NATIONAL TRANSPORTATION SAFETY BOARD
Public Meeting of September 24, 2019
(Information subject to editing)

Overpressurization of Natural Gas Distribution System, Explosions, and Fires in Merrimack Valley, Massachusetts
September 13, 2018
NTSB/PAR-19/02

This is a synopsis from the NTSB's report and does not include the Board's rationale for the conclusions, probable cause, and safety recommendations. NTSB staff is currently making final revisions to the report from which the attached conclusions and safety recommendations have been extracted. The final report and pertinent safety recommendation letters will be distributed to recommendation recipients as soon as possible. The attached information is subject to further review and editing to reflect changes adopted during the Board meeting.

Executive Summary

On September 13, 2018, about 4:00 p.m. local time, a series of structure fires and explosions occurred after high-pressure natural gas was released into a low-pressure natural gas distribution system in the northeast region of the Merrimack Valley in the Commonwealth of Massachusetts. The natural gas distribution system was owned and operated by Columbia Gas of Massachusetts, a subsidiary of NiSource, Inc. Columbia Gas of Massachusetts delivers natural gas to about 325,000 customers in Massachusetts. One person was killed and 22 individuals, including three firefighters, were transported to local hospitals due to injuries; seven other firefighters incurred minor injuries. The fires and explosions damaged 131 structures, including at least 5 homes that were destroyed in the city of Lawrence and the towns of Andover and North Andover. Most of the damage occurred from fires ignited by natural gas-fueled appliances; several of the homes were destroyed by natural gas-fueled explosions. Fire departments from the three municipalities were dispatched to the fires and explosions. First responders initiated the Massachusetts fire-mobilization plan and received mutual aid from neighboring districts in Massachusetts, New Hampshire, and Maine. Emergency management officials had National Grid United States (the electric utility) shut down electrical power in the area, the state police closed local roads, and freight and passenger railroad operations in the area were suspended. Columbia Gas of Massachusetts shut down the low-pressure natural gas distribution system, affecting 10,894 customers, including some outside the area who had their service shut off as a precaution.

The accident investigation focused on the following safety issues:

- Adequacy of natural gas regulations
- Project documentation
- Constructability review
- Project management
- Risk assessment

- Safety management systems
- Licensed professional engineer approval of natural gas projects
- Emergency response

Findings

1. None of the following were factors in this accident: the training and qualification of the construction crew, the use of alcohol or other drugs, or the condition and operability of the regulators at the Winthrop Avenue regulator station.

2. The multiple overpressurization accidents investigated by the National Transportation Safety Board over the past 50 years demonstrate that low-pressure natural gas distribution systems that use only sensing lines and regulators as the means to detect and prevent overpressurization are not optimal to prevent overpressurization accidents.

3. A comprehensive and formal risk assessment, such as a failure modes and effects analysis, would have identified the human error that caused the redundant regulators to open and pressurize the system.

4. Columbia Gas of Massachusetts' inadequate planning, documentation, and recordkeeping processes led to the omission of the relocation of the sensing lines for the South Union Street project.

5. The abandonment of the cast iron main without first relocating the sensing lines led to the system overpressurization, fires, and explosions.

6. The delay between the development of the initial project work order and its execution had no impact on this accident.

7. The Columbia Gas of Massachusetts constructability review process was not sufficiently robust to detect the omission of a work order to relocate the sensing lines.

8. NiSource's engineering risk management processes were deficient.

9. Requiring a licensed professional engineer to stamp plans would illustrate that the plans had been approved by an accredited professional with the requisite skills, knowledge, and experience to provide a comprehensive review.

10. The municipal public safety answering points had available and ready resources to handle the large number of distress calls requesting emergency services.

11. The field radio communications used across fire departments on September 13 lacked adequate interoperability and availability to ensure that emergency responders had efficient means of interdepartmental and intradepartmental communications.

12. The communications issues during the September 13 overpressurization illustrate the need for emergency planning for a multi-jurisdictional response.

13. The Columbia Gas of Massachusetts incident commander faced multiple competing priorities, such as communicating with affected municipalities, updating the emergency responders, and shutting down the natural gas distribution system, which adversely affected his ability to complete his tasks in a timely manner.

14. Columbia Gas of Massachusetts was not adequately prepared with the resources necessary to assist emergency management services with the response to the overpressurization.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the overpressurization of the natural gas distribution system and the resulting fires and explosions was Columbia Gas of Massachusetts' weak engineering management that did not adequately plan, review, sequence, and oversee the construction project that led to the abandonment of a cast iron main without first relocating regulator sensing lines to the new polyethylene main. Contributing to the accident was a low-pressure natural gas distribution system designed and operated without adequate overpressure protection.

Recommendations

New Recommendations

As a result of this investigation, the National Transportation Safety Board makes the following new safety recommendations:

To the Pipeline and Hazardous Materials Safety Administration:

1. Revise Title 49 *Code of Federal Regulations* Part 192 to require overpressure protection for low-pressure natural gas distribution systems that cannot be defeated by a single operator error or equipment failure.

2. Issue an alert to all low-pressure natural gas distribution system operators of the possibility of a failure of overpressure protection; and the alert should recommend that operators use a failure modes and effects analysis or equivalent structured and systematic method to identify potential failures and take action to mitigate those identified failures.

To the States of Alabama, Alaska, Arizona, Arkansas, California, Colorado, Connecticut, Florida, Georgia, Idaho, Illinois, Iowa, Kentucky, Louisiana, Maine, Maryland, Minnesota, Mississippi, Missouri, Montana, Nebraska, Nevada, New York, North Carolina, Pennsylvania, South Carolina, South Dakota, Texas, Utah, Virginia, and Wyoming:

3. Remove the exemption so that all future natural gas infrastructure projects require licensed professional engineer approval and stamping.

To the Commonwealth of Massachusetts Executive Office of Public Safety and Security:

4. Develop guidance that includes a component for effective communications when deploying mutual aid resources within the first hours of a multi-jurisdictional incident.

To NiSource, Inc.:

5. Review your protocols and training for responding to large-scale emergency events, including providing timely information to emergency responders, appropriately assigning NiSource emergency response duties, performing multi-jurisdictional training exercises, and participating cooperatively with municipal emergency management agencies.

Classified Recommendations

To the Commonwealth of Massachusetts:

1. Eliminate the professional engineer licensure exemption for public utility work and require a professional engineer's seal on public utility engineering drawings. (P-18-5)

   This recommendation is classified *Closed—Acceptable Action*.

To NiSource, Inc.:

2. Revise the engineering plan and constructability review process across all of your subsidiaries to ensure that all applicable departments review construction documents for accuracy, completeness, and correctness, and that the documents or plans be sealed by a professional engineer prior to commencing work. (P-18-6) (Urgent)

   This recommendation is classified *Closed—Acceptable Action*.

3. Review and ensure that all records and documentation of your natural gas systems are traceable, reliable, and complete. (P-18-7) (Urgent)

   This recommendation is classified *Closed—Acceptable Action*.