COMMONWEALTH OF MASSACHUSETTS

DEPARTMENT OF
TELECOMMUNICATIONS & ENERGY

PIPELINE ENGINEERING AND SAFETY DIVISION

INCIDENT REPORT

225 North Avenue, Weston, Massachusetts
September 12, 2005

PIPELINE ENGINEERING AND SAFETY DIVISION

Location: Weston, Massachusetts

Date of Accident: September 12, 2005

Gas Company: KeySpan Energy Delivery New England

Estimated Property Damage: Over $50,000 *

Injuries: 2

Report Issued - March, 2007

* Estimated by KeySpan Energy Delivery New England

TABLE OF CONTENTS

I. INTRODUCTION

A. Scope of this Investigation

The Pipeline Engineering and Safety Division ("Pipeline" or "Division") of the Massachusetts Department of Telecommunications and Energy ("Department"), pursuant to G.L. c. 164, § 105A and G.L. c. 82, §§ 40, 40A through 40E ("Dig Safe"), has investigated a natural gas ("gas") explosion at 225 North Avenue, Weston, which occurred on September 12, 2005 ("Incident").[1] The operator of the pipeline was KeySpan Energy Delivery New England ("KeySpan" or "Operator"). In a report[2] to the United States Department of Transportation ("U.S. DOT") KeySpan reported the damages to be in excess of $50,000 (Exh. 1). There were two injuries as a result of the Incident (Exh. 2).

As part of the Department's annual certification process by the U.S. DOT, the Department must report to the U.S. 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.

---

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 judgement 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 Form F 7100.1 is an incident report form that operators must tender to the U.S. DOT within 30 days of an incident.

49 U.S.C. § 60105(c)

The purpose of this report is to inform the U.S. 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 U.S. DOT safety standards for gas pipeline systems as set forth in 49 C.F.R. Part 192.

B. Overview of Incident

At approximately 10:45 a.m. on September 12, 2005, the Department received telephonic notice from KeySpan of an explosion at 225 North Avenue, Weston. The caller reported that a contractor, W. C. Rowe Corp. ("Rowe Corp" or "Contractor") hit a gas service line[3] while testing for a septic system. The Department dispatched three investigators to the scene.

The homeowner had contracted Rowe Corp. to install a septic system. While excavating in the front yard of 225 North Avenue, a Rowe excavator struck and pulled a ¾-inch high pressure[4] service line that transitions to one-inch piping, operated by KeySpan

---

3 A distribution line that transports gas from a common source of supply to an individual customer, to 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's piping, whichever is further downstream, or at the connection to customer piping if there is not a meter.

4 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. § 192.3

(Exh. 3). The contractor caused the line to break at a coupling located upstream of the pulled section of pipe. The failure allowed gas to enter the basement. The area was evacuated by the Weston Fire Department ("Fire Department") prior to the explosion. No one was in the house. A Weston town employee was injured by flying debris. A Weston fireman onsite was also injured. The ignition source is uncertain.

The Division's investigation finds that KeySpan improperly located and marked the location of this underground service line in response to a Dig Safe request by Rowe Corp. The Dig Safe law requires operators of underground facilities to correctly mark the location of their facilities within 72 hours of a request from an excavator. Markings on the ground indicated that the service line extended from the service riser located on the west side of the house straight out to the street (Exh. 4). However, the service actually began on the west side of the house and made a 90 degree turn down the front of the house, towards the center of the house (Exh. 5). When the service reached the center of the house it made another 90 degree turn going towards the street (id.)

II. THE DEPARTMENT'S INVESTIGATION

A. Description of the Site

North Avenue is located in a residential area of Weston. The area is comprised of single-family residences. The structure at 225 North Avenue is a two-story house, with a basement. A two-inch steel gas main, installed in 1930, underlies North Avenue (Exh. 6). The operating pressure of the main was between 48 and 56 p.s.i.g. (id.). A ¾-inch steel service line was installed to 225 North Avenue in 1930 (Exh. 7). In 1992, the service line was relocated to the west side of the house (Exh. 5). At that time, 24-feet of one-inch plastic pipe

was installed and the meter was placed outside (id.). On the outside service riser was a manual shut off valve. The service regulator was mounted downstream of this valve.

B. Description of the Scene

On September 12, 2005 at about 1:30 p.m., three Division investigators arrived at 225 North Avenue to investigate the Incident. Representatives from KeySpan, Rowe Corp., the Fire Department, OSHA, and the State Fire Marshal's Office were already at the scene.

The house had been completely destroyed by the explosion and ensuing fire (Exh. 8). The house had collapsed into the foundation. Debris had been blown across the street into a wooded area (id.). A furnace, washer, dryer, dehumidifier, and water heater were in the basement. In the front of the house, with slight charring of its boom, was a track excavator (Exh. 9). The gas meter was discovered approximately 11 feet from the location of the service riser (Exh. 2). It was discovered under a section of the wall that had been displaced from the foundation during the gas explosion. The meter had been severed from the riser at a point downstream of the meter valve (Exh. 10).

KeySpan attempted to locate the curb valve on the service to shutoff the flow of natural gas, but was unsuccessful. KeySpan then disconnected the service from the main at a coupling located in the street, thus stopping the flow of gas through the service line. The section of main at the service connection was capped (Exh. 2).

The Division's investigators requested that KeySpan conduct a pressure test of the portion of the service line that extended from a kink where the contractor pulled the pipe to the outlet of the service riser. Prior to the test, KeySpan placed a cap at the service valve. The pipe was then cut on the downstream side of the kink and capped. The service was first

pressurized to 10 p.s.i.g; then the pressure was raised to 20 p.s.i.g. (Exh. 2). A coupling approximately 21 inches downstream of the kink began to leak (id.). The leak was not significant enough to have contributed to the explosion. The coupling was cutout and the service line was capped again. The service pipe held at a pressure of 40 p.s.i.g. for 15 minutes (id.). The Division investigators observed no pressure drop, which indicated no leakage (id.).

After completion of the test, investigators attempted to expose the remaining portion of the service just upstream of the kink. As the area was excavated, the portion of the service line that was exposed, the kink, fell onto the ground indicating that the service pipe was no longer intact (id.). When the pipe was completely excavated, it was clear that the service had been pulled apart at a threaded coupling (id.). This appears to have happened when the contractor hit the service line (id.). Measurements by the Division's investigators showed that the kink in the service line was located 119 inches from the foundation wall (Exh. 2). The depth of the service pipe where it pulled out of the coupling was 42 inches (id.). After the section of the pipe with the kink was cut out, it was cut into two sections to help in the transportation of the pipe. The Fire Department took custody of the section of pipe that contained the kink, the two sections of pipe containing the leaking coupling, and the impacted coupling upstream of the kink in the pipe. After the investigation was completed at the scene, the Division's investigators took these sections of pipe into custody.

C. KeySpan Energy Delivery, New England

1. KeySpan's Locating Services

District Inspectors ("Locator" or "Mark-out Person"), employed by KeySpan, locate

and mark KeySpan's facilities in response to excavators' notifications to Dig Safe. This location was marked nine days prior to the Incident. KeySpan locators obtain service information from SPIPE[5] records and Scanned Service Records (Exh. 11). Information pertaining to mains is located on map records which along with the service records are obtained using a field data capture unit ("FDC") (id.). The FDC is located in the vehicles of the mark-out personnel.

The mark-out person for 225 North Avenue did not utilize distribution system map records because the work was "on property" (Exh. 12). During this mark-out, the locator used a MetroTech Model 510 pipe and cable locator (Exh. 14).

The SPIPE record for 225 North Avenue provided measurements for distances from the service line to known locations such as the front of the house and building corners (Exh. 15). According to the file, the service meter is located outside on the left (west) side of the house (id.). The length from the main to the curb shutoff is 11.7 feet; the length from the valve to end is listed as 0 feet and total length of the service is listed as 76 feet (id.). The file also provides the pipe sizes of the service along with a field work note stating that the service was relocated on December 18, 1992 (id.). The Scanned Service record provides a sketch of the service including the service pipe sizes. The service records state that the service was relocated; date of relocation, pipe sizes and a remark indicating that the service was relocated from the front of the house around the left hand corner (Exh. 5).

---

5 The name is short for Service PIPE. These files contain information such as size, length, pressure classification, installation date, size of main to which the service is connected, material, location of service entry, and distance from reference points (i.e., building corners). KeySpan Damage Prevention Manual, 2004 ed., pages 27-31.

2. Dig Safe Request

On September 1, 2005, Rowe Corp. called Dig Safe and requested a Dig Safe number for 225 North Avenue, Weston (Exh 16). The Dig Safe ticket indicated that Rowe would be testing for a septic system and the extent of the work would be the entire private property (id.). Dig Safe provided a start date of September 7, 2005 (id.). On September 7, 2005, a KeySpan locator arrived at 225 North Avenue to mark out the location. He attempted to locate SPIPE and Scanned Service record for 225 North Avenue (Exh. 2). Both of these computer inquiries indicated that no information was available for this service. Unable to verify the location of the service, the mark-out person went to the house and located the meter that was on the left side of the house (id.). He used his MetroTech 510 pipe and cable locating equipment to tie onto the service riser and flagged out the service. The locator did not see the tracer wire that is used to locate plastic pipe installations at the riser (Exh. 17). He attempted to locate the service line curb valve but was unable to find it (Exh. 18). The locator also indicated to the Division investigator that he had been having problems with his 510 locating machine (Exh. 3).

When the locator completed marking out the service line to 225 North Avenue, he completed a computer generated dig safe completion ticket for the mark-out (Exh. 16). The completion ticket indicated he visited the site and marked out the service line on September 3, 2005 (id.). The method of locating was direct, meaning that he tied directly onto the service to determine its location. In the comment section of the completion ticket the

locator had the following comments: Flagged Service, No Service Card, Locator Down [6], Talked to Owner, Don't Dig in Gas area (id.).

The incident investigation revealed that the locator did not retrieve the SPIPE and Scanned Service records because he failed to access the computer application system correctly (Exh. 12). The mark-out flags that were placed in the lawn area of 225 North Avenue did not accurately indicate the location of the service line (Exh. 4). The flags indicated that the service went from the riser at the building straight out to the street (id.). The service actually took a 90 degree turn and ran along the front side of the house, made another 90 degree turn and went straight towards the street (Exh. 5). The locator had relied solely on his 510 locating machine and his connection to the riser to mark out the service (Exh. 12).

The service to 225 North Avenue is comprised of the following: bare steel pipe; plastic pipe and a steel riser inserted with plastic. In order to locate a plastic service, a tracer wire is utilized. In this case, the locator never located the tracer wire (Exh. 17). During the investigation, the tracer wire was found near an excavated portion of the service line (id.). The KeySpan locator also relied solely on equipment that he considered problematic, the Metrotech 510 locating machine (Exh. 3). The Company reported that it tested the Metro Tech 510 machine, and concluded that it was working correctly. (Exh. 26).

On September 29, 2005, a KeySpan supervisor tested the locating equipment used by

---

6 The locator was referring to his MetroTech 810 pipe and cable locating machine, not the Metro Tech 510 that was used for the markout of 225 North Ave, Weston (Exh. 26).

the locator, making direct connection to the service riser at 225 North Avenue. The locating equipment did not provide signals in the marked location (Exh. 19).

KeySpan's O&M procedure, DAMAGE 5020: Procedure for Locating and Marking Out Sub-Surface Facilities, provides requirements to be followed by locators in the field. The O&M states that a locator should utilize any or all of the following Maps and Records: 1) Maps and Records provided electronically through FDC unit; 2) Scanned records provided electronically through FDC unit; 3) S-Pipe file provided electronically through the FDC unit; 4) New construction notes; and 4) Regulator construction notes available upon request through Pressure Group (Exh. 20).

The procedure also states that "if the markout person notices a discrepancy between the engineering records and the actual location of the gas facility, he/she shall fill out the Misc. AMMS Correction Form within the FDC unit. The markout person shall use their electronic pipe locator and their best judgement to markout the service" (id.).

The locator for 225 North Avenue attempted to use KeySpan's Scanned records and SPIPE records to obtain the location of the service line. He followed company procedures by utilizing the available records; however, he failed to access the information correctly (Exh. 12). As a result of the locator's actions, the FDC unit supplied inaccurate information to the locator. The FDC unit scanned records indicated that there was only one service on North Avenue, 535 North Avenue. The SPIPE record indicated that there wasn't a service at 225 North Avenue (id.). The locator went one more step by attempting to locate the service with a pipe locator (id.). This also produced an incorrect result.

All existing services are listed in the SPIPE system (Exh. 19). During the locator's search for these records, if the SPIPE system says that no service records were found, that should suggest to the locator the existence of either a records problem, or a records retrieval problem, and assistance should have been requested (id.). If assistance had been requested, it would have alerted the company of a records problem (id.). There are occasions in which records are not available, but that was not the case here (id.).

The locator did not notify the Damage Prevention supervisor of any of the problems he had been having with the mark-out (Exh. 19). When a mark-out person notices a discrepancy between the engineering records and the actual location of the gas facility, KeySpan's O&M Procedures require the locator to fill out the Misc. AMMS Correction Form within the FDC unit (Exh. 20). The locator did not complete a Misc. AMMS Correction Form (id.).

3. Operator Qualification and Training Records

KeySpan provided training records for the locator who marked out the gas service at 225 North Avenue. The records date back to 1994 (Exh. 21). Annual training provided by KeySpan's Norwood Training facility included the following: District Inspector Training (1994-1998) and Mark-out Refresher Training (1999-2004). These training sessions are the same. The name of the training was changed to Mark-out Training in the 1990's (id.). The Damage Prevention Manual which is used during training sessions includes: Summary of the Dig Safe Law; Locating and Marking Procedures; Cast Iron replacement Guidelines; Methods for Identifying and Marking Company facilities; Maps and Records (SPIPE, symbols etc). The training also includes a review of maps, records, S-Pipe and also the electronic means to access

records.

The Damage Prevention Manual (August 2004) contained two sets of O&M procedures with a May, 2004 revision date. One of the procedures contained a reference to scanned records in the section pertaining to Maps and Records and the other did not. The damage prevention procedures in the O&M, which has a revision date of July 2004, contained a reference to the use of scanned records as a tool to be utilized by the locator. It is unclear why the Damage Prevention Manual did not contain the July, 2004 revised O&M procedure.

The KeySpan locator also received individual training by Damage Prevention Supervisors. The training included the following:

* August 1, 2005 – A Damage Prevention Supervisor provided one-on-one training in the use of the MetroTech 810 pipe and cable locator (Exh 21).
* June 22, 2005 – A Damage Prevention Supervisor provided a one-on-one training with the locator after a mismark at 33 Juniper Road, Weston. One reason for this mismark was that the locator did not use the scanned service cards to markout the location (Exh. 21).
* May 10, 2005 – Safety and Operations meeting was held. The Damage Prevention Supervisor demonstrated the proper method of accessing services in the Scanned Records application. The supervisor also told the attendees not to put in a street address because they would miss addresses with no street number such as lot numbers, pole numbers (Exh. 21).

* March 1, 2005 – Safety and Operations meeting was held (Exh. 21).

49 C.F.R. Part 192, Subpart N Federal Pipeline Safety Regulations require operators to develop a qualification program for its employees who have particular job functions. The Districts/markout employees have to be qualified to perform their job responsibilities. The locator of 225 North Avenue received Operator Qualification ("OQ") tests on October 28, 2002, December 10, 2004 and August 16, 2005 (Exh. 22). The results of the tests indicated that the locator passed all of the required tests (id.). The OQ testing included the following:

- Inspecting for atmospheric corrosion
- Visually inspecting for internal corrosion
- Line Locating and markout
- Inspecting third party excavations
- Inspecting exposed pipe
- Inspecting pipe at a maintenance job for damage
- Abnormal conditions and properties of natural gas.

4. History of Locator's Performance

In 2005, the locator of 225 North Avenue mismarked three locations which resulted in damages: 1) Whispering Lane, Weston - 6/1/05; 2) 17 Robert Best Road, Sudbury - 6/6/05; 3) 1 Highland Road, Sudbury - 6/29/05 (Exh. 23). There were also two other locations that were mismarked by the same locator in 2005. These mismarks did not result in damages to KeySpan's facilities they were: 1) 33 Juniper Road, Weston – 6/22/05 and 2) 29 Barnett Road, Sudbury - 9/1/05 (Exh. 24). The locator was retrained on three separate occasions between

June, 2005 and August, 2005: June 22, 2005, August 16 and 17, 2005 (Exh. 21).

5. Electronic Pipe and Cable Locators Performance

The KeySpan locator was provided with the following pieces of equipment in his vehicle and available to him: MetroTech 810 pipe and cable locator (one meter on this unit was not working properly); MetroTech 510 pipe and cable locator; Heath Sure-lock All Pro pipe and cable locator; and Pipehorn Model 100 pipe and cable locator (Exh 13). KeySpan locators also have other types of locating equipment including valve box locators (id.). KeySpan was unable to provide a maintenance history for the 510 and 810 pipe and cable locators (Exh. 25). The 510 locating machine, used by the locator who marked out 225 North Avenue was manufactured and calibrated on or about July 16, 2003 (Exh 14). The manufacturer's procedures do not require the machine to be calibrated. The procedures do require that the batteries be checked on a regular basis (id.).

On June 22, 2005, the KeySpan locator requested that the supervisor provide him with a new locating machine after he performed a mismark at 22 Juniper Road. On August 17, 2005, the locator was given a MetroTech 810 (Exh 24). At that time, the Damage Prevention supervisor spent an hour showing the locator how to use the machine (id.).

On September 1, 2005, at 29 Barnett Road, the locator informed the Damage Prevention supervisor that the meter on his Model 810 was pinned and not working (id.). The supervisor told the locator that he could still use the digital readout if it worked (id.). The locator decided to use his MetroTech 510 machine. Even with the new machine the locator was still having problems marking out. The supervisor came out to Barnett Road and

determined that the marks were off at some locations (id.). The supervisor informed the locator that they would get together another day to go over the markout of this location. KeySpan did not provide a date as to when the supervisor and the locator met to discuss the mismark (id.).

6. KeySpan Incident Report Determinations and Recommendations.

KeySpan conducted an investigation into the incident that occurred at 225 North Avenue, Weston. As a result of the investigation, KeySpan made determinations as to the cause of the mismark and recommendations (Exh. 26). A few of the determinations and recommendations are listed below:

Determinations

1) The locator did not properly look up the service records to 225 North Avenue, Weston, that were available in the Host Inquiry and Scanned Records application. Had he entered "North Av" instead of "North Ave" in the Host Inquiry SPIPE application, he would have found accurate service information for 225 North Avenue, Weston.
2) Had the locator entered "North*"instead of "North Ave*" in the "Street Name" box of the Scanned Service application on his FDC unit he would have received 179 scanned records for North Avenue, Weston.
3) The locator received training on the proper method to find service information in the Scanned Records application on May 10, 2005 in the Waltham Yard.
4) When the locator arrived on site at 225 North Avenue, Weston, and found a service riser on the left side of the building, he did not delay his markout and seek assistance to gather any existing records of the service.
5) When the locator met his supervisor on Tuesday September 6, a day before the Dig Safe ticket was legal to be dug, to pick up a MetroTech 810 pipe and cable locator, he did not mention problems with finding records to 225 North Avenue, Weston or request his supervisor's assistance with the mark out at that location.
6) The final determination is that the service to 225 North Avenue was improperly marked due to the locator not following proper KeySpan procedure and due to locator error. The mismarked gas service was struck and pulled by the excavating contractor ultimately causing the incident (id.).

Recommendations

1) Employee Discipline – Action taken
2) Re-train all Damage Prevention employees in record access applications and in the proper operation of electronic locating equipment – Action to be taken
3) Review of all department procedures and the Damage Prevention Manual – Action to be taken
4) Re-training of all others involved in markout activities in records access applications and in proper operation of electronic locating equipment – Action to be taken
5) Train the trainer sessions for yard training representatives in record access applications – Action to be taken
6) Damage Prevention supervisors conduct more frequent periodic field audits of all locating activities – Action to be taken
7) Use QA/QC inspectors to periodically review mark out activities of all Damage Prevention employees – Action to be taken (Exh. 1)

7. Homeowners

The homeowners have lived at this residence since 1992 (id.). After moving into their house, they enclosed a three season porch. The existing septic system for the house is located on the left front area of the house. They never smelled gas in their home (id.). One of the homeowners was home when his natural gas service line was being marked out by a KeySpan locator (Exh. 2). He spoke to the locator and asked what he was doing. The locator proceeded to place flags in the yard to show the location of the gas line.

On the morning of September 12, 2005, one of the homeowners was at home. At approximately 8:30 a.m., the contractor's backhoe arrived onsite with an engineer. At 9:30 a.m., the homeowner left the house to go to the Post Office (id.). When he left, the backhoe operator was digging in the area of the gas service. The homeowner had left one window open on the lower level of the front side of his house. He had a conversation with the backhoe operator who asked him how long he had lived at the house and if the pipes had

been changed. When he returned home from the Post Office, he discovered that there had been a gas explosion (id.).

8. W.C. Rowe Corp.

The W. C. Rowe Corp. was hired to perform excavating work for a new septic system at 225 North Avenue. The day of the explosion was the first day of excavation for the project. Rowe had obtained a valid Dig Safe number (Exh. 16). The Dig Safe ticket became valid on September 7, 2005 at 9:30 a.m. (id.). The excavator was unsure if the area was premarked. Prior to the damage to the service line, Rowe had excavated by hand near the service riser and along the route of the flagged service line in an attempt to locate the service line.

Unable to locate the service, Rowe decided to move to a safe area to begin excavating. After moving approximately 15 feet east of the flagged area, the backhoe operated by a Rowe employee struck the service line feeding 225 North Avenue, placing a kink in the pipe (Exh. 3). The gas smell permeated the area while a plume of dirt surrounded the backhoe at the kinked area. After the service was hit, the employee took photographs of the area.

Rowe notified Dig Safe Inc. and the Fire Department of the hit gas service line. KeySpan's Call Center received a call from Dig Safe at 10:21 a.m., reporting that a contractor working at 225 North Avenue, Weston, hit a gas line (Exh. 27). At 10:25 a.m., KeySpan dispatched a service technician to the site (Exh. 27). The Fire Department arrived at the site and detected a high level of natural gas in the basement. They evacuated civilians and public safety personnel (Exh. 28). The house exploded shortly thereafter. (Exh. 27).

III. 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 in air]." 220 C.M.R. § 101.06(20)(a). Operators are also required to conduct periodic sampling of odorant concentrations throughout their systems. 220 C.M.R. § 101.06(20)(a). KeySpan conducts odorant sampling on a monthly basis.

On September 12, 2005, several odor level tests were conducted in Weston after the explosion (Exh. 29). The results of the test are as follows:

1. 227 North Avenue @ 12:10 p.m. - Odor level @ 0.12 percent gas in air
2. 4 Hastings Road, Weston @ 1:00 p.m. - Odor level @ 0.080 percent gas in air
3. Weston Fire Station, Boston Post Road @ 1:40 p.m. - Odor level @ 0.080 percent gas in air.

The odor detectability levels of gas in air ranged from 0.080 percent to 0.120 percent gas in air, indicating that the odorant levels were within the prescribed state regulation. See 220 C.M.R. § 101.06(20)(a). There were reports of an odor of gas prior to the explosion (Exh. 2).

IV. LEAK INVESTIGATIONS AND MAINTENANCE ACTIVITY

On January 30, 2004, KeySpan responded to a leak at 225 North Avenue, Weston (Exh. 31). A leak at a union, down stream of the riser shutoff, was found and the gas was shutoff so that fitters could repair the line (id.). The leak was repaired that day. Over the last

year, KeySpan is not aware of any maintenance or replacement work performed on the main in the area of the incident (Exh. 6).

V. LEAKAGE SURVEY

In order to determine if other leak sources were contributing factors to the Incident, the Department reviewed the leak history of the mains and service to 225 North Avenue. Leakage surveys of gas mains and services are required by federal and state regulations. See 49 C.F.R. § 192.723(a) and 220 C.M.R. § 101.06(21). The week of August 18, 2003, a walking survey of the main and service was performed (Exh. 32). On November 12, 2004, KeySpan conducted a mobile leakage survey over the gas main underlying North Avenue (id.). The mobile survey did not detect any leaks in the area (id.). After the Incident, KeySpan conducted a leak survey. This survey detected no gas readings on the main or service to 225 North Avenue. There were no gas readings in the adjacent homes to 225 North Avenue (Exh. 33).

VI. FINDINGS AND CONCLUSIONS

A. Findings

1. A two-inch steel main was laid under North Avenue in 1930.
2. A three-quarter inch steel service line to 225 North Avenue was connected to the two-inch main on North Avenue. The service line, which was installed in 1930 was partially relayed with 24 feet of one-inch plastic pipe in 1992. The plastic pipe was installed from the meter to the front center of the house.
3. The meter, regulator and service riser were located on the west side of the house.
4. The service card shows that in 1992, plastic pipe was installed and the meter was relocated to the left side of the house.
5. The SPIPE file for 225 North Avenue indicated that the service was relocated in 1992 and the meter was located outside on the left. The size and measurements of the steel and plastic portions of the service were listed.
6. W.C. Rowe Corporation tendered notification to Dig Safe on September 1, 2005 for septic testing at 225 North Avenue, Weston.
7. A KeySpan locator marked the service line to 225 North Avenue on September 3, 2005.
8. The KeySpan locator failed to access scanned service records and SPIPE file correctly.
9. The locator did not access the tracer wire, at the service riser which is used to locate plastic pipe because it was inaccessible.
10. The locator connected directly to the service riser to mark out the service which resulted in a mismark of the service line.
11. The locator indicated on his Dig Safe completion record that one of his locators was down.
12. KeySpan's procedures call for locators to use scanned records and SPIPE file to be utilized when marking out a service.
13. The locator failed to complete a Misc. AMMS Correction Form after noticing discrepancies with the engineering records and the actual location of the gas facility.
14. An excavator, operated by W.C. Rowe Corporation on the south side of the house, struck the service line to 225 North Avenue on September 12, 2005.
15. The force exerted by the excavator pulled the underground section of the service line, horizontally, in a northerly direction.
16. Post incident investigation showed no service line or other underground metallic structure at the location indicated by the Dig Safe markings placed by the KeySpan locator.

B. Conclusions

On September 1, 2005, W.C.Rowe Corporation tendered notification to Dig Safe Inc. That septic testing work would be conducted on the private property of 225 North Avenue, Weston. KeySpan's locator improperly marked the service line. The locator failed to use the computerized record keeping system correctly. Further, the locator failed to notify the supervisor of problems he was having with the markout.

The damage to the gas line servicing this residence occurred during mechanized excavation activity relating to the testing for a septic system. The only identifying marks on the private property to indicate the location of the gas service line were flags that were placed in a manner showing that the service went directly out to the street with no offsets. These markings did not identify the true location of the gas service. In an apparent "safe" area, away from the markings, the backhoe struck the unidentified gas service line. The horizontal movement by the backhoe caused the pipe to fracture at the inlet connection to a threaded coupling, which was located in close proximity to the contractor excavation. This fracture allowed gas to enter the house, which led to the explosion.