



**The Commonwealth of Massachusetts**  
**DEPARTMENT OF PUBLIC UTILITIES**

**PIPELINE ENGINEERING AND SAFETY DIVISION**

**INCIDENT REPORT**

76 Eastern Avenue, Gloucester Massachusetts  
January 25, 2009

PIPELINE ENGINEERING AND SAFETY DIVISION

Accident File

Location: 76 Eastern Avenue, Gloucester, Massachusetts

Date of Accident: January 25, 2009

Gas Company: Boston Gas Company d/b/a National Grid

Estimated Property Damage: Over \$400,000\*

Injuries: One

Report Issued – August 2, 2010

\* Estimated by Boston Gas Company d/b/a National Grid

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## **I. INTRODUCTION**

### **A. Scope of Investigation**

The Massachusetts Department of Public Utilities (“Department”), Pipeline Engineering and Safety Division (“Division”), pursuant to G.L. c. 164, § 105A and a Federal Certification Agreement as provided for in 49 U.S.C. § 60105, has investigated a natural gas (“gas”) release at 76 Eastern Avenue, Gloucester on January 25, 2009 (“Incident”).<sup>1</sup> The release of gas contributed to an explosion, fire and over \$400,000 in property damage to the dwelling, as estimated by the Operator of the natural gas facilities, Boston Gas Company, d/b/a National Grid (“National Grid” or “Operator”) (Exh. 1). One person was hospitalized as a result of the Incident.

As part of the Department’s annual certification process by the United States Department of Transportation (“U.S. DOT”), the Department must report to the U.S. DOT

each accident or Incident . . . involving a fatality, personal injury requiring hospitalization, or property damage or loss of more than an amount the Secretary establishes... and any other accident the [Department] considers significant, and a summary of the investigation by the [Department] of the cause and circumstances surrounding the accident or Incident. 49 U.S.C. § 60105(c).

The purpose of this report is to inform the U.S. DOT as to the cause and circumstances surrounding the Incident.

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<sup>1</sup> Incident means any of the following events:

1. An event that involves a release of gas from a pipeline or liquefied natural gas or gas from an LNG facility and,
  - a. A death, or personal injury necessitating in-patient hospitalization; or
  - b. Estimated property damage, including cost of gas lost, of the operator or others, or both, of \$50,000 or more.
2. An event that results in an emergency shutdown of an LNG facility.
3. An event that is significant in the judgment of the operator, even though it did not meet the criteria of paragraphs (1) or (2). 49 C.F.R. Part 191, § 191.3.

The Department has established procedures for determining the nature and extent of violations of codes and regulations pertaining to safety of pipeline facilities and the transportation of gas, including but not limited to, 220 C.M.R. §§ 101.00 through 113.00. See 220 C.M.R. § 69.00 et seq. The Division also enforces the U.S. DOT safety standards for gas pipeline systems as set forth in 49 C.F.R. Part 192 ("Part 192"). G.L. c. 164, § 105A.

**B. Overview of Incident**

On January 25, 2009, at approximately 9:15 a.m., National Grid notified the Department of a house explosion at 76 Eastern Ave. Gloucester (Exh. 2).<sup>2</sup> The Department dispatched two investigators to the scene, and upon arrival, found that the reported address had been demolished by the blast and ensuing fire. The investigators reported to the Gloucester Fire Chief, Gloucester Police Lieutenant, and Massachusetts State Police detectives from the Fire and Explosion Investigation Section of the Office of the State Fire Marshal ("State Fire Marshal's Office") to provide their assistance in the investigation.

The State Fire Marshal's Office and the Gloucester Police and Fire Departments determined that the explosion was caused by escaping gas from the leak on the six inch gas main entering the structure at 76 Eastern Avenue, and that the source of ignition was unknown (Exh. 3).

The investigators met with National Grid management personnel to review the conditions present and the actions being taken as a result of the Incident. National Grid distribution personnel were in the process of pinpointing the gas leak, and were barring over

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<sup>2</sup> In a letter to all operators, the Director of the Division has requested that operators inform the Department of any incident promptly, but no more than two hours after the incident.

the main in front of the Incident location. Service technicians had been dispatched across the neighborhood to perform a leak investigation of the area and inspect buildings to check for gas migration.

The Operator detected gas readings inside three locations, and vented and monitored these locations (Exh. 4). Two homes had been evacuated due to the damage sustained by the explosion (Exh. 3). Several manholes in streets within the neighborhood also had gas readings as gas had migrated via sewer lines, at these locations the Operator pried open manhole covers to allow gas to vent to the atmosphere (Exh. 4).

National Grid performed leak surveys of the area to monitor the gas mains and services. As a result of the surveys, the Operator identified and subsequently repaired two additional leaks (Exh. 5).

National Grid personnel pinpointed the leak on the gas main located in front of 76 Eastern Avenue and began to excavate. The Operator exposed the gas main and found a circumferential crack on the six inch cast-iron low pressure main at the 1 ¼" bare steel service tee supplying gas to 77 Eastern Avenue (Exh. 6). National Grid secured the leak by removing the service tee, and installing a Servi-Seal clamp on the gas main (Exh. 4).

## **II. THE DEPARTMENT'S INVESTIGATION**

### **A. Description of the Site**

Eastern Avenue is in a residential area of Gloucester. The area is comprised of single-family residences. The structure at 76 Eastern Avenue was a two-story house with a basement (Exh. 6). The foundation of the original structure was field stone, with a dirt floor crawl space on the left front corner of the home, and an addition at the rear of the house had a poured concrete foundation (photo of the house (id.)). The oil fired house heater and gas fired water heater were located in the basement (id.).

In 1922, the Operator installed the six-inch cast-iron gas main<sup>3</sup> that underlies Eastern Avenue (Exh. 7). At the time of the incident, the operating pressure of the gas main was between nine and 9.5 inches water column (id.).<sup>4</sup> The 1½" coated steel gas service supplying 76 Eastern Avenue was installed in 1960, and the meter was located in the basement of the house (Exh. 8).

### **B. Description of the Scene**

The house at 76 Eastern Avenue was destroyed by the explosion and ensuing fire (Exh. 6). The house collapsed into the foundation, debris had been blown onto the street and into adjoining properties (Exh.9).

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<sup>3</sup> "Main" means a distribution line that serves as a common source of supply for more than one service line.

<sup>4</sup> Inches water column is a measurement of pressure with 27.71 inches of water column equal to one pound per square inch gauge. Pounds per square inch gauge refer to the pressure expressed in pounds exerted on one square inch of surface area. The designation "gauge," indicates the readings are already adjusted to ignore the surrounding atmospheric pressure, which is 14.7 psi at sea level. If psig gauge were not connected to any pressure source, it would read zero even though it is actually sensing 14.7 psi at sea level.

National Grid dispatched technicians across the neighborhood to investigate the buildings in the area for gas migration. The Operator vented and monitored three homes that had gas entering the structures, and two additional locations were evacuated due to the damage sustained by the explosion (Exh. 4).

National Grid distribution personnel pinpointed a gas leak on the gas main in front of 76 Eastern Avenue, and began digging in the street to expose the gas main. When the Operator exposed the gas main, National Grid found a circumferential crack on the six inch cast-iron main at the 1 ¼" gas service tee supplying 77 Eastern Avenue (Exh. 6). The cracked cast iron main was in front of, and in proximity to, the left front corner of 76 Eastern Avenue (Exh. 9).

The Operator removed the service tee, cleaned the main, and installed a Servi-Seal clamp to both secure the leak and provide a temporary tap for the replacement service for 77 Eastern Avenue. To install the clamp, National Grid personnel had to clear away a large piece of ledge directly below the section of the cracked main (Exh. 4).

National Grid detected gas readings in several manholes in streets within the neighborhood, as gas had migrated via sewer lines. At these locations the Operator pried open the manhole covers to allow gas to vent to the atmosphere (id.).

The gas service to 76 Eastern Avenue had not been immediately shut off as there was no service valve installed, and fire fighting apparatus were blocking the street, preventing National Grid from excavating at the service location on the main. When access was available, a National Grid crew dug and exposed a 1 ½" coated steel service pipe (Exh. 9). The Operator cut and capped the service pipe, removed the tee, and plugged the main (Exh. 4).



National Grid also cut and capped the gas service to 74 Eastern Avenue, removed the tee and plugged the main as the building had been deemed uninhabitable.

**C. Leak Detection**

**1. Post Incident**

After the Incident, National Grid initiated leak surveys of the area (Exh. 5). On January 25, 2009, the Company identified and repaired a joint leak on the main in front of 79 Eastern Avenue (id.). In addition, National Grid initiated an extensive leak survey, which encompassed the surrounding streets of the Incident location, and all of the cast-iron mains within the Town of Gloucester (id.). The Operator also performed a walking survey on Eastern Avenue, and on eleven streets adjacent to the Incident area (id.). National Grid reported that the leak surveys it conducted from January 25 to February 2, 2009, identified a total of 47 leaks, of these, 32 were repaired, and 15 did not require immediate attention (Exh. 5).

**2. Winter Patrol Survey**

National Grid initiated the Winter Patrol Survey of its cast-iron mains in Gloucester during the winter of 2008/2009, and conducted a first pass of the area on January 15, 2009, ten days before the Incident occurred (Exhs. 10, 17). This Winter Patrol Survey detected no gas leaks on the cast-iron gas main located at Eastern Avenue, Gloucester (Exh. 17).

**D. Pressure Test of the Service Line**

On Monday January 26, 2009, National Grid personnel prepared to pressure test the gas service at 76 Eastern Avenue (Exh. 4). The State Fire Marshall's Office was conducting its investigation of the Incident scene, and did not allow access to the basement (Exhs. 4, 12).

The gas service, meter and inside piping were intact to the outlet of the meter. The inside piping was broken off at an elbow above the meter. The meter assembly and the inside service piping were bent over at a 90° angle as the tee on the service had been turned down by the falling debris (Exhs. 4, 12).

The service cock inside the basement was found in the on position (Exhs. 4, 12). In order to perform the pressure test, the service cock was shut off. The Operator introduced ten pounds of air pressure into the gas service to determine if the piping was tight (Exhs. 4, 12). The test did not hold, and the fittings in the basement were soap tested (Exh. 4). A leak was found on a nipple between the tee and service cock (id.).

The gas pipe above the service cock was cut (id.). The service cock was un-threaded from the tee, attached were the leaking nipple below the cock and the small section of pipe cut above the cock (id.). The service tee was plugged with a steel plug and again ten pounds of air pressure was introduced into the gas service (id.). The fittings, piping and pressure test assembly were soap tested and no leaks were present (id.). The gas service was pressure tested for 17 minutes and the test held (id.). The air pressure in the test was then increased to 90 pounds and again the fittings were soap tested, the test held for 18 minutes and the gas service to 76 Eastern Avenue was determined to not be leaking (id.).

**E. 76 Eastern Avenue – Resident Interview**

On March 10, 2009, Department investigators had an opportunity to interview the resident of 76 Eastern Avenue (Exh. 13). The resident was inside the house at 76 Eastern Avenue when it exploded. He described what had occurred on Sunday January 25, 2009, the date of the Incident (id.).

He stated that on January 25, 2009, he arrived home from work at approximately 8 a.m. and could see black smoke emanating from the house chimney (id.). He stated that he entered his home through the rear door, noticed a haze in the kitchen, and could also see small particles floating in the air (id.). He stated that the air had a garlic smell to it (id.).

He heard a humming noise coming from the house heater and opened the cellar door (id.). He recalls turning on a light switch at the top of the stairs, walking down the stairs and then turning on another light switch for additional lighting (id.).

He checked the house heater, and he knew that it was running, but not producing much heat, as the pipes were not hot - just warm - and the heater was making noise sounding like "jake braking" (id.). He recalled walking around the cellar and didn't notice a gas odor (id.). He remembered that the cellar was also filled with a heavier haze than had been present in the kitchen (id.).

He then walked up the stairs and into the kitchen, where he called the oil company to report the problem with his oil burner (id.). He spoke with an oil company employee and requested service for the burner (id.).

He hung up the phone, and walked to the cellar door (id.). As he stood at the open cellar door he saw a white flash at the bottom of the stairs and heard a loud noise (id.). He stated that he fell into the cellar along with the debris from the home and when he was able to stand he could see daylight where the house walls were once present (id.).

The resident provided sketches detailing the floor layout of his home (id.). He explained that the home had been built by his grandfather, and that an addition had been built in 2001 at the rear of the house (id.). The addition at the rear of the house had a poured

concrete foundation and floor, the remainder of the house foundation was constructed of stone and mortar with a cement floor (id.). A crawl space was located at the left front corner of the house that was constructed with concrete blocks, it had a dirt floor and approximately 3-4 feet of headroom (id.). No insulation or vapor barrier had been installed on the first floor joists inside the crawlspace (id.). Inside the basement, a window led into the remainder of the basement (id.). This window from the crawlspace had been framed, but no window had been installed (id.). The window opening was approximately five feet off the ground and served as an entrance to the crawlspace.

### **III. MAINTENANCE ACTIVITIES**

#### **A. Odor Calls and Leak Repairs**

The Operator responded to a number of odor calls on Eastern Avenue from December 26, 2008 to the time of the Incident (Exh. 17). On December 26, 2008, National Grid received notification from the Gloucester Fire Department of an odor complaint at 75 Eastern Avenue (id.). On December 28, 2008, National Grid found that the six inch cast-iron main in front of 70 Eastern Ave had broken, and installed a clamp to secure the leak in the street. (Exhs. 14, 17).

On December 29-31, 2008, the Operator reported gas readings at 69 and 71 Eastern Avenue (Exh. 17). On January 1-2, 2009 the Operator reported gas readings at 69 Eastern Avenue only (id.). On January 2, 2009, National Grid repaired a leak on the main in front of 72 Eastern Avenue (Exhs. 14,17). On January 5, 2009, the Operator completed an installation of a full seal muff on a bell joint in front of 72 Eastern Avenue (Exhs. 14, 17).

On January 11, 2009, National Grid responded to an odor complaint at 70 Eastern Avenue (Exh. 17). The Operator found a ¼ percent gas reading inside the premise and purged gas from the ground (id.). The Operator returned on January 12, 2009 to the same location, and found no gas readings, but again purged gas from the ground (id.). On January 13, 2009, the Operator installed full seal muffs on three bell joints at the intersection of Eastern Avenue and Hartz Street (Exhs. 14, 17).

On January 15, 2009, the Operator responded to another odor complaint at 70 Eastern Avenue (Exh. 17). The Operator found no gas readings (id.). The following day, the Operator completed a routine mobile leak detection assessment of Gloucester and recorded no gas readings (Exh. 10).

On January 19, 2009, the fire department responded to an odor call at 70 Eastern Avenue (Exh. 17). The Operator reported no gas readings (id.). On January 20, 2009, National Grid investigated another odor call at 70 Eastern Avenue, but detected no gas readings (id.). On January 25, 2009, the Operator was contacted about the Incident at 76 Eastern Avenue (id.).

**B. Records of Odorization**

An operator must odorize the gas in its distribution system of sufficient intensity so that the gas is readily perceptible to the normal or average olfactory senses of a person coming from fresh, uncontaminated air, into a closed room containing 0.15 percent gas in air. 220 C.M.R. § 101.06(20). An operator must also conduct periodic sampling of the gas to assure the proper concentration of odorant throughout its system. Id.

National Grid conducts odorant sampling throughout its system on a monthly basis. On January 25, 2009, National Grid personnel performed odorant measurements at three separate locations in the Town of Gloucester (Exh. 15). The results (in percent gas and air) are as follows:

1. 77 Eastern Avenue: Reading actual 0.035; 0.10; 0.09
2. 82 Eastern Avenue: Reading actual 0.04; 0.075; 0.075
3. 8 School Street: Reading actual 0.035; 0.09; 0.10

The odor detection levels indicate that the odorant was within the limit prescribed by the State regulation. The odorant levels also met the federal pipeline safety requirement, contained in Part 192, § 192.625, which requires that gas be odorized so that it can be detected at a level of one percent gas and air (Exh. 15).

**C. Cast-Iron Main Replacement Program**

The Operator stated that it performed an evaluation to select cast-iron main replacement candidates for the 2008 construction season (Exh. 16). National Grid reported that the six inch low pressure cast-iron main segment installed near 76 Eastern Avenue did not qualify as a condition based replacement in 2008 (id.).

The Operator added that, based upon the broken cast-iron main at 70 Eastern Avenue on December 28, 2008, and the broken cast-iron main at 76 Eastern Avenue on January 25, 2009 that this main segment would qualify for replacement under its replacement program for inclusion in the 2009 replacement program (id.). The Operator stated that it would replace the main (id.).

The Operator collects leak data from its leak management system ("LMS") which is linked to the Company's mapping system (id.). For all cast-iron mains that have a break in the main, the Operator creates a 200 foot arc around the location of the break (id.). Each instance where two or more arcs combine to indicate that two or more broken mains have been repaired within 400 feet of each other creates a base line candidate for replacement (id.).

#### IV. CONSTRUCTION ACTIVITY ON EASTERN AVENUE

National Grid reported that it received three Dig Safe requests for work to be performed on Eastern Avenue by Third Parties (Exh. 17). The scope of the work included blasting for a drainage ditch, a sewer connection, and an emergency utility pole replacement (id.). The blasting was proposed to have taken place approximately 1,800 feet away (id.). National Grid determined that the six inch cast-iron main had not been encroached as a result of third party construction during the last two years (id.). See 220 C.M.R. §§ 113.05; 113.06; 113.07.

## **V. ANALYSIS OF THE PIPE SAMPLES**

Massachusetts Materials Research, Inc. ("MMR") performed an analysis of the cracked section of gas main, gas service tees and elbows supplying 76 and 77 Eastern Avenue, and inside service piping and meter for 76 Eastern Avenue. On April 27, 2010, it issued a report on the results of its analysis ("MMR Report").<sup>5</sup> The MMR Report concludes that

the crack in the service main originated at the tapped hole [at twelve o'clock for the service pipe to 77 Eastern Avenue] and traveled to the 6 o'clock position in service where final fracture occurred. This accounts for the non-planar transverse crack profile. The cause of the crack appears to be the combination of graphitic corrosion at the tap location likely combined with differential frost heave effects between the pipe and the tap. Frost heave effects on the tap and connected service line would stress the threaded hole in the service main. The January, 2009, temperature profile contains numerous temperature plunges from at to slightly above freezing down into the teens and single digits.

(MMR Report at 12)

## **VI. FINDINGS AND CONCLUSIONS**

### **A. Findings**

1. The structure at 76 Eastern Avenue was a two-story house with a basement.
2. The foundation of the original structure was field stone, with a dirt floor crawl space on the left front corner of the home, and an addition at the rear of the house with a poured concrete foundation.
3. The resident of 76 Eastern Avenue arrived home from work at approximately 8 a.m. on January 25, 2009.
4. The resident noticed black smoke emanating from the chimney, and a haze in the kitchen.
5. He recalled hearing a noise from the heater, opened the cellar door, and turned on the cellar lights.

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<sup>5</sup> Copies of the MMR report can be obtained by contacting: Veda-Anne Ulcickas, Massachusetts Materials Research, Inc., P.O. Box 810, Century Drive, West Boylston, MA 01583.



6. He walked down to the cellar and turned on another cellar light.
7. He returned upstairs to call for service on the heater, hung up the phone and walked to the open cellar door.
8. As he stood at the open cellar door, he saw a white flash, heard a loud noise, and fell into the cellar.
9. On January 25, 2009, National Grid notified the Department of a house explosion at 76 Eastern Avenue, Gloucester.
10. The Operator found a circumferential crack on the six-inch cast-iron main at the 1 ¼" gas service tee supplying 77 Eastern Avenue.
11. The cracked cast iron main was in front of, and in proximity to, the left front corner of 76 Eastern Avenue.
12. Inside the basement, an open window faced the remaining basement from the crawlspace under the left front corner of 76 Eastern Avenue.
13. On January 25, 2009, the operating pressure of the National Grid Cast-iron gas main underlying Eastern Avenue was between 9 and 9.5 inches water column.
14. On January 25, 2009, the Gas odorant levels met state and federal regulations.
15. On December 28, 2008, National Grid repaired a break on the main in front of 70 Eastern Ave.
16. On January 2, 2009, National Grid repaired a leak on the main in front of 72 Eastern Avenue.
17. On January 5, 2009, the Operator sealed a bell joint in front of 72 Eastern Avenue.
18. On January 13, 2009, the Operator sealed three bell joints at the intersection of Eastern Avenue and Hartz Street.
19. For 2008, the Operator concluded that the six inch low pressure cast-iron main segment near 76 Eastern Avenue did not qualify for replacement.
20. Prior to the incident, Dig Safe requests for Eastern Avenue included blasting, a sewer connection, and a utility pole replacement.
21. The blasting was proposed to have taken place approximately 1800 feet away.

22. National Grid determined that the six inch cast-iron main had not been encroached as a result of Third Party excavation during the last two years.

**B. Conclusions**

The MMR Report's conclusions that cause of the crack in the main appears to be a combination of graphitic corrosion at the service tap location, combined with the effect of differential frost heaves between the pipe and the tap are reasonable, and based upon substantial and specific evidence.

The release of gas from the cracked gas main possibly traveled through voids in the ledge, the dirt floor in the crawl space under the left front corner of the house, and the field stone foundation walls. The gas accumulated in the basement. The ignition source for this gas could not be determined from the many electrical devices within the basement and the first floor.