The Commonwealth of Massachusetts

DEPARTMENT OF PUBLIC UTILITIES

PIPELINE ENGINEERING AND SAFETY DIVISION

INCIDENT REPORT

39 Jenny Lind Street, Easton, Massachusetts
September 10, 2007

PIPELINE ENGINEERING AND SAFETY DIVISION

Accident File

Location: 39 Jenny Lind Street, Easton, Massachusetts

Date of Accident: September 10, 2007

Gas Company: Bay State Gas Company

Estimated Property Damage: $2,000,858.51*

Injuries: 7

Report Issued - July 15, 2009

* Estimated by Bay State Gas Company

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I. INTRODUCTION

A. Scope of this Investigation

The Massachusetts Department of Public Utilities ("Department"), Division of Pipeline Engineering and Safety ("Division"), pursuant to G. L. c. 164, § 105A and Federal Certification Agreement as provided for in 49 U.S.C.§ 60105, has investigated a release of natural gas ("gas") at 39 Jenny Lind Street, Easton that occurred on September 10, 2007 ("Incident").[1] The release contributed to an explosion, fire and $2,000,858.51 in property damage, as estimated by Bay State Gas Company ("BSG") (Exh. 1). There were seven injuries as a result of the explosion and fire (Exh. 2). The pipeline involved was owned and operated by BSG.

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 US DOT:

> each accident or incident involving a fatality, personal injury requiring hospitalization, or property damage or loss of more than an amount the secretary established 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).

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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 or gas from an LNG facility and
(i) A death, or personal injury necessitating in-patient hospitalization; or,
(ii) Estimated property damage, including cost of gas lost, of the operator or others, 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 judgement of the operator, even though it did not meet the criteria of paragraphs (1) or (2). 49 CFR Part 191 § 191.3.

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

The Department has established procedures for determining the nature and extent of violations of the 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 Department also enforces the U.S.DOT safety standards for pipeline systems as set forth in 49 C.F.R. Part 192 ("Part 192"). G.L. c. 164, § 105A.

B. Overview of Incident

At approximately 11:08 a.m., September 10, 2007, the Town of Easton Fire Department received a report of a house explosion and fire at 39 Jenny Lind Street, Easton (Exh. 3). At approximately 11:40 a.m.,[2] BSG reported to the Division a house explosion at Seaver Street and Jenny Lind Street, Easton (Exh. 4).

The Department sent two investigators to the scene. The residential two story wood house with an asphalt shingle roof had been completely destroyed (Exh. 5). The house was being rented to six people (id.). The structure at 35 Jenny Lind Street received substantial damage (Exh. 6). There were 7 persons transported to the hospital with injuries.

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[2] 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.

A backhoe operated by a BSG contractor was replacing the gas service[3] line and removed a rock from near the existing gas service line (Exh. 7). The rock contacted the gas service pipe and apparently caused a release of gas inside the basement. The gas was ignited by the gas water heater in the basement (Exh. 2).

II. THE DEPARTMENT INVESTIGATION

A. Description of the Site

Jenny Lind Street runs East and West between Williams Street and Seaver Street. Number 39 is located at the East end of Jenny Lind Street at the South corner of Seaver Street. The house was two story, wood frame construction with an asphalt shingle roof and a full basement (Exh. 2). The house contained two rental units.

On the day of the Incident, there were two live gas mains[4] on Seaver Street. The two inch bare steel main was installed in 1925. BSG and was in the process of replacing it. The replacement main was a 2 inch plastic main. On the day of the Incident, both high pressure[5]

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3 A distribution line that transports gas from a common source of supply to an individual customer, or two adjacent or adjoining residential or small commercial customers, or to multiple residential or small commercial customers served through a meter header or manifold. A service line ends at the outlet of the meter or at the connection to a customer' piping, whichever is further downstream, or at the connection to customer piping if there is not a meter.

4 A main is a distribution line that serves as a common source of supply for more than one service line. Part 192, § 192.3.

5 A high pressure system is where the pressure in the main is higher than the pressure provided to the customer. Part 192, § 192.3.

mains were operating at 60 pounds per square inch gauge ("psig")[6] (Exh. 8).

The service line to 39 Jenny Lind Street entered the house on the Seaver Street side. The service line was one inch steel pipe installed in 1955, with a curb valve[7] and valve box (Exh. 9). There were two meters, one customer regulator,[8] and an insulating locking valve inside the basement. Two investigators from the Division went to the scene along with representatives of the Easton Police and Fire Department, Bay State Gas, OSHA, Easton DPW and the Department of Public Safety.

The Division investigators observed that the house had been completely destroyed. The walls were blown out and the floors and roof collapsed onto the foundation. The house next door, 35 Jenny Lind Street, received substantial damage from the blast and resulting fire.

B. Bay State Gas Company

1. The Main and Service Replacement Project

BSG hired a contractor to replace its mains and services on Jenny Lind Street, Seaver Street and other streets in the area ("BSG Contractor") (Exh. 10). The process is to install the replacement main and connect the ends of the replacement main to the old main so they are

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6 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.

7 A curb valve is a service line valve buried near the property line with a valve box that makes the valve accessible.

8 A service regulator is a valve which reduces the pressure in the service line from the pressure in the main to the pressure provided to the customer.

both live. The services are then renewed and connected to the replacement main. If the meters and other equipment are located inside, then a BSG fitter relocates them outside. When all the services are connected to the replacement main, the old main is abandoned (Exh. 11).

2. The Scope of the Service Replacement Work at 39 Jenny Lind Street

BSG obtained a Dig Safe ticket for the excavation at the Incident site (Exh. 12). BSG stated that it used its own system maps to locate the service, but had no specific documents to demonstrate that it marked out the service to 39 Jenny Lind Street (Exh. 13). However, the BSG service card and their mapping system did not accurately show where the service at 39 Jenny Lind Street was, in fact, located. After the service was exposed on the day of the Incident, Pipeline Division inspectors observed that the service was bent, and installed at an angle over a rock and with approximately 3 to 5 inches of cover at the most shallow point.[9]

Prior to the day of the Incident, a BSG fitter installed a new meter manifold on the outside of the house at 39 Jenny Lind Street near the existing gas service entrance to the house. The manifold consisted of the service regulator, piping for two meters, piping from the manifold to inside the house through the board on the top of the foundation and under the first floor. BSG completed this work so that on the day the service is connected over to the replacement main, some of the fitters work would already be completed. BSG would connect

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[9] BSG's excavation procedures require that, prior to excavation, a check shall be made to ensure that all sub structure utilities or installations are located (Exh.11). The procedures also require that all boulders, trees or other surface impediments be removed or made safe before commencing excavation (id.) with respect to changing services (relocating service pipe from one main to another), BSG is also required to locate and mark all company facilities and be sure of the locations of other underground utilities when digging (id.) BSG is also required to shut off the gas at the meter and tee connection (id.).

the replacement service to the new outside manifold, and the BSG fitter would connect the customer piping to the new manifold.

3. The Incident

At time of the Incident, the BSG Contractor had a backhoe operator, two laborers, and a truck driver assigned to work at the site. A BSG fitter was also at the Incident site.

The backhoe operator excavated from the house to near the property line, where the curb valve was located. The curb valve was exposed. The curb valve would have to be removed to install the new service. The service was to be inserted in the old service line under the street area, and then be direct buried in the private property area (Exh. 14).

One laborer and the BSG fitter were at the Incident scene at the time of the explosion. The truck driver was away from the area with the dump truck and another laborer was on Seaver Street working on connecting over another service. The backhoe operator had excavated the trench for the replacement service and left the location. BSG presented evidence that it had qualified this backhoe operator for this task (Exh. 15).

The laborer stated that, at the time of the Incident, he was in the trench clearing rocks and finishing the trench with a shovel for the new service pipe installation.

The backhoe operator stated that he excavated a trench from the house to near the property line (Exh. 2). The trench then cut over to where the curb valve was, and the valve was exposed. This trench was approximately parallel to the existing service. The live service pipe did not appear to be exposed (Exh. 16). The backhoe operator stated that he removed a

rock from the trench while excavating, but did not hit the service with the backhoe (Exh. 17). He stated that the explosion occurred 7-10 minutes after he finished the excavation.

The laborer working in the trench at the time of the explosion stated that the explosion occurred one half hour after the trench was excavated (Exh. 2). He stated that he did not smell gas or hear anything prior to the explosion (id.). He also stated that the entire service from the house to the curb valve was uncovered.

One of BSG's Contractor employees stated that the BSG fitter was working at the rear of his truck, which was parked on Seaver Street near the side driveway to 39 Jenny Lind Street (id.). The truck was approximately 50 feet from the south east corner of the house. The BSG fitter's tool bag was found at the top step of the bulkhead. After the explosion, the BSG fitter was found near the Seaver Street driveway. The BSG fitter informed the Pipeline Division investigators that he cannot remember where he was at the time of the explosion (Exh. 18).

4. BSG Leak Survey after the Incident

BSG conducted leak survey tests on September 10, 2007 on Jenny Lind Street, Seaver Street, around the Incident scene, and in and around the adjacent houses. BSG found no leaking gas in the ground or in any of the houses in close proximity to 39 Jenny Lind Street (Exh. 17).

5. BSG Odorization

The state regulation, 220 C.M.R. § 101.06(20), requires operators to odorize gas in their distribution systems. Gas must be "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 and air." The state regulation, 220 C.M.R. § 101.06 (20)(a), requires operators to conduct periodic sampling of odorant concentrations throughout their system.

BSG conducts odorant sampling throughout its system on a monthly basis. On September 10, 2007, two odorant tests were conducted in Easton after the explosion (Exh. 19). The results of the tests are as follows:

1. 224 Main Street, Easton. Reading Actual 0.07
2. 15 Williams Street, Easton. Reading Actual 0.08

The odor detection level of gas in air, which ranged from 0.07 percent to 0.08 percent gas in air, indicates that the odorant was within the limit prescribed in the state regulation. The odorant level 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.

There were four residents in the house at the time of the explosion (Exh. 2). Two of them stated that they did not hear or smell anything before the explosion (id.). One of the residents smelled gas just prior to the explosion and the other resident heard a "psst" sound just prior to the explosion (id.).

C. Failure Analysis of Pipe Sections

Massachusetts Materials Research, Inc ("MMR") conducted failure analysis of the interior piping and the exterior section of the service line from 39 Jenny Lind Street and issued

a report ("MMR Report").[10] The piping was recovered by the Easton Fire Department and stored at their facility. The piping and fittings were released to the Division and were taken to MMR for metallurgical testing. The piping and fittings partly consisted of the high pressure service line including the curb valve and fittings up to the regulator. The low pressure piping from the regulator to the meter inlet, the regulator and regulator vent pipe, and the meters were also part of the evidence sent to MMR. The purpose of the testing was to document the condition of the evidence and to determine the cause of the Incident.

MMR conducted debris analysis, leak testing, radiographic examination, microscope examination, fracture surface conditions and chemical analysis. Its analysis and testing found:

- All steel fractures were consistent with ductile overload formed during the house collapse;
- Long longitudinal scrapes along the underside of the bend in the pipe indicate that the rock that was removed from under this bend contacted the pipe in a sliding, dragging motion. Movement against this pipe would translate to movement of the service inside the basement;
- The force was not likely enough to have created enough tensile pulling to fracture the service pipe at the inlet elbow;
- The isolation fitting is most likely the source of the gas;
- Damage to the isolation joint could release gas at high pressure into the basement

(MMR Report at 20).

Based on the analysis, MMR concluded the following:

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[10] 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

Contact of the service pipe with the rock removed from its bend likely caused movement of the service inside the 39 Jenny Lind Street basement. This movement was sufficient to smear the service pipe coating, but not enough to dent or significantly scratch. Therefore, the movement would not likely be sufficient to fracture the service pipe at the elbow, but could be sufficient to cause damage to either the regulator or the polymer part of the isolation fitting adjacent to the high pressure cock . . . Damage to the regulator from the wall contact would have occurred on the vent side, where no gas circulates under normal operating conditions.

Damage to an isolation fitting, however, has a high potential to release natural gas at high pressure. Recall that the Incident damage to both the regulator and the isolation joint intervals was severe enough to prevent verification of any non-fire related damage.

The bend in the service pipe did not have the same features as a service pipe altered by a backhoe (e.g. backhoe tooth marks and buckling at the region where the bend ends and transitions to straight pipe). In addition, the Jenny Lind Street pipe was still located within the cellar wall and penetrated into the cellar
(MMR Report at 21).

III. FINDINGS AND CONCLUSIONS

A. Findings

1. A two inch bare steel main was laid under Jenny Lind Street Easton in 1925.

2. The operating pressure in the main on September 10, 2007 was 60 psig.

3. A one inch coated steel service line to 39 Jenny Lind Street was installed in 1955.

4. The service card for this service line indicated that the service line was straight.

5. BSG was in the process of replacing the main and services on Jenny Lind Street and Seaver Street and other streets in the area.

6. By September 10, 2007, the two inch replacement plastic main installation had been completed and the main was live.

7. On September 10, 2007, BSG was replacing the service line and relocating the meters outside to 39 Jenny Lind Street.

8. BSG's contractor excavated a trench for the replacement service line from the house at 39 Jenny Lind Street to near the property line.

9. BSG's contractor cut the trench over to where the curb valve was, and exposed the valve.

10. The trench was approximately parallel to the existing service.

11. BSG's contractor removed a rock from the trench while excavating.

12. Gas was released and accumulated in the basement, and the source of ignition was most likely the gas hot water heater.

B. Conclusions and Recommendations

It is reasonable to infer that, when installing the service line in 1955, the operator bent the service line to accommodate a rock. The MMR report's conclusion is that: (1) the rock came in contact with the service pipe; (2) damage to the isolation joint could release gas at high pressure into the basement; and (3) the isolation fitting is the most likely source of the gas release, is reasonable, and supported by substantial and sufficient evidence.

The Division agrees with MMR's conclusion that the cause of the release of gas in this Incident is most likely the movement of the service line by the BSG backhoe operator when he removed a rock that contacted the service pipe.

On June 8, 2009, the Division and BSG entered into a Consent Order that concluded a Dig-Safe enforcement action with BSG. G. L. c. 82, §§ 40 through 40E ("Dig Safe Law"). 220 C.M.R.§§ 99.00 et seq. The Division has reason to believe that, while excavating near the service line, the Operator failed to employ reasonable precautions to avoid damage to the service line. The Division concluded that this was a probable violation of the Dig Safe Law.

BSG is required to determine the cause of a failure so that corrective action can be taken to minimize the possibility of a recurrence or to minimize the consequences should there be a recurrence. 49 CFR Part 192, § 192.617. As part of this process, the Division recommends that BSG consider reviewing amending portions of its operations, construction and emergency manuals in order to prevent a similar situation from occurring. In addition to any changes to its procedures BSG may implement on its own, the Pipeline Division suggests that BSG consider the practices contained in this section.

In 2002, the Pipeline Hazardous Materials and Safety Administration ("PHMSA") issued an Advisory Bulletin urging operators to follow the "best practices" for excavating based upon a study performed by the Common Ground Alliance ("CGA"). ADB 02-01 (67 FR 3667 (May 24, 2002)). Since then, the CGA has continued to review and revise these "best practices" first established in the Common Ground Study. In March, 2008, CGA issued its most recent guide ("CGA Best Practices"). In 2006, the Pipeline Hazardous Materials and Safety Administration ("PHMSA") issued two Advisory Bulletins on preventing construction-related underground utility damage. ADB-06-01; ADB-06-03. PHMSA recommended that operators follow the guidelines in CGA Best Practices. ADB-03-03.

PHMSA reminded operators that excavation is a covered task and recommended operators review the adequacy of covered tasks involving line locating, excavating, and inspection of excavation activities of qualified employees and contractors. ADB-06-01, at 2 citing 49 C.F.R. Part 192, § 192-801-809. PHMSA recommended that operators review the adequacy of covered tasks involving line locating and inspection of excavation activities.

ADB-06-01. Operators should always locate and mark pipelines accurately before excavation begins, and not rely solely on maps, drawings, or other written materials to locate pipelines. ADB-06-03, at 3. Operators should also confirm the accuracy of the pipe location before excavation begins. ADB-06-03, at 3. This applies when the pipeline operator conducts the excavation using its own employees, a contractor, or a third party. ADB-06-03, at 3. Finally, when pipelines are hit or almost hit during excavation, evaluate the practices and procedures in use before continuing the construction activity.

Accordingly, based upon review of all of the evidence in this investigation, the Division recommends that BSG consider implementing the following changes to its operating procedures.

1. BSG should amended its operating procedures to include more detailed requirements for its excavators to verify the location of its gas facilities when using powered equipment in proximity to live gas lines.

2. BSG should consider establishing in its operations and construction manuals minimum clearances from facilities when using powered equipment.

3. BSG should consider using an observer to assist equipment operators when operating excavation equipment around known underground facilities.