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*. 