



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

**PIPELINE ENGINEERING AND SAFETY DIVISION**

**INCIDENT REPORT**

**Webster Street, Needham, Massachusetts**

**April 28, 2006**

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## PIPELINE ENGINEERING AND SAFETY DIVISION

### Accident File

Location: Webster Street, Needham, Massachusetts

Date of Accident: April 28, 2006

Gas Company: NSTAR Gas Company

Estimated Property Damage: Approximately \$20,000 \*

Injuries: 0

Report Issued - March 2009

\* Estimated by NSTAR Gas Company

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I. INTRODUCTION

A. Scope of this Investigation

The Massachusetts Department of Public Utilities (the "Department"), pursuant to G.L. c. 164, §105A and G.L. c. 82, §40 ("Dig Safe"), has investigated a release of natural gas ("gas") that resulted in an ignition and fire at the intersection of Webster Street and Harris Avenue, Needham, MA, which occurred on April 28, 2006, (the "Incident").<sup>1</sup> There was one injury requiring in-patient hospitalization as a result of the Incident. The Incident resulted in approximately \$21,000 of damage as estimated by NSTAR Gas Company ("NSTAR" or "Operator") (Exh. 1). The operator of the pipeline was NSTAR.

As part of the Department's annual certification process by the United States Department of Transportation ("DOT"), the Department must report to the DOT

[e]ach accident or incident . . . involving a fatality, personal injury requiring hospitalization, or property damage or loss more than an amount the Secretary establishes, any other accident the [Department] considers significant, and a summary of the investigation by the authority 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 DOT of 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 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 Department also enforces the DOT safety standards for gas pipeline systems as set forth in 49 C.F.R. § 192 et seq.

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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 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 § 191.3.

B. Overview of Incident

On April 28, 2008, at 2:15 P.M., NSTAR notified the Department of an ignition of gas at Webster Street and Harris Avenue, Needham that resulted in a serious injury to one person (Exh. 2). The Needham Fire Department ("Fire Department") stated that on April 28, 2006, at 1348 hours (1:48 p.m.) it received notification of a release of gas and ignition at Webster Street and Harris Avenue (Exh. 3). The Fire Department's Report stated that a gas main being serviced in a road provided the fuel for the fire. And one person sustained injuries (id.).

NSTAR's report of this Incident to the Pipeline Hazardous Materials Safety Administration ("PHMSA") states:

The injured employee was tapping the 2 inch high volume tapping tee installed on an existing 2 inch intermediate pressure plastic main. The electrofusion tapping tee was one of four taps planned on a double bypass to facilitate a main cutout in conjunction with a leak repair. An employee in close proximity in the same trench who was preparing a second tap reported hearing a "blowing sound". As he turned toward the location of the tap in progress he observed the gas ignition and immediately assisted the injured employee exit the trench. The gas continued to escape through the top of the tapping tee and burn until main isolation valves were closed and the fire allowed to extinguish.

(Exh 1).

The report indicated that there was one injury requiring in-patient hospitalization (id.). This report also indicated that property damage totaled \$21,000 (id.).

The Department's investigation finds that the resulting fire at Webster Street and Harris Avenue was caused by the ignition of escaping gas through the top of a two-inch plastic high volume tapping tee on a main in an excavation where a NSTAR crew was working to repair a gas leak. An employee had completed tapping the high volume tapping tee, and as he was withdrawing the cutting tool from the high volume tapping tee, the cutting tool and the cap blew off the tee. Ignition of the gas occurred shortly thereafter. The Department was not able to determine the ignition source.

II. BACKGROUND

The Incident occurred at a NSTAR gas distribution crew work site at the intersection of Webster Street and Harris Avenue, Needham, MA on April 28, 2006. The crew was working to repair a gas leak at this location. This area consists primarily of single-family residential dwellings. The gas facilities supplying these buildings are located in the roadways.

There are four segments of main in Webster Street and Harris Avenue in the vicinity of the Incident (Exh. 4). They operate at high pressure.<sup>2</sup> These segments are:

- 1307 feet of three-inch bare steel main installed in 1926 (Webster Street)
- 196 feet of two-inch bare steel main installed in 1957 (Harris Avenue)
- 268 feet of two-inch plastic main installed in 1986 (Harris Avenue)
- 84 feet of two-inch plastic main installed in 1987 (Harris Avenue)

The operating pressure of these mains at the time of the Incident was approximately 57 pounds per square inch gauge ("psig.") (id.). The maximum allowable operating pressure<sup>3</sup> ("MAOP") of the mains is 60 psig (id.).

### III. THE DEPARTMENT'S INVESTIGATION

#### A. Initial Actions and Observations

On April 28, 2006, at approximately 3:30 p.m., an inspector from the Department's Pipeline Engineering and Safety Division ("Division") arrived at the site to investigate the Incident. He met with representatives from the Fire Department and NSTAR. During the course of the investigation, the inspector learned that a NSTAR crew was working to repair a Grade 2 leak on a three-inch bare steel high pressure main at this location (Exh 5). This work required a four-way main cutout procedure and the installation of bypasses to maintain service to customers (id.). This work was completed in the morning, and a pressure test of the new facilities was conducted at 100 psig (id.). Soon after the pressure test was concluded, an employee tapped a two-inch plastic High Volume Tapping Tee ("HVTT") (id.). As he withdrew the cutter into the body of the HVTT, the cap of the HVTT and the tool and cutter blew off the top of the HVTT (id.). This permitted high pressure gas to be released to the atmosphere and ignite, seriously injuring the employee (id.). The inspector observed the work area, and he photographed the scene as well as the facilities in the excavation, the damaged pipe that had been removed from the excavation and the HVTT and the cutting tool.

#### B. NSTAR Gas Company

A NSTAR crew had been working at this location for several days preparing to repair a grade 2 leak in the intersection that had been discovered by a leak survey on April 14, 2006

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<sup>2</sup> A high pressure system is a system in which the gas pressure in the main is higher than the pressure provided to the customer.

<sup>3</sup> The maximum pressure at which a pipeline may be operated as set forth in 49 C.F.R. § 192.619.

(id.). Once the leak area had been excavated it became apparent that a four-way main cut-out procedure was required to eliminate the leak (id.). In addition, bypasses were required to maintain continuous gas services to NSTAR's customers in the affected area (Exh. 6).

The Area Supervisor had conducted a job briefing in the morning with the local supervisor and the crew members to review the tie-in piece, the air test and the sequence for tapping the four tees included in the tie-ins (Exh 5). He also reviewed the locations of existing valves in the system located on Webster Avenue in the event it became necessary to shut down the system (id.). This work was completed by 12:30 P.M., and the pressure test was applied to the tie-in section (id.). The crew then went to lunch (id.). The successful pressure test was removed at 1:45 P.M., and the employee began to make the first of four taps (id.). The first tap involved a two-inch HVTT (id.).

Another employee who was working in the excavation a short distance away heard what appeared to be a blowing sound from the two-inch tap the employee was working on (id.). The second employee turned to look, and he observed the gas ignite within a few seconds (id.). The second employee assisted the employee who was making the tap to get out of the excavation (id.). The Area Supervisor was notified of this Incident, and he arrived back at the site at 2:11 P.M. He instructed crew members to shut the valves in Webster Street, at the intersection of Great Plain Avenue and at Dedham Avenue (id.). The fire was extinguished at 2:32 P.M. (id.). The existing segments of mains and the replacement tie-in section were removed from the excavation in order for the system to be reconnected and returned to service ( Exh. 7). The HVTT (Exhs. 8 a, 8b) and the Tapping Tool with the cap and cutter (Exhs. 9 a, 9b) were also recovered.

#### C. The Needham Fire Department

The Fire Department received an alarm of an outside gas ignition at Webster Street and Harris Avenue at 1:48 P.M (Exh. 3). The first unit arrived on scene at 1:52 P.M (id.). A number of additional units were dispatched to the site for support (id.). The last unit departed the site at 9:39 P.M. (id.). Fire department personnel stood by while NSTAR personnel shut two main valves to stop the flow of gas (id.). This caused the fire to become extinguished. Approximately 30 buildings, involving 125 persons, were evacuated as a result of the Incident (Exh. 1). The evacuation ended at 6:00 P.M (Exh. 3).

#### D. Interview with the Employee Who Performed the Tapping Procedure

On August 17, 2006, two Division inspectors interviewed the NSTAR Gas employee who tapped the HVTT (Exh. 10). He stated that he has been involved with dozens of similar tapping procedures in the past, and that he is current in his Operator Qualification ("OQ") certification (id.). The employee stated he tapped the main through the HVTT (id.). He then began the reverse procedure to remove the tool from the HVTT (id.). At some point, he heard

gas escaping from the tee (id.). The employee stated that he became aware that the cap was loose and spinning with the tool as he rotated the handle (id.). He stated that he picked up the cap from the tee to see what was there (id.). At this time, he stated he began to reset the cap to try to stop the flow of escaping gas (id.). But as he was applying pressure to the handle, he stated that the gas pressure forced the equipment out of the tee, permitting gas to escape from the open end of the HVTT (id.). He stated that he attempted to stop the flow of gas by placing his foot on the tee until a coworker could shut off a nearby valve in the excavation (id.). He was unable to do this, and a very short time later ignition of the gas occurred (id.).

E. NSTAR's Operating & Maintenance Procedures

NSTAR incorporated Central Plastics' Operation Instructions for the use of the No Blow-By Punch Tool into its Operating and Maintenance Procedures (Exh. 11) Item 3 of Central Plastics Operations Instructions states that "the cap can be installed and tightened just enough to get a good seal on the o-rings (hand tighten only) (Exh. 12)."

In May 2001, Central Plastics Company issued a revision to its No Blow-By tool Operation Instructions (Exh. 13). These revised instructions added the following items:

- 1) Inspect the sealing surface of the No-Blow By Tapping Tool and ensure the O-Ring seal is properly installed and in good condition . . . .
- 5) . . . Retighten the cap after rotating the tapping tool a couple of revolutions.
- 6) . . . (NOTE: If at any time you hear gas escaping - tighten the cap)
- 7) Occasionally there will be a slight deformation of the I.D. o-ring and a small amount of gas leaking around the punch. This is normal and will not prevent the cap from sealing properly

(id.).

F. Other Tests and Observations

The Federal Regulation, 49 C.F.R. Part 199, § 199.11(b), Drug tests required, states in relevant part:

Post-accident testing. As soon as possible but no later than 32 hours after an accident, an operator shall drug test each employee whose performance either contributed to the accident or cannot be completely discounted as a contributing factor to the accident, and

49 C.F.R. Part 199, § 199.225(a) Alcohol tests required, states in relevant part:

Post-accident. (1) As soon as practicable following an accident, each operator shall test each surviving covered employee for alcohol if that employee's performance of a covered function either contributed to the accident or cannot be completely discounted



as a contributing factor to the accident.

Five NSTAR employees were working on the main at Webster Street on April 28, 2006. Two had left prior to the Incident. None of these employees were subjected to drug and alcohol tests after the Incident.

The employee who performed the tapping procedure was the person who was injured. NSTAR was unable to obtain drug or alcohol tests from him as he was transported to the hospital immediately following the Incident (Exh 14). In addition, he was medicated before drug tests could be performed (*id.*). NSTAR did not drug test the other employees in the crew as they were not involved in the tapping procedure (*id.*)

#### IV. LEAKAGE SURVEYS

Leakage surveys of gas mains and services are required by federal and state regulations, 49 C.F.R. Part 192, § 192.723<sup>4</sup> and 220 C.M.R. § 101.07.<sup>5</sup> An operator generally employs flame ionization detectors<sup>6</sup> and combustible gas indicators to locate and quantify gas leakage. NSTAR conducted a mobile survey of Webster Street and Harris Avenue on July 14, 2005. No leaks were detected. (Exh.15).

A NSTAR supervisor conducted a leak survey of each main segment as it was returned to gas service. No leaks were detected. On May 4, 2006, a walking survey of the entire area was conducted, and no leaks were detected. (Exh. 16).

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<sup>4</sup> Leakage survey with leak detection equipment must be conducted outside business districts at intervals not exceeding five years. However, for cathodically unprotected distribution lines subject to § 192.465(e) on which electrical surveys for corrosion are impractical, survey interval may not exceed three years.

<sup>5</sup> Operators shall conduct leakage surveys over all service lines as frequently as experience and technology indicate are necessary, and in accordance with 49 C.F.R. Part 192.

<sup>6</sup> Flame Ionization Detector - An instrument that uses hydrogen fuel to power a small flame in a detector cell. A pump is used to pass continuous air samples through the cell. If a sample contains hydrocarbons such as gas, it will be burned or ionized in the hydrogen flame. It is accurate in the parts per million range.

V. TRAINING AND OPERATOR QUALIFICATION

NSTAR provided training records of the four employees in the crew that placed the new main into gas service on April 28, 2006 (Exh. 17). The employee who performed the tapping procedure received training on pipe joining on February 20, 2002 (id.). He received training on high volume electrofusion tees on March 21, 2000 (id.).

49 C.F.R. Part 192, Subpart N, requires operators to have a qualification program for its employees who perform covered tasks on its pipeline system. Among other criteria, a covered task is an activity that is performed as an operations or maintenance task. NSTAR provided the operator qualification records for the employee who performed the tapping procedure at Webster Street and Harris Avenue (Exh. 18). The employee received his Operator Qualification for "Tapping Pipelines Under Pressure" (Covered Task No.37) on March 30, 31 and April 1, 2004 (id.). He received his Operator Qualification for "Joining Pipe Materials Other Than Plastic or Steel During Maintenance" (Covered Task No.49) and "Joining Plastic Pipe for Maintenance" (Covered Task No.50) on January 19, 2006 (id.). The employee was also certified in "Abnormal Operating Conditions/Properties of Natural Gas", (Covered Task No.70) on March 31, 2004 (id.).

VI. FAILURE ANALYSIS OF THE HIGH VOLUME TAPPING TEE

Altran Corporation ("Altran") conducted failure analysis of the Webster Street and Harris Avenue two-inch high volume tapping tee. The purpose of the testing was to perform tapping operations on similar fittings in as many ways as reasonable to result in the disengagement of the cutter from the tapping tee as it may have occurred in the Incident. The tests were performed with a used NSTAR tapping tool and a new NSTAR tapping tool. The Department observed all aspects of the failure analysis.

On January 7, 2008, Altran submitted its report<sup>7</sup> ("Altran Report") to the Department. Altran's findings and conclusions are shown below:

Cutter punching tests performed showed no significant difference in tapping (punching) force between tapping with a loose cap and tapping with a hand tightened cap. It also showed no significant difference in tapping (punching) force between pressurized and non-pressurized samples.  
(Altran Report at 12).

Cutter retracting tests were performed to compare correct vs. incorrect positioning of

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<sup>7</sup> Copies of the Altran Report report can be obtained by contacting: Altran Corporation, 451 D Street, Boston, MA 02210

the No Blow-By tapping tool's cap.

- If the tool's cap was tight on the high volume tapping tee, the cutter was not able to disengage from the tee. The cap withstood an average torque force of 155 ft lbs from the cutter when retracted and in contact with the inside of the cap. In this case the cutter remained within the tee, and the high torque applied was rotating the cutter in place damaging (shredding) the internal threads of the tee. When this test was repeated under pressure, there was no leaking of the internal Nitrogen gas.
- If the tool's cap was loose it became disengaged from the high volume tapping tee and subsequently, the cutter was able to completely thread itself out of the tee during retraction. The torque required for this disengagement of the cutter was on average, 49 ft lbs. This torque is actually less than the torque required for the tapping operation (55 ft lbs). When this test was performed under the 56 psi Nitrogen pressure, no gas leaked until the cutter came out to a point where the pressure pushed it from the tee. These findings indicate an operator may not notice a significant change in torque while retracting the cutter beyond its intended position within the fitting

(id.).

It was also noted during the testing that the used corroded No Blow-By tool supplied by NSTAR caused the loosened tool cap to unscrew and become disengaged after 9 ½ full turns of the tool (id. at ). The same test performed with the new No blow-By tool did not disengage the tool's cap, and required 39 turns to unscrew the tool's cap only half way (id.).

Based on the findings from the laboratory testing of exemplar fittings, and the examination of the failed fitting from the incident site, it was likely that during the retraction step in the tapping procedure in the field, the No Blow-By punch tool's cap backed out completely or nearly completely (id.). This allowed the cutter to continue to retract beyond the top of the tee, and become disengaged (id.). This is supported by the evidence that the internal and external threads of the tee from the incident and the internal threads of the tool's cap from the incident were found intact indicating a condition where the cap was not in place and the cutter was free to disengage from the tee allowing the release of gas (id.). It was noted in the laboratory testing the top edge of the exemplar tees were deformed due to the cutter disengaging (id.). After the testing this deformation returned nearly to its original position (id.). The tee from the incident was damaged to heat from the fire and this feature was not identifiable (id.).

## VII. ODORIZATION

In accordance with 220 C.M.R. § 101.06(20), 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. An operator must also conduct periodic samplings of the gas to assure the proper concentration of odorant throughout its system.

Tests were conducted by two employees after the Incident at the following Needham locations:

<u>Time</u>	<u>Location of Sample</u>	<u>Technicians</u>	
		<u>Waldron</u>	<u>Piper</u>
1625	793 Great Plain Ave.	.080/.090	.060/.090
1658	786 Webster St.	.080/.090	.050/.080
1725	929 Webster St.	.080/.090	.080/.110
1745	938 Webster St.	.080/.090	.070/.090
1815	865 Central St.	.050/.060	.090/.120

The odor detectibility levels of gas in air after the Incident ranged from 0.05 to 0.12 percent gas in air, indicating that the odorant levels were within the prescribed state regulations (Exh. 19).

## VIII. FINDINGS AND CONCLUSIONS

### A. Findings

1. There are four main segments on Webster Street and Harris Avenue where the Incident occurred. They are:
  - a. 1307 feet of three-inch bare steel pipe installed in 1926;
  - b. 196 feet of two-inch bare steel pipe installed in 1957;
  - c. 268 feet of two-inch plastic pipe installed in 1986;
  - d. 84 feet of two-inch plastic pipe installed in 1987.
2. The MAOP for these mains is 60 psig.
3. On April 28, 2006, a NSTAR crew prepared to repair a Grade 2 gas leak by performing a four-way main cut-out.
4. The NSTAR crew conducted a successful pneumatic test of the new tie-in section from 12:30 P.M. to 1:45 P.M. at 100 psig to verify there were no leaks.
5. After the pressure test had been completed, the employee began to tap the Central Plastics HVTT.

6. As the employee withdrew the cutter into the body of the HVTT, he heard gas escaping from the tee.
7. The employee stated he observed that the cap was loose and spinning with the tool as he rotated the handle.
8. The employee stated he picked up the cap from the tee to see what was there, and he began to reset the cap to stop the flow of escaping gas.
9. The gas pressure forced the equipment out of the tee, permitting gas to escape from the open end of the HVTT.
10. The cap, handle and cutter were all forced out of the HVTT by the gas pressure.
11. The source of the gas leak was through the open end of the HVTT.
12. On April 28, 2006, at 1:48 p.m., the Fire Department received notification of an outside gas ignition at Webster Street and Harris Avenue.
13. There was one injury, requiring in-patient hospitalization, as a result of the Incident.
14. NSTAR had conducted leakage surveys of the area during the year preceding the Incident and found no leaks in its system.
15. The gas odorant levels in NSTAR's distribution system at Webster Street and Harris Avenue met regulatory requirements.
16. NSTAR qualified the employee who performed the tap.
17. NSTAR incorporated Central Plastic's Operation Instructions for use of the No-Blow By Punch Tool into its Operating and Maintenance Procedures. Item 3 of Central Plastics Operations Instructions states that . . . "the cap can be installed and tightened just enough to get a good seal on the o-rings (hand tighten only)."
18. In May 2001, Central Plastics Company issued a revision to its No Blow-By tool Operation Instructions to further ensure that the cap remained tightened

B. Conclusions

The Department has reason to believe that NSTAR failed to apply its own procedures to address the tap of the HVTT on the new main segment at Webster Street and Harris Avenue, and that failure was causally related to the Incident. The employee who was making the tap at Webster Street and Harris Avenue failed to adequately follow NSTAR's procedures. It appears that the cap may not have been tightened on the body of the HVTT during the tapping procedure. The loose cap permitted gas to escape and caused its subsequent ignition.

IX. NSTAR ACTIONS

On March 20, 2008, pursuant to G.L. c. 164, § 105A and C.M.R. §§ 69.00 *et seq.*, the Department concluded an enforcement action with NSTAR. NSTAR Gas Company, D.P.U. 06-PL-07. NSTAR agreed to review the instructions for tapping with a HVTT and revise its Operating and Maintenance Procedures to include the most recent instructions from

the manufacturer. NSTAR also agreed to retrain all personnel who perform tapping operations on live gas pipelines.