The Commonwealth of Massachusetts

DEPARTMENT OF PUBLIC UTILITIES

PIPELINE ENGINEERING AND SAFETY DIVISION

INCIDENT REPORT

22 Manning Street, Reading Massachusetts

January 25, 2010

PIPELINE ENGINEERING AND SAFETY DIVISION

Accident File

Location: 22 Manning Street, Reading Massachusetts

Date of Accident: January 25, 2010

Gas Company: Boston Gas Company, Essex Gas Company, and Colonial Gas Company each d/b/a National Grid

Estimated Property Damage: *$250,000

Injuries: One

Report Issued – November 26, 2012

* Estimated by 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 22 Manning Street, Reading, on January 25, 2010 ("Incident").[1] The release of gas contributed to an explosion, and over $250,000 in property damage to the dwelling, as estimated by the Operator of the natural gas facilities, Boston Gas Company and Colonial Gas Company d/b/a National Grid ("National Grid" or "Operator") (Exh. 1). One individual was injured (Exh. 2).

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

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1 "Incident" means any of the following events:

> (1) An event that involves a release of gas from a pipeline, or of liquefied natural gas, liquefied petroleum gas, refrigerant gas, or gas from an LNG facility, and that results in one or more of the following consequences:
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> > (i) A death, or personal injury necessitating in-patient hospitalization;
> > (ii) Estimated property damage of $50,000 or more, including loss to the operator and others, or both, but excluding cost of gas lost;
> > (iii) Unintentional estimated gas loss of three million cubic feet or more;
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> (2) An event that results in an emergency shutdown of an LNG facility. Activation of an emergency shutdown system for reasons other than an actual emergency does not constitute an incident.
> (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) of this definition.

49 C.F.R. Part 191, § 191.3.

> 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.

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, 2010, at approximately 8:00 p.m., National Grid notified the Department of a house explosion and fire at 22 Manning Street, Reading (Exh. 3). The Department dispatched two investigators to investigate the Incident. The Reading Fire Department reported that one person was admitted to the hospital for observation (Exh. 2, at 3). National Grid operates a 6-inch diameter cast iron gas main[2] located in the vicinity of the intersection of Manning and Pleasant Streets (Exhs. 3, 4).[3]

> The State Fire Marshal's Office determined that the most probable
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> . . . cause of this explosion and subsequent fire was a migration of gas vapors from a cracked six-inch gas main on the street through the soil and into the basement. The vapors most likely entered the basement through two sewage

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2 *"Main"* means a distribution line that serves as a common source of supply for more than one service line.

3 The leaking gas main was on Pleasant Street, near the intersection of Pleasant Street and Manning street, and in front of the house at 22 Manning Street. The house was at the corner of Manning Street and Pleasant Street.

> drain lines as well as the crack in the basement floor. The most likely ignition source . . . was the furnace located in the basement.
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> (Exh. 4, at 2)

Massachusetts Materials Research, Inc. ("MMR") performed an analysis of the cracked section of gas main and issued a report ("MMR Report"). The report concluded that damage to the cast iron main was believed to have been caused by natural forces associated with temperature changes and subsequent frost heave (MMR Report at 3).

II. THE DEPARTMENT'S INVESTIGATION

A. Description of the Site

Manning Street is in a residential area of Reading with single and two family dwellings. The structure at 22 Manning Street was a 2½ story wood frame structure (pitched roof) with a full basement, and a 1½ story in-law apartment attachment (Exh. 5). The building facade also consisted of wooden clad-board siding, while the foundation was poured concrete (id.). The heating system for the house was located in the basement (id.). Two (2) sewer line clean-outs were observed in the basement; one sewer clean-out was located adjacent to the boiler unit along the rear wall, while the other was located along the center of the opposite wall which is at the front of building (id.). There was also a crack in the concrete slab in the basement floor that ran from the front wall to the back wall (Exh. 4).

The Company reported that the 6-inch diameter cast-iron gas main that underlies Pleasant Street was installed in 1930 (Exh. 6). The portion of the leaking main near the intersection of Manning Street and Pleasant Street was buried four feet deep (id.). At the time of the incident, the operating pressure of the gas main was 1.8 pounds per square inch gauge

("psig") (id.).[4] The MAOP of the system is 2 psig (id.). There was a one-inch plastic gas service supplying gas to 22 Manning Street (id.). The existing gas meter was located outside, on the left side of the house (id.).

B. Description of the Scene

The house at 22 Manning Street, Reading sustained significant structural damage due to the explosion and ensuing fire (Exh. 4). Several exterior walls of the house were pushed out, thus compromising the structural integrity of the building (id.). Interior walls, doors and ceilings also sustained structural damages, while other parts of the house encountered only moderate fire damages (Exhs. 3, 4).

National Grid distribution personnel located the gas leak on the gas main on Pleasant Street - in front of 22 Manning Street - and began excavating in the street to expose the existing cast iron gas main (Exh. 3). At 9 p.m., National Grid exposed the six-inch cast iron main (id.). When the Operator exposed the gas main, it found the main broken, but not completely severed (id.). The break on the main was located directly across the street from 22 Manning Street (id.). The Operator noted that the frost line was approximately twelve inches below the surface (id.).

The Operator cleaned the main, and installed a clamp to secure the leak until permanent repairs were completed—the cracked main was permanently repaired by removing the cracked section of cast iron main, and replacing it was a new segment of plastic pipe (Exhs. 3, 5).

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[4] "psig" refers 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.

At 7 p.m. (before National Grid exposed the main), National Grid detected gas readings that showed 100 percent gas in sewer manholes on both sides of the house, minimal readings at the water service, and one percent gas at 228 Pleasant Street (Exh. 3).

On January 26, 2010, National Grid permanently removed and replaced the section of main that had fractured, and pressure tested the gas service to 22 Manning Street (Exhs. 8 and 10).

C. Leak Detection

1. Post Incident Leak Surveys and Repairs

After the Incident, National Grid initiated a leak survey, which encompassed the surrounding streets of the Incident location (Exh. 7). National Grid discovered and repaired one leak at 228 Pleasant Street (Exh. 8). During the period January 25 to 29, 2010, additional post-incident leaks were reported and repaired (id.). The repairs were located on Main, Manning, Pleasant, South and Prescott Streets, Reading (id.).

2. Pre-Incident - Winter Patrol Surveys

Prior to the Incident, National Grid had not commenced its Winter Patrol Survey for the 2010 winter season for the affected area (Malden Division) (Exh. 9). Company records indicate that National Grid last conducted winter patrols beginning January 16, 2009 (Exh. 9). The final pass was conducted early spring (March 2009) (id.). The Operator did not detect any main breaks or new gas leaks during said period (id.).

D. Pressure Test of the Service Line

On January 26, 2010, National Grid pressure tested the one-inch service line supplying gas to 22 Manning Street, Reading (Exh. 10). The service line was pressure tested for 15 minutes at 90 psig — no loss in pressure was observed (id.). As such, the gas service was eliminated as one of the possible sources of gas leakage (id.).

E. Odor Calls and Leak Repairs

National Grid reported that the homeowner stated to the Reading Fire Department that he smelled gas in the basement about one hour before the Incident, but did not report it to National Grid (Exh. 3). National Grid did not get an odor call for the Incident site (id.).

From December 30, 2005, to the time of the incident on January 25, 2010, the Operator conducted a series of leak surveys within the affected area (Exh. 9). The Operator conducted both walking and mobile leak surveys during said period.

However, according to the Operator's records, located within the affected area was a number of existing Grade 3 leaks that the Operator monitored and rechecked from 2006 to 2009 (Exh. 11). The Grade 3 leaks were located at 97 and 217 Pleasant Street (id.).

F. 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.

National Grid conducts odorant sampling throughout its system on a monthly basis. On January 25, 2010, National Grid personnel performed odorant measurements at three (3) separate locations in the Town of Reading (Exh. 12). These locations were located in close proximity to the incident. The distinct odor level (DOL) results (in percent gas and air) were as follows:

Location	Threshold Level (% Gas in Air)	Distinct Odor Level (% Gas in Air)
Lowell Street (Reading take Station):	0.04	0.10
John @ Haven Street (Regulator Station):	0.03 0.04	0.07 0.09
235 Pleasant Street, Reading	0.05 0.06	0.09 0.10

(Exh. 12)

The odor detection levels indicate that the odorant was within the limit prescribed by the State regulation (id.). 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.

III. ANALYSIS OF THE PIPE SAMPLES

MMR performed an analysis of the cracked section of 6-inch cast iron gas main supplying gas to 22 Manning Street, Reading. MMR issued a report on the results of its analysis ("MMR Report").[5] The MMR Report at 10-11, noted that:

> Although this incident pipe was spun cast, its chemistry (wt. % phosphorous) and metallurgy are more like a pit cast pipe. These in combination with a notable amount of shrinkage porosity resulted in a pipe that would be weaker than the average spun cast pipe and more typical of a pit cast pipe in behavior. Many times, when a spun cast pipe exhibits anomalous microstructure, it is the result of the manufacturing technique of the company that made it.

The MMR Report concludes that:

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[5] 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

This pipe exhibited a classic transverse fracture due to bending loads. Subsurface soils are not static and their variations along the length of a pipe can produce variable tensile, compressive, and bending loads. Additionally, variations in soil/backfill composition and saturation can affect responses to freeze/thaw cycles and heavy precipitation. A combination of graphitic corrosion, porosity, and anomalous microstructure would have produced a spun cast pipe that was weaker than others more typical of that casting method. This pipe was metallurgically more similar to older pit cast pipes and thus would be more sensitive to soil loading than the average spun cast sample.

IV. FINDINGS AND CONCLUSIONS

A. Findings

1. National Grid operates the natural gas distribution facilities in Reading, MA.

2. A 6-inch diameter cast-iron gas main underlies Pleasant Street, Reading.

3. The maximum allowable operating pressure of the main was 2 psig.

4. The cast iron main on Pleasant Street was installed in 1930.

5. From 2006 to 2009, the Company monitored a number of existing non-hazardous Grade 3 gas leaks at 97, and 217 Pleasant Street.

6. National Grid conducted its first pass of winter patrol surveys in January 2009, and concluded its last pass before the Incident in March 2009.

7. These winter patrol surveys did not detect any main breaks or new gas leaks.

8. The Operator had no records of maintenance or replacement of gas mains within close proximity to 22 Manning Street.

9. The house at 22 Manning Street, Reading had gas service provided by National Grid.

10. The basement of the house at 22 Manning Street, Reading had a sewer line.

11. On January 25, 2010 natural gas was released into 22 Manning Street, Reading, that ignited, and significantly damaged the home.

12. On January 25, 2010, National Grid located a gas leak on the cast-iron gas main in front of 22 Manning Street.

13. On January 25, 2010, the service line to 22 Manning Street did not leak any gas.

14. The operating pressure of the main at the time of the failure was 1.8 psig.

B. Conclusions

The State Fire Marshal Report concludes that gas most likely migrated into the basement of the house from the cracked cast iron main on Pleasant Street - in front of 22 Manning Street - through the soil, into the basement, through the two existing sanitary sewer lines and the cracks in the basement floor. This conclusion is reasonable, and supported by the evidence in this investigation. The most likely point of ignition of the gas was the furnace located in the basement area.

The MMR conclusion that the failed pipe exhibited a classic transverse fracture due to bending loads is reasonable, and supported by the evidence in this investigation. A main cause of bending loads in the soil surrounding this pipe is most likely frost heaves.