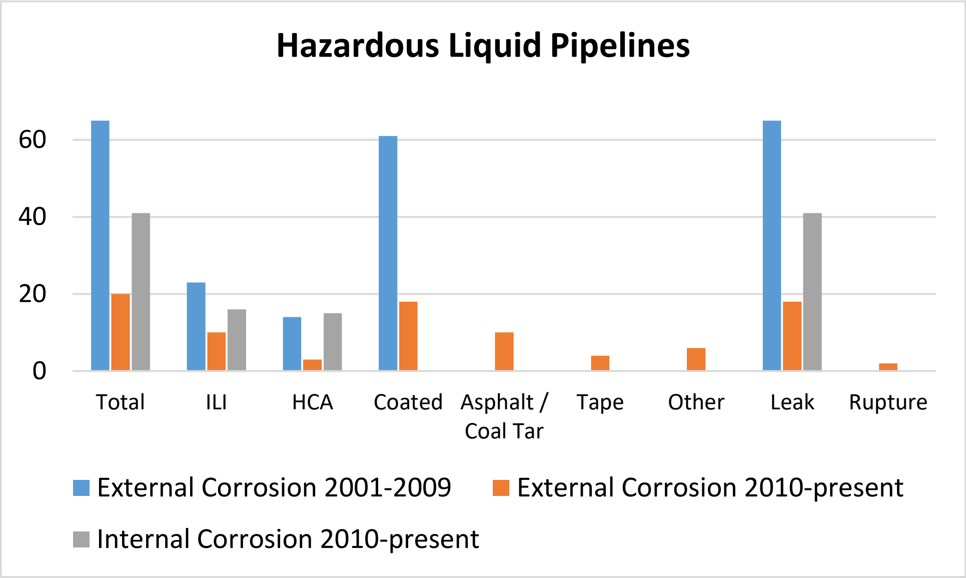
## 2010 to present

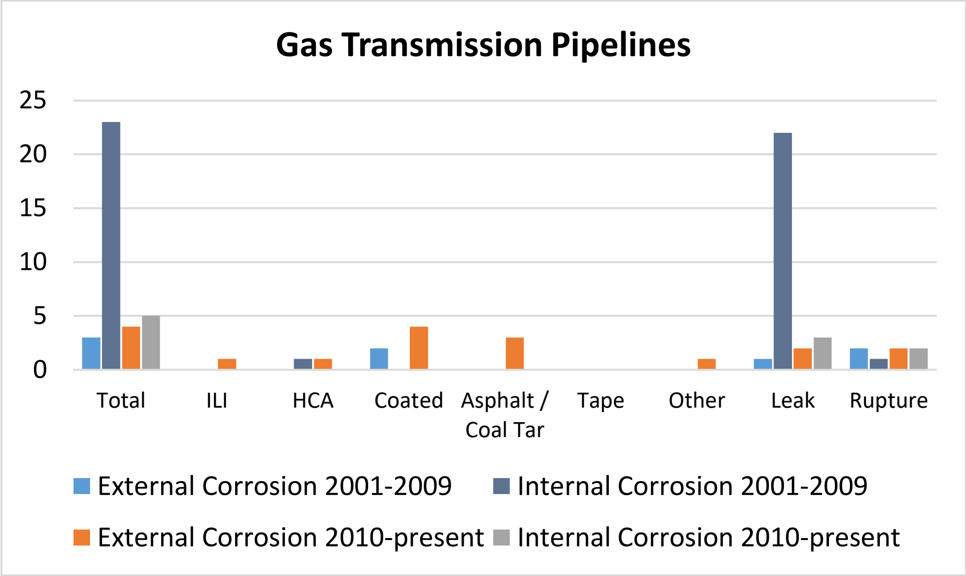


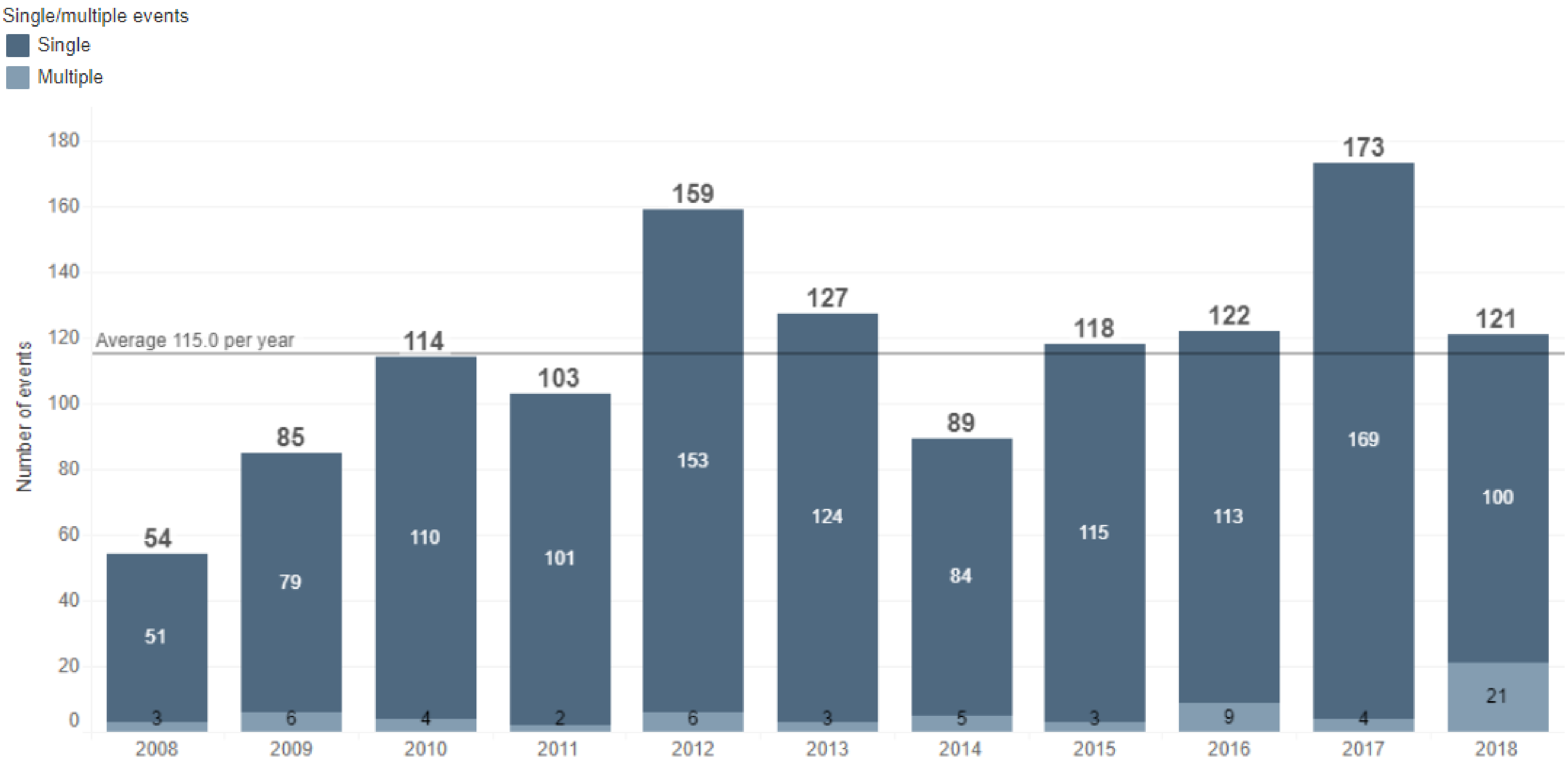

Overall: 6.0% MIC Transmission: 0.8% MIC

# PHMSA Incident Data



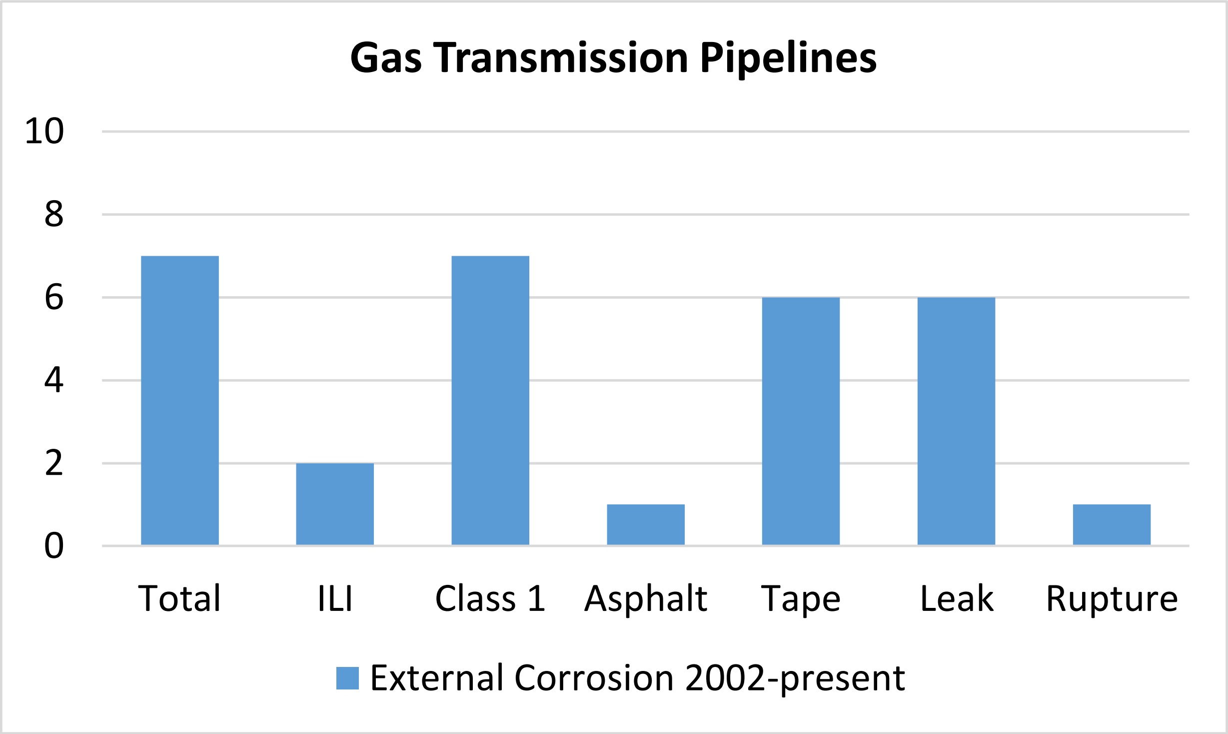



# NEB Incident Data




Canada

# NEB Incident Data with MIC as the main or as a contributing cause




- No reported incidents on liquid lines
- No reported internal corrosion incidents
- The role of MIC may not be known and may not be reported

- MIC failures have been most strongly associated with clay soils and tape coating
- However, MIC failures have been recorded in different soil types with many types of coating

# Where can we expect MIC?

The conclusion that MIC has taken place should be based on the preponderance of circumstantial evidence (NACE TM0106-2016)

- Gathering and aligning data
- Coating condition
  - Type of coating, field or plant applied, age of coating, soil type and conditions, excavation data on the line
  - Above-ground inspections (e.g. DCVG, ACVG)
- Anaerobic/aerobic conditions, water table (elevation profile), soil type
- In-situ monitoring of the environment at pipe depth, e.g. NOVAProbe (soil resistivity, ORP, T, pH)
- Rely still largely on In-Line Inspections


IPC2004-0371

# 2009 Rupture of the NGTL Peace River Mainline (PRML)

- 481 km, 20-inch dia (7.14 mm wall) gas pipeline in NW AB, Class 1
- Built in 1968, field coated with PVC tape
- 1973-2009: experienced 16 leaks and 6 ruptures
- External corrosion as the predominant failure mechanism
- Operated under the jurisdiction of the ERCB (now AER) until 2009, when it moved to the jurisdiction of the NEB
- ILI and excavation program in place
- Rupture in silty soil with some clay present; considerable water at pipe depth

# 2009 Rupture of the NGTL PRML

- Extensive corrosion with localized areas of deep corrosion (complex corrosion geometries)
- Corrosion deposit analysis indicated the presence of iron oxide, iron carbonate, and iron sulphide (mackinawite)
- The presence of MIC thought to be primarily the result of SRB
- Supported by the presence of sulphate rich soil
- MIC was a contributing factor to the external corrosion and the rupture of PRML
- Average corrosion rates were of the order of 0.2 mm/y, where MIC may accelerate pitting rates up to 0.7 mm/y
- Increasing the CP to -1000 mV ON potential was ineffective in the presence of the disbonded shielding coating
- ILI process improvements prioritized areas of external corrosion for coating repair (2004, 2006, 2007)

# 2009 Rupture of the NGTL PRML

- Undersizing of the complex corrosion by the MFL tool

| Characteristic | 2007 MFL Prediction | 2009 Measurement |
| --- | --- | --- |
| Depth | 71% wall thickness | 95% wall thickness |
| Failure Pressure | 8310 kPa (1.47 MOP) | 5540 kPa (0.98 MOP) |

- A field investigation was not triggered
- A new set of field investigation criteria for complex corrosion was developed
- The new criteria were validated with a pressure test
- NEB imposed a more conservative criterion for depth of 70% wall thickness or deeper

# 2009 Rupture of the NGTL PRML

Management system causes of the rupture

- Operational control deficiencies within the IMP, including ineffective external coating, cathodic protection, and in-line inspection
- Inadequate criteria for field investigation by not accounting for the unforeseen tool limitation of sizing complex corrosion

NEB made recommendations to all companies regulated under its jurisdiction to consider the occurrence of complex corrosion and implement the appropriate complex corrosion field investigation criteria

# Conclusions

- The pipeline company is accountable to implement an adequate and effective IMP
- The regulator must have the confidence in the company's ability and commitment to do so

# Challenges

- Difficulty of locating MIC using ECDA methodology, monitoring local conditions, and relating these conditions to the severity of corrosion
- Development of In-line inspection technology that reliably detects pinhole and pitting corrosion, complex corrosion
- Setting appropriate and conservative field investigation criteria