

THE DEPARTMENT OF PUBLIC UTILITIES
Review of Natural Gas Explosions

I. **DEPARTMENT REVIEW OF PREVIOUS FINDINGS**

In March 2009, responding to heightened public concern in the wake of several natural gas explosions during the winter of 2008-2009, the Department of Public Utilities (DPU) undertook a review of the Department's completed investigations of explosions that occurred in Massachusetts over the past five years. The intent was to re-open the books on these closed investigations, comparing and contrasting their findings to determine if the Department could detect any trends or common threads regarding the root causes of the explosions.

Six explosions during this five-year period remained under investigation and, as such, were not part of this review. An additional incident – a fatal house explosion on December 17, 2009 in Scituate – was ruled outside the DPU's jurisdiction and referred to the Plymouth County District Attorney, who later determined it to be an act of suicide. The Department took a fresh look, however, at its findings involving six other explosions that occurred between January 13, 2004 and November 9, 2005 in the communities of Sudbury, Walpole, Boston, Weston and Lexington. The DPU Pipeline Engineering and Safety Division's review of investigative reports of these six completed cases concluded that no single or common cause linking the occurrence of explosions could be determined. That is, the DPU cannot point to any of the main categories of cause (excavator error; property owner action; gas company operator error; or infrastructure material, condition, or age; and natural causes) as the most common or probable reason for explosions during that time period. The review found that the explosions were caused by a variety of factors, and indicated no trend.

In summary, two explosions resulted from **material failure**. At one location, a cast iron main cracked and leaked gas into an MBTA substation. At another, a gasket on a service line failed, allowing gas into the basement of a house. Two were the result of **gas company operator error**. In one incident, a gas company employee sent to delineate the location of a gas service line failed to use his locating equipment and computer correctly, allowing a contractor to hit the mismarked service and release gas into the house. In a second incident, after a gas company crew left open a valve that should have been closed, a second crew put gas into the line (assuming that the valve was closed) and gas leaking from the open valve was ignited by an appliance in the basement. One explosion was caused by a **combination of gas company operator error and corrosion**. A gas company crew mistakenly connected gas mains operating at different pressures, resulting in an over pressurization of a large portion of the gas distribution system in one town. A badly corroded service line then failed due to the excess pressure. A **homeowner accident** was responsible for another explosion. A homeowner working on his house accidentally started a fire, which damaged the gas service regulator and allowed gas to escape into the house.

More detailed accounts of each accident investigation reviewed by the Department follow.

II. SUMMARY OF NATURAL GAS EXPLOSION INVESTIGATIONS 2004 – 2009

Between January 2004 and March 2009, the Pipeline Division investigated thirteen natural gas explosions that occurred in Massachusetts (See Appendix A: Table of Investigations).

A. Explosions Still Under Investigation

Six of the explosions are still under investigation, and therefore the Department cannot comment on the following ongoing investigations:

- **39 Jenny Lind Street, N. Easton, September 10, 2007**
- **44 Willowdale Road, Groton, December 11, 2007**
- **88 Waltham Street, Maynard, January 2, 2008**
- **76 Eastern Avenue, Gloucester, January 25, 2009**
- **93 New York Avenue, Somerset, February 19, 2009**
- **1415 Osterville Avenue, Barnstable, March 9, 2009**

B. Summary of Concluded Investigations

The Department's investigations into seven explosions have concluded, and are summarized below.

1. **72 Austin Road, Sudbury, January 13, 2004 (Material Failure)**

KeySpan Energy Delivery, New England (now National Grid) operates the gas distribution system in Sudbury.

An explosion occurred in the basement of a single family home. The Department interviewed the homeowner and gas company personnel who responded to the emergency. The incident resulted in approximately \$20,000 in property damage.

Gas was leaking from a nylon gasket in the service riser outside of the home. The riser is where the buried service line rises above the ground to connect to the service regulator and meter. Laboratory examination of the riser indicated that the nylon gasket in the riser had cracked, allowing gas to escape. The gas flowed into the building through a furnace air intake added by the customer after the gas meter was installed. The furnace's burner ignited the gas.

Prior to the incident, KeySpan had conducted periodic leak surveys, consistent with regulations, and found no leaks. KeySpan had not responded to any house calls or maintenance at this location since the service installation in 1971. The customer's installation of the furnace air intake, which allowed gas to flow into the house, took place two years prior to the incident.

As a result of this incident, the Department recommended that KeySpan check other service risers of the same vintage with the same type of gaskets. The metallurgical report did not recommend a material change to these gaskets. No other defective gaskets were found.

2. **9 Rockwood Street, Walpole, April 13, 2004 (Third Party Damage)**

Bay State Gas Company operates the gas distribution system in Walpole.

A fire and an explosion occurred in a single family home in Walpole. The incident resulted in an estimated \$150,000 in property damage. Interviews revealed that the homeowner had been installing siding on the home and accidentally knocked a jar of flammable liquid off a shelf in the home's utility room. The spilled liquid caught fire. The fire and falling objects damaged the service regulator and the gas meter, which were inside the utility room. Accumulating gas exploded after the initial fire was extinguished.

Although it was not related to the cause of the explosion, the Department's investigation found that the gas company had not inspected the inside meter and regulator for corrosion and leakage. The lack of inspection was in violation of federal regulations (49 CFR Part 192, § 192.481) requiring that each operator inspect each pipeline or portion of pipeline that is exposed to the atmosphere for evidence of atmospheric corrosion at least once every 3 calendar years, but with intervals not exceeding 39 months .

Bay State Gas Company paid a civil penalty of \$5,000 and revised its inspection procedures.

3. **96 The Fenway, Boston, April 6, 2005 (Operator Error)**

KeySpan Energy Delivery, New England (now National Grid) operates the gas distribution system in Boston.

Gas company crews were installing a new service line to a dormitory and activating a replacement gas main. The crew installing the service line removed a flange and left open a valve in the basement. The other crew, mistakenly thinking that the valve was closed, put gas into the new main. The gas flowed out of the open valve into the basement where an explosion and fire occurred. There were seven injuries, including one person who was hospitalized overnight. The incident resulted in approximately \$800,000 of property damage.

KeySpan paid a civil penalty of \$50,000. The Department also required the gas company to review and revise its operating and maintenance procedures, specifically with regard to purging air out of gas pipelines in order to safely insert gas into the service line. Company employees were retrained in the revised procedures.

4. **449 Old Colony Avenue, South Boston, February 2, 2005 (Material Failure)**

KeySpan Energy Delivery, New England (now National Grid) operates the gas distribution system in South Boston.

A six-inch low pressure cast iron main under Old Colony Avenue cracked. The leaking gas flowed into an abandoned electrical duct, which was connected to the MBTA substation. The explosion damaged the unoccupied substation. The estimated property damage was \$50,000.

The Department investigated the explosion and issued a report. The gas odorant levels in KeySpan's system at Old Colony Ave met regulatory requirements. In 2003, there was one dig safe request in the area of 449 Old Colony Avenue. D.P.U. pipeline safety regulations (220 C.M.R. § 113.00, Replacement and Abandonment of Cast Iron Pipelines) require replacement of cast iron pipe that has been "encroached upon" by nearby excavation work. However, the excavation activity on Old Colony Avenue did not meet the cast-iron encroachment activity benchmarks set forth in these regulations.

The depth of the main was 3.5 feet and the frost level in the area extended to 3.5 feet below grade. It was determined that the crack in the main was likely to have been caused by a frost heave, a naturally-occurring phenomenon.

225 North Avenue, Weston, September 12, 2005 (Operator Error)

KeySpan Energy Delivery, New England (now National Grid) operates the gas distribution system in Weston.

The gas company improperly marked out the location of the gas service line to a single family house. Damages were estimated to be in excess of \$50,000. There were two injuries.

The employee used defective equipment and did not properly check the location records for the service line. A contractor working to install a septic tank hit the service line. Leaking gas was ignited inside the house.

KeySpan paid a civil penalty of \$10,000 for failing to correctly mark the location of its underground facilities in violation of the Dig Safe Law. KeySpan also paid a civil penalty of \$12,000 for failing to follow its operating and maintenance manual with respect to reporting a discrepancy between company engineering records and the actual location of the gas facility as required by federal regulations.

The Department also required the company to review and revise its operating and maintenance procedures, specifically with regard to Dig Safe mark-outs. Company employees had to be retrained in the revised procedures.

5. **3 Hancock Avenue, Lexington, November 9, 2005 (Operator Error, Corrosion)**

KeySpan Energy Delivery, New England (now National Grid) operates the gas distribution system in Lexington.

A gas company crew was installing a connection between two existing gas mains and replacing a section of another gas main. Due to a map reading error, they connected a 60-psi gas main to a 2-psi gas main, over-pressurizing much of the gas distribution system in the town. A badly-corroded gas service line failed due to the higher pressure. A single family home was destroyed. The estimated property damage to 3 Hancock Avenue was over \$375,000.

With respect to the over-pressurization of the gas system in Lexington, KeySpan paid a civil penalty of \$37,500. The Department also required the gas company to review and revise its operating and maintenance procedures, specifically with regard to design review of projects, field notification for main tie-in projects, and distribution system mapping.

With respect to 3 Hancock Avenue, KeySpan paid a civil penalty of \$250,000. The Department required the company to develop and implement a program of inspecting its piping located inside of customer premises for corrosion and leakage.

Company employees were retrained in all of the revised procedures.

6. **27 Turner Road, Scituate, December 17, 2008 (Non-jurisdictional)**

Bay State Gas Company operates the gas system in Scituate.

A house exploded in Scituate, killing one person. No leaks were found on the gas main. The gas service line was pressure tested and did not leak. The gas meter was located outside the house. The Department concluded that the explosion did not result from any problem with the gas distribution system, and that, therefore, this incident was not within the Department's jurisdiction. The Plymouth County District Attorney has determined that the explosion was the result of an intentional act.

III. **JURISDICTION OF THE DEPARTMENT OF PUBLIC UTILITIES**

Massachusetts has over 21,000 miles of gas mains, 20 liquefied natural gas (LNG) plants, and 24 propane-air plants. Massachusetts is served by seven natural gas distribution companies: Bay State Gas; Berkshire Gas; Blackstone Gas; National Grid (formerly KeySpan); New England Gas; NSTAR Gas; and Unitil; and four municipal gas departments: Holyoke Gas and Electric Department; Middleborough Gas and Electric Department; Wakefield Gas and Electric

Department; and Westfield Gas and Electric Department. Together, these companies serve about 1.2 million customers.

Natural gas is considered a hazardous fuel by both the state and the federal government. (49 U.S.C. § 60100) To protect the public from the potential hazards involved in the transmission, distribution, production, storage and use of natural gas, both the United States Department of Transportation (US DOT) and the Massachusetts Department of Public Utilities have regulatory authority over natural gas facilities.

The Department's Pipeline Engineering and Safety Division is the certified agent of the US DOT for the enforcement of federal regulation of natural gas distribution pipelines within the Commonwealth. Pursuant to its delegated authority, the Pipeline Division inspects natural gas distribution pipeline facilities within the Commonwealth, investigates natural gas-related incidents, and imposes remedial actions. Remedial actions may include civil penalties, if, after investigation, the Department determines that a natural gas operator did not comply with federal pipeline safety regulations. The US DOT audits the Pipeline Division annually to ensure that the pipeline safety program meets federal guidelines. The Pipeline Division has consistently received a high performance rating from the US DOT, most recently receiving a rating of 98 percent.

The Pipeline Division also enforces state laws and the Department's own comprehensive gas safety regulations pertaining to natural gas distribution systems. (220 C.M.R. § 99.00 et seq) The Pipeline Division is responsible for technical and safety oversight of the seven natural gas companies and four municipal gas departments in Massachusetts listed above. In addition, the Division enforces the state's "Dig Safe" law, M.G.L. c. 82, §§ 40 , 40A- 40E, that requires any person performing excavation work to notify the Dig Safe Call Center of the location of the excavation in order to prevent damage to underground facilities.

The Department is authorized by state and federal laws to assess civil penalties for violations of federal and state safety regulations. The penalties may not exceed \$50,000 per violation for each day the violation persists, up to a maximum of \$1,000,000 for any related series of violations. (G. L. c. 164, § 105A)

A. Natural Gas Facility Inspections

The Pipeline Safety Division's engineers inspect jurisdictional gas facilities (pipelines, meter stations, regulator stations, dispatch centers, LNG plants, and propane-air plants) for compliance with federal and state safety regulations. If the Department believes that a violation may exist, the Pipeline Safety Division issues a Notice of Probable Violation (NOPV) or Warning Letter to the alleged violator along with a Consent Order. The Consent Order includes proposed action(s) to be taken by the alleged violator to correct the violation, and a proposed civil penalty. The alleged violator may agree to the Consent Order, thereby resolving the case, or may request an informal review conference with the Pipeline Safety Division. Following a requested informal review conference, the Pipeline Division issues a

written decision. If a company disputes the written decision, it may request an adjudicatory hearing before the Department.

B. Investigation of Natural Gas Incidents

Pursuant to its authority as a certified agent of the US DOT, and pursuant to G.L. c. 164, §105A, the Department investigates incidents involving the release of natural gas. The Pipeline Safety Division's engineers investigate to determine the cause of the incident; analyze whether the pipeline operator violated any safety regulations; and ascertain what actions an operator should take to prevent or minimize a recurrence. The investigations are comprehensive and may include most or all of the following: inspection(s) at the scene; collection of evidence; metallurgical testing laboratory;¹ interviewing witnesses and gas company personnel; and inspection of gas company records.

While conducting the investigation, the Department remains mindful of due process requirements and the possibility that litigation may be initiated by persons suffering personal injury or property damage as a result of the incident.

Explosions caused by the release of natural gas may be also subject to the jurisdiction of the local fire department, the Office of the State Fire Marshal, and law enforcement officials, such as the local police department or Office of the District Attorney. While the Department cooperates and may share information with other investigative authorities, the Department issues its own findings at the conclusion of its investigation.

C. Dig Safe Law Enforcement

Massachusetts' Dig Safe law requires any person who proposes to excavate in public or private land to notify the Dig Safe Center of his or her intent to excavate. The Dig Safe Center then contacts all operators of underground gas pipelines and electric, telecommunication and television cables in the excavation locale. These operators, in turn, must mark the locations of their facilities in advance of the excavation to minimize the risk of potential damage to the facilities. Lastly, the excavator must take adequate precautions to prevent damage to the facilities while digging.

Any person aware of possible violations of Dig Safe procedures may report them to the Pipeline Division. Utility operators are mandated by regulation to report possible Dig Safe violations. The Pipeline Division investigates the reports, may issue a NOPV, conduct informal review conferences with the excavators, and perform field inspections, as necessary. The Department has the authority to assess a civil penalty of \$1,000 for a first offense and up to \$10,000 in certain circumstances.

The Department also works with utilities and the Dig Safe Center to conduct training sessions for excavators. The sessions provide excavators with information about underground utility

¹ Metallurgical testing is conducted by private laboratories.

lines and precautions to take when excavating near those lines. Programs such as “Managing Underground Safety Training” are an important tool for preventing damage to underground pipelines and cables.

D. Other Jurisdictional Responsibilities

1. Intrastate LNG Facilities

The Department is responsible for ensuring the safe and effective operation of LNG plants. The Pipeline Division monitors the security of the LNG plants by conducting on-site inspections, reviewing safety procedures and operating and maintenance records.

2. Intrastate Transmission Pipelines

There are 27 miles of intrastate gas transmission lines in Massachusetts, which are distinguishable from intrastate natural gas “mains.” Gas transmission lines provide direct interconnections to high users of natural gas, such as power plants or industrial facilities.

The increased use of natural gas to generate electricity has resulted in the construction of new intrastate pipelines to connect power plants directly to gas transmission lines. As intrastate facilities, these pipelines fall under the aegis of the Pipeline Safety Division, whose engineers inspect their design, construction, operation, and maintenance. Such pipelines typically operate at pressures significantly higher than local gas distribution pressures.

3. Cast Iron Pipe Replacement

Massachusetts is one of the few states that has addressed the replacement or abandonment of aged cast-iron pipe. The Department’s regulations require pipeline operators to prioritize and replace segments of old cast-iron pipe in accordance with Department-developed criteria. In addition, companies must replace or abandon such pipes, subject to specific criteria, when third-party excavation occurs nearby.

The Department has taken measures to address the potential safety hazards posed by unused service lines. Department regulations require gas companies to abandon gas service lines by cutting them off at the gas main and plugging them. Companies must abandon older service lines, installed before the federal code went into effect, within five years after customer service is discontinued. Newer service lines, installed after 1971, must be abandoned within ten years. (220 C.M.R. 107.00) Additionally, the Department has updated existing regulations with more stringent gas leakage survey methods for operating lines.

APPENDIX A: TABLE OF INVESTIGATIONS

PIPELINE DIVISION INVESTIGATIONS OF NATURAL GAS EXPLOSIONS: 2004 - 2009

DATE	LOCATION	CAUSE(S)	DPU ACTIONS
January 13, 2004	72 Austin Road, Sudbury	Ignition of an accumulation of natural gas in the furnace ventilation system. The source of the gas was a leak in a gasket on a riser fitting. Ignition source was the furnace burner.	Recommended that the company review fittings with gaskets of similar materials and vintage.
April 13, 2004	9 Rockwood Street Walpole	The investigation found that a flammable liquid spilled onto the regulator and the floor. The flammable liquid then ignited. A falling can and the fire damaged the regulator, allowing gas to leak. The explosion was caused by the accumulation of gas in the room after the initial fire was extinguished and after the damage to the regulator occurred.	Recommended that the company to develop an inside piping inspection program.
April 6, 2005	96 The Fenway, Boston	Natural gas entered the basement through the service valve in the basement, which has been inadvertently left in the open position. An ignition occurred which resulted in a fire and explosion.	Required the company to revise its procedures and retrain all employees on the revised procedures.
February 2, 2005	449 Old Colony Avenue, South Boston	Cracked cast iron pipe. May have been due to frost in the ground.	None.
September 12, 2005	225 North Avenue, Weston	Company improperly located and marked the underground service line in response to a Dig Safe requested by a construction company.	Required the company to revise its procedures and retrain all employees on the revised procedures.
November 9, 2005	3 Hancock Avenue, Lexington	Service leak due to overpressurization.	Required the company to revise its procedures and retrain all employees.

PIPELINE DIVISION INVESTIGATIONS OF GAS EXPLOSIONS: 2004 – 2009 (continued)			
DATE	LOCATION	CAUSE(S)	DPU ACTIONS
September 10, 2007	39 Jenny Lind Street, North Easton	Still under investigation.*	
December 11, 2007	44 Willowdale Road, Groton	Still under investigation.*	
January 2, 2008	88 Waltham Street, Maynard	Still under investigation.*	
December 17, 2008	27 Turner Road, Scituate	Non-jurisdictional – No leaks were found on the gas main and the service passed a pressure test.	None.
January 25, 2009	76 Eastern Avenue, Gloucester	Still under investigation.*	
February 19, 2009	93 New York Avenue, Somerset	Still under investigation.*	
March 9, 2009	1415 Osterville Avenue, Barnstable	Still under investigation.*	

* Consistent with long-standing Department policy, the Department does not comment on or discuss our open investigations.