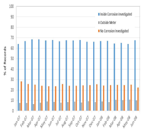
OTD Operations Technology Development

# Risk-Based Atmospheric Corrosion / Leak Survey Considerations



To address new regulations, researchers reviewed historical and current data on indoor gas service piping. In addition, thousands of recent inspections on outdoor and indoor services were collected and statistically analyzed to determine the trends and drivers behind corrosion rates.

## Project Description

The New York State Department of Public Service has notified New York state utilities of a change in code which will update the definition of "Service Line" under Part 255.3(29) to mirror the federal definition under Part 192. This essentially changes the existing service-line definition that limits operator responsibility for jurisdictional piping at the first fitting inside the building wall relative to the federal definition that includes jurisdictional responsibility to the outlet of the meter, regardless of who owns the piping within the building.

The implications of these code changes will be substantial and will impact every operator throughout the state.

To illustrate the complexity of this issue, as of 2013 one New York operator had approximately 900,000 active indoor services statewide. This rule change would therefore involve inspection through the outlet of the meter(s). These installations include a variety of configurations and locations within the premises, including simple single-family meters at the inside front wall, single-family meters located remotely in apartments in multifamily dwellings, and complex multi-meter sets in remote/or high-level meter rooms in high-rise buildings with customer-owned, concealed piping systems.

Recognizing the complexity and challenges of this transition, gas system operators formed a collaborative through the Northeast Gas Association (NGA) to explore reasonable alternatives to implementation that meets the intent of the current federal definition. More specifically, operators suggested that there may be an opportunity for adopting a practical approach to implementation under current Distribution Integrity Management provisions.

This project is focused on developing a risk-based framework to establish sound atmospheric corrosion- and leak-survey intervals. The framework will be based on corrosion and material degradation first principles, historical corrosion and leak-survey data, and practical/operational considerations.

## Deliverable

The deliverables for this project include a White Paper that can support requests to extend inspection periods via a special permit.

## Benefits

Results from this project provide statistically sound data to help utilities address new regulations and maintain safe and efficient operations.

## Technical Concept & Approach

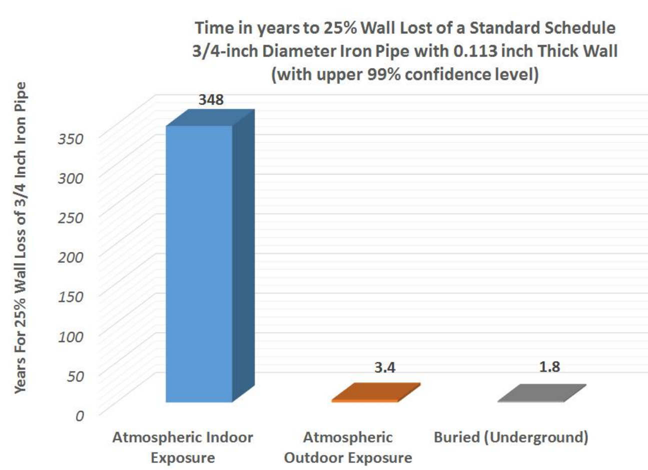
Specific tasks in this project included:

**Literature Review**

A literature review and compilation of subject-matter expertise was conducted to define the governing first principles for atmospheric corrosion and leak formation rates as a function of material, system, and environmental variables.

**Statistical Analysis of Operator Data**

Investigators analyzed the data for trends and created corrosion and leak categories based on the attributes of materials, environment, etc.




*Comparison of time in years to corrode 25% of ¾-inch-diameter iron pipe exposed to indoor vs. outdoor vs. buried conditions.*

**Summary of Precedents from Historical Waivers/ Special Permits**

Waivers and special permits were compared and contrasted and a summary of the precedents established by state and federal regulators developed.

**Establishing a Risk-Based Framework for Extending Survey Intervals**

The risk-based framework was created based on, and defensibly supported by, the scientific and engineering body of knowledge.

## Results

A White Paper was prepared presenting the fundamental principles of indoor and outdoor atmospheric corrosion. The paper also provides a detailed review of the published, peer-reviewed literature related to field data on indoor corrosion, and compares and contrasts this to outdoor corrosion for iron and steel piping materials.

The literature search concluded that relative humidity and its interaction with atmospheric constituents are the main drivers for atmospheric corrosion. The variation in humidity and temperature are dramatically lower indoors than outdoors and, when combined with the absolute lower humidity and pollutant levels, results in lower corrosion rates for indoor steel and iron assets.

Based on decades of field testing and analysis, coupled with 2007, 2008, and 2014 in-field surveys, the indoor corrosion rate is typically 100-1,000s of times lower than the outdoor rates. Furthermore, the occurrence of noteworthy indoor atmospheric corrosion is encountered less than 1% of the time, sometimes significantly less than 1%.

A set of risk-based considerations for categorizing the indoor atmospheric service and indoor leak survey environments was developed. The findings suggest that the intervals for indoor corrosion surveys can defensibly be set to longer periodicities as compared to outdoor surveys of similar meter sets and piping. This would facilitate focused optimization of available operator resources on other, more aggressive environments, thereby lowering composite risk and increasing overall safety.

The project team reviewed utility records of atmospheric corrosion and investigated the factors which influence the occurrence of indoor corrosion, finding that:

- Most of the indoor inspection records had mild surface rust or no indications of corrosion. A minimum number of records (1%) had corrosion indications which prompted immediate or scheduled repairs.
- Foundation type and the presence of sleeves or applied coatings were not significant in affecting the pipe or the meter piping-corrosion conditions.
- Pipe age, percentage of humidity, and pipe material type (i.e., bare vs. coated steel pipes) were significant parameters affecting indoor pipe corrosion condition. However, when it comes to the meter piping system, age and humidity were not significant terms affecting corrosion.
- Investigation of corrosion is routinely performed during by workers when inside buildings. More than 80% of the utility work records included reporting corrosion condition, regardless to the type of job performed on site.
- The number of locations with pitting corrosions was very small. An average of 1% of the atmospheric corrosion inspections had pitting corrosion that required repair or further actions.

A practical example of pipe corrosion using the very conservative 99% upper confidence levels for corrosion rates showed that it would take about 100 times longer to corrode through 25% of a ¾-inch-diameter iron pipe wall indoors as it would outdoors. It also shows that the buried conditions would corrode the same distance in about half the time of outdoor.

Historical (2007-2008) corrosion and leak surveys (outside and indoor) of meter-set populations were collected and analyzed. A statistical regression analysis concluded that the most significant parameter related to corrosion condition was relative humidity, just as the peer-reviewed literature concluded.

The effect of pipe age, humidity, meter locations, and pipe material type were investigated on leak records. None of these parameters were identified as variables affecting leak records. Leak records did not correlate to corrosion indications. Most of the leaks were in the pipe and threaded connections. A small percentage (2%) was at the meter and regulator piping system.

## Status

This project was completed in 2015. A White Paper is available.

## For more information:

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