The Commonwealth of Massachusetts

DEPARTMENT OF PUBLIC UTILITIES

INCIDENT REPORT

Overpressurization
3 Hancock Avenue, Lexington, Massachusetts
November 9, 2005

PIPELINE ENGINEERING AND SAFETY DIVISION

Accident File

Overpressurization

Location: Lexington, Massachusetts

Date of Accident: November 9, 2005

Gas Company: KeySpan Energy Delivery New England

Estimated Property Damage: Over $1,000,000 *

Report Issued - March 2008

* Estimated by KeySpan Energy Delivery, New England

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I. INTRODUCTION

A. Scope of this Investigation

The Massachusetts Department of Public Utilities ("Department"), formerly known as the Department of Telecommunications and Energy, 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 release of natural gas ("incident")[1] in the Town of Lexington, that occurred on November 9, 2005. KeySpan inadvertently over-pressurized its two psig distribution system supplying 1,634 customers in Lexington, to approximately 56 psig. The incident contributed to an explosion and fire that caused the collapse of a structure at 3 Hancock Avenue, Lexington.[2] Boston Gas Company d/b/a KeySpan Energy Delivery, New England ("KeySpan" or "Operator")[3] estimated the damage to the structure to be $394,000 and Operator's damage to be in excess of $1,000,000 (Exh. 1).

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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, 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

2 The cause and circumstances surrounding the incident at 3 Hancock Avenue is addressed in a separate report.

3 As a result of a merger completed in 2007, KeySpan is part of the National Grid utility system.

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

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

The Department has established procedures for determining the nature and extent of violations of codes and regulations pertaining to the 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").

B. Overview of Incident

On November 9, 2005, KeySpan was in the process of replacing approximately 550 feet of six-inch bare steel pipe with six-inch plastic pipe for a main replacement project in the vicinity of Hancock Street and Coolidge Avenue, Lexington (Exh. 2). This process involved laying plastic pipe parallel to and abandoning the existing bare steel main, in place. In addition, the new main was going to be connected to another existing main to reinforce the

distribution system. KeySpan stated that it believed the entire scope of the project was high pressure (i.e., 60 pounds per square inch gauge ("psig")) (Exhs. 3,4).[4,5]

KeySpan reported that the two psig distribution system, supplying 1,634 customers in Lexington, was over-pressurized to approximately 56 psig (Exh. 3 at § 1.0; Exh. 4). KeySpan stated that the two psig system returned to normal operating pressure at 12:04 p.m. (id.).[6] The over pressurization of the two psig system to 56 psig exceeded the maximum allowable operating pressure of the two psig system.[7]

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4 Pounds per square inch gauge 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 thought it is actually sensing 14.7 psi at sea level.

5 A high pressure system is a system in which the pressure in the main is higher than the pressure provided to the customer. 49 C.F.R. Part 192, § 192.3

6 The Operator monitors the two psig system at three Supervisory Control and Data Acquisition points (Exh. 5). The three points are: (1) the School Street at Roosevelt Street station; (2) the Mass. Ave. at Edison Way station; and (3) the Simmons Rd. at Preston Rd. station (id.).

7 The federal regulation, 49 C.F.R. Part 192, § 192.621 Maximum allowable operating pressure: High-Pressure distribution system, states:

> (a) No person may operate a segment of a high pressure distribution system at a pressure that exceeds the lowest of the following pressures, as applicable . . . .
>
> > (5) The pressure determined by the operator to be the maximum safe pressure after considering the history of the segment, particularly known corrosion and the actual operating pressures.
>
> (b) No person may operate a segment of pipeline to which paragraph (a)(5) of this section applies, unless over pressure protective devices are installed on the segment in a manner that will prevent the maximum allowable operating pressure from

(continued...)

On November 9, 2005, sometime after 11:00 a.m., KeySpan stated that its crew connected, tapped and purged the new six-inch plastic main on Hancock Street. When the crew connected and purged the main at Coolidge Avenue, they noticed a different sound (Exh. 2). The KeySpan crew on site was not aware that the main relay tie-in was connecting two mains with differing pressures (60 psig to two psig) (Exh. 4).

At approximately 11:19 a.m., the Lexington Fire Department was notified of an explosion and fire (Exh. 4) at 3 Hancock Avenue. At approximately 12:00 p.m., KeySpan notified the Division of the Incident (id.).[8]

As a result of the over-pressurization, the home at 3 Hancock Avenue was destroyed and KeySpan reported leaks on company owned piping at 11 other addresses. Further, KeySpan found and replaced 165 service regulators that had been compromised (Exh. 3). In addition 317 gas meters were subsequently replaced (Exh. 6). KeySpan stated that the two psig system returned to normal operating pressure at 12:04 p.m. (Exh. 3,4).

At 3:51 p.m., KeySpan began to shut down the two psig distribution system. By 4:45 p.m., KeySpan confirmed that the system was shut down (id.). Once the system was isolated and shut down, it took Keyspan six days to test the integrity of the system and the customer services (id.). KeySpan restored the system on Tuesday, November 15, 2005 (id.).

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7 (...continued)
being exceeded, in accordance with §192.195.

8 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.

II. THE DIVISION'S INVESTIGATION

A. Background

Hancock Street and Coolidge Avenue are located in a residential area of Lexington. The neighborhood is classified as a class 3 location.[9] The main relay project consisted of replacing 550 feet of six inch bare steel main with six inch plastic. The project was initiated by KeySpan's Corrosion Control Department (Exh. 7). KeySpan's maps listed two different pressures for the main on Hancock Street, intermediate[10] and high[11] pressure (id.). The maps indicated an intermediate pressure section of pipeline that was installed in 1958, and a high pressure section of pipeline that was installed in 1960 (id.).

B. Project Description

KeySpan Energy has a Bare Steel/Wrought Iron Replacement Program. As part of the Program's 2005 supplemental budget, and based on the distribution main history of leaks, the KeySpan Corrosion Control department recommended the relay of approximately 550 feet of

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9 A "class location unit" is an onshore area that extends 220 yards (200 meters) on either side of the centerline of any continuous 1 - mile (1.6 kilometers) length of pipeline. A class 3 location is: any class location unit that has 46 or more buildings intended for human occupancy; or an area where the pipeline lies within 100 yards (91 meters) of either a building or a small, well-defined out-side area (such as a playground, recreation area, outdoor theater, or other place of public assembly) that is occupied by 20 or more persons on at least 5 days a week for 10 weeks in any 12 month period. (The days and weeks need not be consecutive.). Part 192, § 192.5.

10 Intermediate pressure is pressure greater than low pressure, but not over 25 psig. Low pressure is substantially the same pressure in the main as the pressure delivered to the customer (KeySpan Gas Construction Standards, Specifications and Procedures).

11 High pressure is the pressure in the main that is higher than the pressure provided to the customer.

six inch bare steel pipe (installed in 1960) with six inch plastic pipe. This section of main had a cluster of leaks ranging between 75 to 82 Hancock Street, as a result, this section was selected for replacement (Exhs. 8). The project boundaries began at an existing six inch plastic pipe in front of 84 Hancock Street and extended to Coolidge Avenue (Exh. 7).[12]

C. Preconstruction

On October 10, 2005, KeySpan provided to a KeySpan supervisor a work package for the main replacement project (Exh. 7). The work package contained maps for the project area and service card information for the gas services within the scope of the work area (id.). Of the eight service cards in the work package, four denoted the operating pressure as "IP" or "MP"(Intermediate Pressure) (e.g. 2 psig.) (id.). On October 11, 2005, the supervisor reviewed the work to be done at Hancock Street and Coolidge Avenue, Lexington and walked the length of the project (Exh. 9). The supervisor notified Dig Safe[13] and requested a markout of the proposed work area. On October 14, 2005, the Town of Lexington granted KeySpan a road opening permit (Exh. 7).

During the preconstruction review, the KeySpan supervisor identified inconsistencies on the maps in the work package. He identified a section of the gas main that had been labeled

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12 A KeySpan Street Main Authorization Work order (444904) indicates that the pipe is to be installed from 73 - 84 Hancock St.

13 Dig Safe System, Inc. is a communication network, assisting excavators, contractors and property owners in complying with state law by notifying the appropriate utilities before digging. Dig Safe, a free service, notifies member companies of proposed excavation projects. In turn, these member utilities respond to the work area and identify the location of underground facilities. Callers are given a permit number as confirmation.

as intermediate pressure (two psig) in front of 84 Hancock Street, while the other sections of the gas main were labeled high pressure (60 psig) (Exhs. 7, 8). The supervisor visually inspected the service to 84 Hancock Street, confirmed it was high pressure and not intermediate pressure. He then walked the other services from 84 Hancock Street to Coolidge Avenue and concluded that the section of gas main in front of 84 Hancock Street was labeled incorrectly on the maps as intermediate pressure (Exh. 9). The KeySpan supervisor stated that the project was a fairly routine high-pressure tie over, and that there would be no interruption of service and as such the use of gauges would not be required (id.).

D. Construction Requirements

KeySpan has several specifications in its Operations and Maintenance manual ("O&M manual"), that prescribe the required procedures required when tying in mains. One of the procedures, **STOP-5040: Installation of Gas Main Tie-in Connections and Stopping Off**, describes the requirements for planning and performing a main connection that requires the interruption of gas flow (Exh.10).[14] At the time of the incident, KeySpan's Procedure **STOP-5040-MA-NH (B)(4)** stated in relevant part:

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[14] Other procedures include the following: **HTAP-5010**: **Procedure for Hot Tapping Mains** (minimum requirements for hot tapping mains); **CNST-5010: General Construction Requirements**, Section B.2,Plans and Specifications (detailed plans and/or specifications may be supplied); **GCON - 5100: Operating Procedure for Coordinating Gas Main Connections or Shutdowns** (KeySpan policy for preparing and processing of system operating procedures); **GCON - 5020: MAOP and Operation Pressure for Distribution Systems** (MAOP for all Keyspan elevated-pressure distribution and feeder systems, and operating pressures for low-pressure distribution systems.

> Pressure gauges shall be installed whenever the flow of gas in a main is **interrupted**, regardless of distribution system operating pressure. [Emphasis added]

However, the main replacement project in Lexington did not require that the flow of gas be interrupted.

Subsequent to the incident, KeySpan amended its O&M manual to require the use of pressure gauges on live-main jobs, such as the project in Lexington. This procedure, **GCON 5100 (4)(g)**, states:

> Whenever live mains are tapped, pressure gauges shall be installed, regardless of system operating pressure. Sufficient gauges shall be installed, and utilized, to determine pressure of all mains associated with job.
> (Exh. 10)

In addition, on January 6, 2006, the Division issued an advisory letter to all operators, requesting that all operators review - and revise if necessary - their respective written procedures regarding planning and performing all live gas main connections in order to reduce the possibility of the over-pressurization of gas mains occurring in the future (Exh. 11).

E. Training

The federal code requires that gas company personnel be qualified to perform hot-tapping of pipelines under pressure.[15] KeySpan personnel who perform hot tapping are initially trained by KeySpan in conjunction with a T.D. Williamson manufacturer's

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[15] Each tap made on a pipeline under pressure must be performed by a crew qualified to make hot taps. Part 192, § 192.627 Tapping pipelines under pressure

representative. The training is hands on and reviews the use of, setup and breakdown of the equipment, simulated on live pipelines that are pressurized with air (Exh. 12). In addition, the Northeast Gas Association provides procedural training based on the Operator Qualification Program guidelines. KeySpan records indicate that one of the two persons was trained by a representative of T.D. Williamson, the manufacturer of the equipment (id.). The other person was trained by a Senior KeySpan welder (id.).

F. Maps

KeySpan's O&M manual, Section **CNST-5010: General Construction Requirements, subsection B2(a)** states, " Depending on the nature of the work, detailed plans and/or specifications may be supplied (Exh.10)." Prior to construction, the KeySpan Supervisor responsible for the oversight of the main relay project was provided a work package containing a map that was generated by the KeySpan System Integrity group (Exh 7). This map was also provided to KeySpan personnel performing the main tie-in at Hancock Street and Coolidge Avenue.

KeySpan admitted that the main pipeline segment between buildings 81 and 82 Hancock Street was incorrectly marked as intermediate pressure (two psig) (Exh. 8). The map for Hancock Street and Coolidge Avenue showed only the six inch high pressure bare steel mains on each street (Exhs 7, 13). KeySpan determined that the mapping system had incorrectly attributed a segment of 60 psig high pressure pipe as intermediate pressure pipe (Exhs. 7, 13). In addition, the maps did not show the presence of the intermediate pressure (two psig) main that the KeySpan Crew tied into and over pressurized. KeySpan included the inaccurate maps in the work package for the main relay project (Exhs. 7, 9).

The U.S. Department of Transportation/Pipeline Hazardous Materials and Safety Administration has stated that construction maps and operating history should be comprehensive and current, and include the maximum operating pressure of each pipeline. See Advisory Bulletin ADB-02-03, 67 Fed Reg. 40,768 - 40,770 (June 13, 2002) (Research and Special Programs Administration, Office of Pipeline Safety).

G. Service Line Regulators

KeySpan reported that 165 regulators had failed inspection, and that it tested 21 of the failed regulators (Exh. 3, at § 1.0). Of the 21 regulators, the test sample contained eight different styles of regulators (id. at § 6.0). The test consisted of exposing the regulator to an inlet pressure of 60 psig, the tests revealed that each of the 21 service regulators delivered unacceptable downstream pressure (id. at 1.0). The testing was performed by an independent lab and witnessed by Department personnel.

III. FINDINGS AND CONCLUSIONS

A. Findings

1. KeySpan's, Corrosion Control department initiated a main replacement project to replace 550 feet of six inch bare steel pipe with six inch plastic pipe from 84 Hancock Street to Coolidge Avenue.
2. The KeySpan supervisor responsible for the main relay project reviewed the work to be done prior to the November 9, 2005 incident, and identified inconsistencies on the map that labeled a section of the high pressure (e.g. 60 psig) main on Hancock Street as intermediate pressure (2 psig).
3. The map for Hancock Street and Coolidge Avenue shows the six inch high pressure bare steel mains on each street. The map does not show the two psig main that was present on Hancock Street that was tied into and over pressurized during the main relay project.
4. The work package for the project included eight service cards for gas services located within the scope of the work area, four denoted the operating pressure as intermediate pressure (2 psig).

5. The supervisor visited the work site to reconcile the mapping differences and visually inspected the services between 84 Hancock Street and Coolidge Avenue and concluded that the section of main in front of 84 Hancock Street was a high pressure main and not intermediate pressure.
6. KeySpan believed that the entire scope of the project was high pressure (60 psig).
7. KeySpan procedures in place at the time of this incident required that pressure gauges be installed whenever the flow of gas in a main is interrupted, regardless of distribution system operating pressure.
8. KeySpan did not plan to interrupt the flow of gas during this tapping procedure (e.g., perform a hot tap) and as such did not use pressure gauges.
9. On November 9, 2005, KeySpan personnel prepared and tapped the mains to be tied in.
10. The KeySpan personnel performing the tie-in received a map that incorrectly attributed pressure on the Hancock Street and Coolidge Avenue mains as high pressure (60 psig).
11. The KeySpan supervisor and crew on site were not aware that the main relay and connection of the two (2) six-inch bare steel mains was connecting mains with differing MAOPs (60 psig to 2 psig).
12. On November 9, 2005, the KeySpan crew connected and purged the new six-inch plastic main to the existing six-inch bare steel main at 73-78 Hancock Street.
13. The KeySpan crew opened the valve at Coolidge Avenue, purged the six inch main , closed the purge stack and noticed a different sound.
14. The main tie in between the high pressure and intermediate six-inch mains fed gas at approximately 56 psig into the two psig main at 73-38 Hancock Street.
15. The two psig distribution system supplying 1,634 servers in Lexington was over pressurized to approximately 56 psig.
16. Within moments of noticing the abnormal sound, the crew was ordered to report to the scene of an explosion at 3 Hancock Avenue, Lexington.
17. The over-pressurization resulted in the maximum allowable operating pressure ("MAOP") of the two psig system to be exceeded.
18. Subsequent to the incident, KeySpan amended its Operations and Maintenance manual to state that pressure gauges shall be installed whenever a gas main is tapped, regardless of distribution system operating pressure.

B. Conclusions

1. The over-pressurization of the two psig system to 56 psig exceeded the maximum allowable operating pressure of the two psig system.
2. The map which the KeySpan supervisor and crew relied upon for the main replacement project in Lexington was not comprehensive and current.

3. The incorrect map utilized by the KeySpan supervisor and the personnel performing the main tie in contributed to the introduction of 56 psig to enter the two psig system.
4. KeySpan's System Integrity Group, responsible for generating the map, failed to notice the inconsistencies on the map.
5. The use of pressure gauges to monitor system pressure during the tapping procedure may have prevented the incident.
6. Utilizing the service card and map information for verification of the gas pressure of the mains present on Hancock Street may have prevented the incident.
7. Taking actual pressure readings at the gas services to verify the gas pressure may have prevented the incident.

IV. KEYSPAN ACTIONS

On February 11, 2008, pursuant to G.L. c. 164, § 105A and 220 C.M.R. §§ 69.00 et seq., the Department concluded an enforcement action with KeySpan. KeySpan Energy Delivery, New England, D.P.U. 05-PL-18. KeySpan has modified its Operations and Maintenance manual to specify the use of pressure gauges when live mains are tapped, regardless of the system operating pressure. Id. In addition, KeySpan agreed to amend its O&M procedures to establish a program that specifies the communication path and title(s) of operational personnel responsible for correcting mapping inconsistencies found by field personnel. Id. KeySpan also agreed to develop and initiate a comprehensive program to ensure that all maps and associated records of the KeySpan distribution system are accurate and up-to-date. Id.