



National Transportation Safety Board

Washington, D.C. 20594

Pipeline Accident Brief

Accident No.:	DCA-06-MP-001
Type of System:	Natural gas distribution
Accident Type:	Pipeline break, explosion, and fire
Location:	Bergenfield, New Jersey
Date:	December 13, 2005
Time:	9:26 a.m. eastern standard time ¹
Owner/Operator:	Public Service Electric and Gas Company
Fatalities:	3
Injuries:	5
Property Damage and Losses:	\$863,300
Material Released:	Natural gas
Pipeline Pressure:	11 1/2 pounds per square inch, gauge
Component Affected:	1 1/4-inch steel service line

The Accident

On December 13, 2005, at 9:26 a.m., an apartment building exploded in Bergenfield, New Jersey, after natural gas migrated into the building from a damaged pipeline. Investigators found a break in an underground 1 1/4-inch steel natural gas distribution service line that was operating at 11 1/2 pounds per square inch, gauge. The break occurred at an underground threaded tee connection downstream from where excavators were removing an oil tank that was buried under the asphalt parking lot adjacent to the building. The break occurred, under the parking lot, about 7 feet 4 inches from the building's wall. Three residents of the apartment building were killed. Four residents and a tank removal worker were injured and transported to hospitals. The property damage consisted of the apartment building, which was a complete loss. (See figure 1.) According to Bergen County tax records, the assessed value of the apartment building was \$863,300.

JP Management, a real estate company that owned the apartment building, hired the American Tank Service Company (American Tank) to remove and replace the buried oil tank. On December 5, 2005, American Tank requested markouts² of the utilities at 30 Elm Street through the New Jersey One Call System.³ On December 7, 2005, a Public Service Electric and

¹ All times are eastern standard time.

² A *markout* is a ground marking that is typically color coded and that indicates the location of underground utilities.

³ *New Jersey One Call* is a one-call operation for anyone planning to dig (excavation, demolition, blasting), regardless of the size of the project. This operation is for both commercial construction and homeowners.

Gas Company (PSE&G)⁴ street inspector went to the site and marked the location of the buried gas service line to the building. The marked location showed that the service line ran under the parking lot and about parallel to the building's wall. At a point downstream of the excavation area, the pipeline turned 90° toward the building. (See figure 2.)



Figure 1. Damage caused by explosion.

About 8:30 a.m. on Monday, December 12, the American Tank crew arrived at the site, saw the gas and water utility markouts, and began excavating in the asphalt parking lot that was adjacent to the building. The work contract indicated that the tank capacity was 2,000 gallons. According to the American Tank foreman, when the excavation was about 30 inches deep, the top of the tank was exposed. At this time, the crew realized that the tank was a 5,000-gallon tank rather than a 2,000-gallon tank.⁵ Because the larger tank was wider, longer, and heavier than expected, and thus closer to the natural gas service line, the excavation crew had concerns about its safe removal. In an interview, one of the crewmembers stated, “[At the time] I said our concern is once we move the tank or roll it over, to roll it and take it out, it may undermine the gas line.” An American Tank vice president went to the site to verify that it was a larger tank and to reassess its removal. He arranged for his office staff to call New Jersey One Call for a second markout of the utilities. The PSE&G inspector arrived at the apartment building about 11:14 a.m. and re-marked the gas service line. He made a slight change to the original marking where the gas line entered the building.

⁴ PSE&G is one of the largest combined electric and gas companies in the United States and is New Jersey's oldest and largest publicly owned utility.

⁵ Based on the length and depth of the tank, an American Tank vacuum truck operator referred to the tank capacity reference books that he carried in his truck and correctly determined the capacity of the tank to be 5,000 gallons.

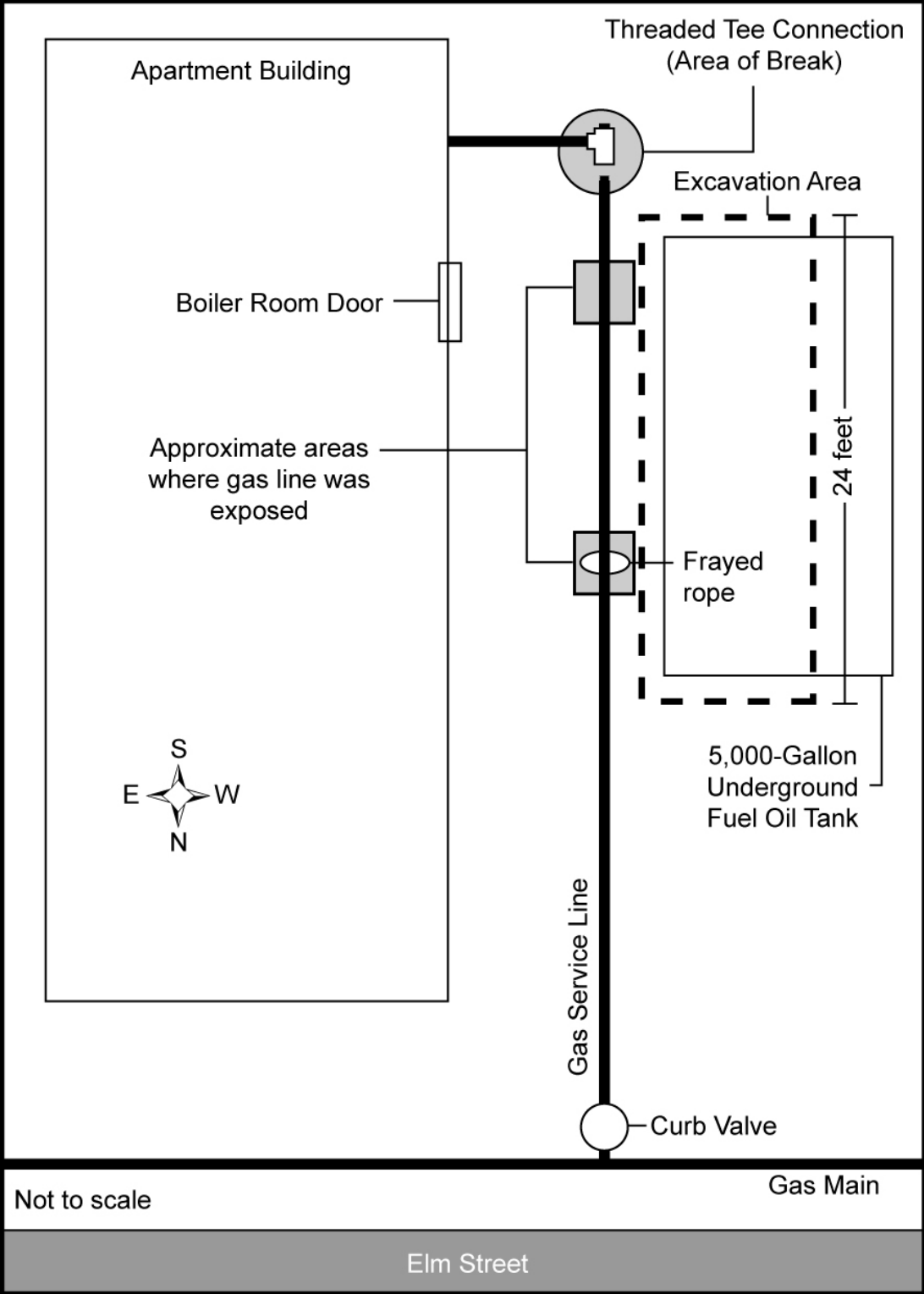


Figure 2. Diagram of accident site.

The American Tank foreman told investigators that on December 12 he asked the PSE&G inspector whether the gas line could be shut off while they excavated. This request was a precaution to prevent the release of gas if the line was damaged during the tank removal. The PSE&G inspector told investigators he stated to the American Tank foreman that because it was wintertime the gas could not be shut off. However, the PSE&G inspector said that he would ask his supervisor. When the supervisor told the inspector that turning off the natural gas to the building would not be possible, the inspector informed the American Tank foreman. According to the PSE&G, shutting off the gas to the building without making prior arrangements with the PSE&G and the building's owner would have created a health risk to the residents by leaving them without gas for heat, hot water, and cooking.

The American Tank foreman and assistant manager said during postaccident interviews that, based on their examination of the worksite after the initial excavation, they thought the excavation was stable and secure, and the excavation wall was far enough from the pipe to be safe. However, the American Tank crew did not evaluate the soil at the walls of the ditch for stability.⁶

The excavation crew exposed a portion of the gas pipeline by excavating with hand shovels to confirm the service line's location. The excavation was done by digging into the eastern trench wall, near the gas pipeline and the building, while standing in the trench. The PSE&G street inspector who had marked the pipeline told Safety Board investigators that he was on site when the service line was first uncovered. The service line was partially exposed in two locations that were each about 1 foot long. The service line was buried about 30 to 36 inches and was about 2 feet from the extended eastern edge of the trench. To excavate the 5,000-gallon tank, the crew had to open a trench that was about 24 feet long, which was considerably larger than originally planned.

The PSE&G inspector determined that the pipeline was a PSE&G gas pipeline and that it was accurately marked. According to the inspector, he reminded the American Tank crewmembers of their obligation to protect the gas pipe from damage by supporting the pipe against an immovable object, such as the building, or shoring the trench. The PSE&G inspector did not remain on the job to ensure that the pipeline was adequately protected. In addition, he did not attempt to test the curb valve to ensure it could be rapidly closed if the pipeline was broken. The inspector gave the American Tank foreman his business card and asked him to call if he needed assistance or had any questions. The inspector departed the site at 11:47 a.m. According to the American Tank foreman, the trench was not shored and was about 4 to 5 feet deep at the end of the first day.

The American Tank crew (assistant manager, foreman, and two crewmembers) arrived about 8:30 a.m. on Tuesday, December 13, 2005, to continue work on the excavation. The American Tank crewmembers told Safety Board investigators that they did not start any of the excavation equipment or expand the excavation on December 13, the day of the accident. When they first arrived, they saw that the ground surrounding the pipeline had collapsed and fallen from underneath portions of the asphalt parking lot along the eastern wall of the trench. The

⁶ Trench wall soils can be tested for stability by using a penetrometer, which is a mechanical device that measures the force needed for a probe to enter the soil. Another method is the "thumb test," in which the thumb is pushed into the soil along the wall.

crewmembers said that they tied one end of a rope to the gas pipeline and the other end to the oil tank vent pipe at the building wall in an effort to help support the pipeline. The American Tank crew also placed a pump into the trench and was removing some of the water that had accumulated when some crewmembers reported hearing a “popping” sound and two crewmembers smelled natural gas. Shortly afterward, the other two crewmembers smelled natural gas.

From across the street, a local business owner saw the American Tank crew working at 30 Elm Street. He said that he saw water flowing down the road and when he went across the street to where the American Tank crew was working, he smelled natural gas. The business owner said that he would call the police for them. He called the Bergenfield Police Department⁷ at 8:49 a.m. and reported a gas leak. His call was the only one that the Bergenfield Police Department received about the incident before the explosion. An apartment resident later told Safety Board investigators that she also had smelled natural gas, but had not called the police department, the fire department, or the PSE&G. The American Tank foreman called the PSE&G at 8:54 a.m. and reported that the ground had collapsed and the service line was broken.

According to the Bergenfield Police Department dispatch logs, at 8:52 a.m., the Bergenfield Fire Department’s chief,⁸ a fire official,⁹ and an engine company responded to an initial notification of a gas leak. Two Bergenfield Police Department police officers were also dispatched. A Bergenfield police officer directed traffic away from the area. After arriving on scene about 8:54 a.m., the fire chief asked the police dispatchers to notify the PSE&G. At 8:58 a.m., police dispatchers notified the PSE&G of the incident. The fire chief told Safety Board investigators that he had not observed any signs of a leak at the trench (that is, smelling gas, hearing a “hissing” sound, or seeing bubbling of water in the trench). The fire official said that he did not smell gas at the scene. No one from the Bergenfield Fire Department checked the apartment building for the presence of natural gas. The fire department did not attempt to evacuate the building before the explosion.

The Bergenfield fire chief said that the American Tank crew warned him, before the explosion, about the soil giving way in the trench and to be careful while walking near the trench. The fire chief also said that he looked into the trench and could see that the soil beneath the asphalt on the east side of the trench had fallen into the trench.

About 9:22 a.m., a PSE&G service technician arrived on scene. The technician attempted to close the curb valve to shut off the gas, but he was unable to apply enough force to close it. In a postaccident interview, the service technician said that as he approached the building to investigate the gas leak, an American Tank crewmember told him to not get too close to the trench because it had already collapsed. The service technician said that he had seen a piece of asphalt that had fallen into the trench. The service technician, using a portable gas detector,

⁷ The Bergenfield Police Department dispatches the police department and the fire department.

⁸ The Bergenfield Fire Department was composed mostly of volunteers. The fire chief, a volunteer, served for a 1-year term.

⁹ Bergenfield had five career fire officials who conducted site inspections and fire investigations. The fire officials also responded to fire incidents.

detected a positive gas reading just inside the boiler room doorway of the apartment building. He started moving away from the building as it exploded at 9:26 a.m.

The police and fire departments, American Tank, and the PSE&G started rescue actions. The fire departments started firefighting. About 10:00 a.m., a PSE&G street crew was able to shut off the gas to the service line by closing the curb valve.

Inspection and Recovery of Pipeline

When the pipeline was later uncovered during the postaccident excavation, a frayed rope was found attached to the gas pipeline. Additionally, a broken piece of “two-by-four” lumber was found near the gas pipeline.

During pressure tests on the steel service line, the only leak was found at the iron threaded tee connection that was about 7 feet 4 1/2 inches from the building wall. The tee had separated from the service line and had a gap of about 3 inches. (See figure 3.) The tee and the separated end of the service line were removed and sent to the Safety Board’s Materials Laboratory for analysis.

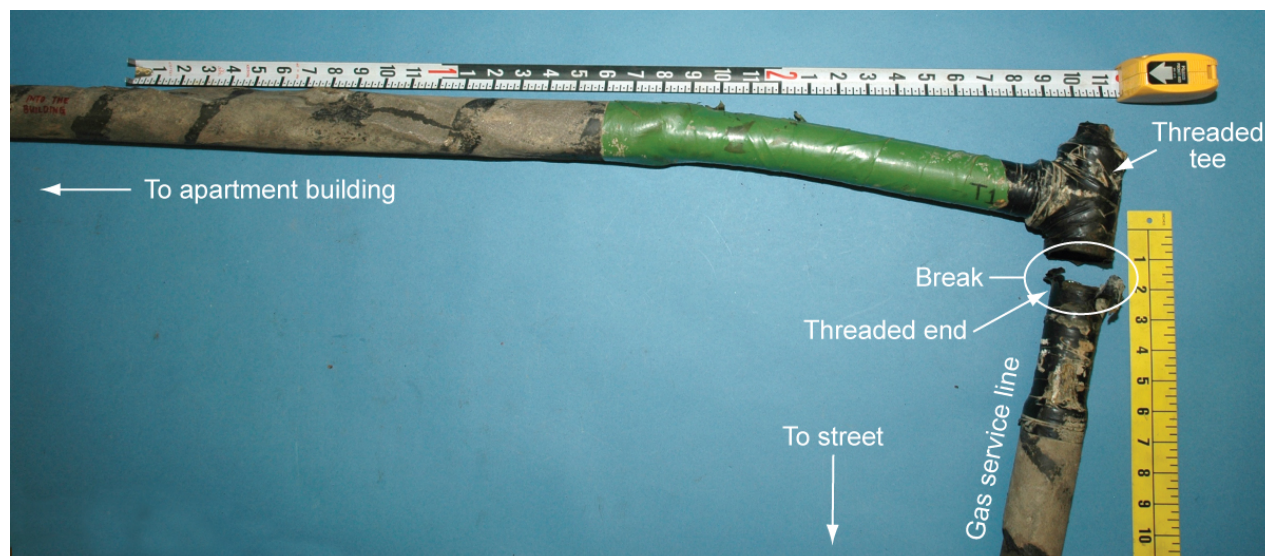


Figure 3. Separation of steel service line.

The threaded end of the service line fractured at the connection. The exposed threads on either side of the mating surfaces showed no evidence of corrosion degradation or fatigue cracking. Microscopic examination of the fracture revealed features consistent with an overstress separation. The evidence is consistent with the pipeline separating in overstress after the ground collapsed into the trench and caused the pipeline to move.

American Tank's Procedures and Training

American Tank's written procedures covered certifications and licensing, obtaining contracts, the steps from signed contract to job execution, and the steps for job completion. American Tank's written procedures for excavation work were limited to using the New Jersey One Call System for marking buried utilities, including gas pipelines. The company did not have written operating procedures for the protection of utilities while excavating.

According to American Tank, its unwritten procedures for the protection of utilities included the following:

- Visit the job site to survey for hazards and logistical issues.
- Obtain all needed permits.
- Survey the job site to ensure markings are in place.
- Uncover the top of the tank to determine its direction and hand excavation of nearby utilities.
- Evaluate the nature of the soil to determine the possibility of collapse.
- Contact the utility company and request shutoff.
- Protect and support the utility; contact the utility company if damaged.
- If damage to the utility is observed, call the emergency telephone numbers for the utility and call 911 or fire and police department emergency telephone numbers.

American Tank had no formal training program on the protection and support of utilities.

PSE&G's Excavation Damage Prevention Program and Emergency Plan

The PSE&G participated in the New Jersey One Call system. It also participated in various damage prevention and awareness activities in 2005. These activities included distributing damage prevention materials to home improvement stores, contractors, equipment rental companies, retail stores, and municipalities. The PSE&G does not use direct mailing to contractors unless damage has been reported. Then, the PSE&G sends information letters about New Jersey's damage prevention laws to contractors who have damaged their company's underground facilities.

The PSE&G has an emergency plan that was developed in accordance with State and Federal regulations. However, the PSE&G emergency plan does not have a provision requiring the testing of curb valves to determine whether the valves can be quickly operated to shut down a service line when excavation activities place the line at risk.

Regulations, Standards, and Oversight

There are a number of applicable regulations and standards regarding excavation safety. These include regulations and standards from the State of New Jersey, the U.S. Occupational Safety and Health Administration (OSHA), the U.S. Department of Transportation, and industry standards and best practices.

New Jersey Board of Public Utilities

The New Jersey Board of Public Utilities publishes a handbook that explains the requirements of the New Jersey One Call law for excavators. Excavators are required to notify New Jersey One Call from 3 to 10 days before excavating and to immediately report any damage to the operator of the facility. Furthermore, the *New Jersey Underground Facility Protection Act*, section N.J.S.A. 48:2-82 d(2 and 3) requires excavators to “plan the excavation or demolition to avoid damage to and to minimize interference with underground facilities” and “to use reasonable care during excavation or demolition to avoid damage to or interference with underground facilities.”

The Board of Public Utilities is charged with overseeing and enforcing compliance with the *New Jersey Underground Facility Protection Act* and the New Jersey One Call law. The Board of Public Utilities also has delegated authority to enforce Federal natural gas pipeline safety standards in 49 *Code of Federal Regulations* (CFR) Part 192.

On November 28, 2006, the New Jersey Board of Public Utilities sent Notices of Probable Violation to American Tank and the PSE&G. American Tank was cited for a probable violation of the *New Jersey Underground Facility Protection Act* for not planning the excavation to avoid damage and minimize interference with an underground facility and not using reasonable care in an excavation.

The Board of Public Utilities cited the PSE&G for three probable violations of 49 CFR Part 192. The first probable violation was that the PSE&G employee, after being notified of a potential hazard, left the site with the potential hazard remaining. The second probable violation was that the PSE&G’s response did not facilitate the most effective course of action under the circumstances following the notice of a reported gas leak and ruptured service on December 13, 2005. The third probable violation was that the PSE&G did not have sufficient communication and exchange of information with the Bergenfield fire officials regarding its gas emergency programs. The outcome of the citations to American Tank and the PSE&G is pending as of May 1, 2007.

U.S. Occupational Safety and Health Administration

OSHA investigated this accident. Title 29 CFR 1926.651 establishes excavation requirements designed to safeguard employees and prevent damage to underground utilities, including a requirement to establish the location of underground installations before excavating.

OSHA and American Tank reached a stipulated agreement for two violations in which American Tank was fined for its conduct during this accident. American Tank was cited for the failure to use safe and acceptable means to exactly locate the underground vent pipe for the oil storage tank and for the failure to safeguard employees while the excavation was open.

Federal Pipeline Safety Requirements

The Pipeline and Hazardous Materials Safety Administration's (PHMSA's) pipeline safety regulations require that each operator of a buried natural gas pipeline must carry out a written program to prevent damage to the pipeline from excavation activities. Specifically, in 49 CFR 192.614(c), the damage prevention program must provide for the inspection of those pipelines that an operator "has reason to believe" could be damaged by excavation activities. These inspections must be done as "frequently as necessary" during and after the excavation activities to verify the integrity of the pipeline.

Title 49 CFR 192.615(a) requires that each natural gas pipeline operator have a written emergency plan that establishes procedures for minimizing the hazards resulting from a natural gas pipeline emergency. The emergency plan must address several emergency responses, including emergency shutdown and pressure reduction in any section of the pipeline system necessary to minimize hazards to life or property and elimination of any actual or potential hazard to life or property.

Industry Guidance

The Gas Piping Technology Committee¹⁰ (GPTC) publishes the *Guide for Gas Transmission and Distribution Piping Systems* to help natural gas operators ensure regulatory compliance. The section of the GPTC guide referring to Section 192.614c(6) states the following:

Where required, the inspection may include periodic or full-time surveillance and may include leakage surveys during and after construction. The operator should consider maintaining field contact with the excavator during the excavation activities to avoid potential problems.

The section of the GPTC guide referring to Section 192.615(a) states, "The objective of the (emergency) plan should be to ensure that personnel who could be involved in an emergency are prepared to recognize and deal with the situation in an expeditious and safe manner."

The *Common Ground Alliance Best Practices*¹¹ manual, version 3.0, states that the excavator must use reasonable care to avoid damaging underground facilities. The excavator

¹⁰ The GPTC is an American National Standards Institute technical committee composed of technical specialists from industry, government, and the public.

¹¹ The Common Ground Alliance, composed of technical specialists from industry, government, and the public, provides a guide on underground utility damage prevention best practices and promotes their use throughout the United States.

should plan the excavation to avoid damage or minimize interference with the underground facilities in or near the work area. The manual also states that the protection of exposed underground facilities is as important as preventing damage to the facility when digging around the utility. Section 5-22 of the manual indicates that excavators are to support or brace exposed underground facilities and protect them from moving or shifting, which could result in damage to the facility. Methods to support, brace, and protect these facilities include shoring the facility from below or providing a timber support with hangers across the top of the excavation to ensure that the facility does not move or bend.

Excess Flow Valves

Excess flow valves are designed to respond to an excessive flow of gas by automatically closing and restricting the gas flow, thereby reducing the likelihood of an explosion and fire. The valves are typically installed at the connection of a service line to a main pipeline. The valves can greatly reduce the consequences of service line breaks. The investigation examined whether an excess flow valve that was compatible with the operating conditions for the apartment building would have been effective. Had the break in the service line been exposed to the open atmosphere, an excess flow valve would have activated immediately to restrict the flow of gas; however, in this accident, the broken section of pipe was underground and under asphalt pavement.

A leakage test conducted 2 days after the accident resulted in a flow rate of natural gas through the broken service line of about 1,600 standard cubic feet per hour. The leakage test could not be conducted until the excavation site was stabilized.¹² Soil conditions at the time of the leakage test were significantly different than at the time the service line was broken; this difference likely affected the flow rate measured during the test. Further, the flow rate of natural gas to the apartment building at the time the service line was fractured cannot be determined.¹³ At the time of the accident, it was quite cold; the temperature was about 18° F. It would be reasonable to assume that the heating system and the replenishment of hot water for the tenants would have been operating near maximum capacity. However, given the uncertainty in the leakage test results and the unknown flow rate to the building, the Safety Board was not able to determine whether an excess flow valve, had one been installed, would have activated after the service line was broken in this accident.

Bergenfield Fire Department Procedures and Training

According to the fire chief, the Bergenfield Fire Department did not have written procedures for natural gas incidents. Safety Board investigators were told in Fire Department

¹² During the firefighting operations, significant amounts of water had been used in the area. The trench adjacent to the broken section of pipe had been filled as a precautionary measure due to concerns that the building wall might collapse. Later, the trench was partially excavated then refilled because of unstable soil. Trench boxes were necessary to stabilize the excavation before the investigators could access the site.

¹³ The flow rate to the building could not exceed 2,500 standard cubic feet per hour because of the capacity of the metering equipment.

interviews that the Bergenfield Fire Department relied heavily on the assistance of the PSE&G in deciding whether to evacuate a structure.

Effective July 5, 2005, the State of New Jersey improved its written course material regarding natural gas hazards for Firefighter I training. The new material is in the *Firefighter's Handbook: Essentials of Firefighting and Emergency Response—New Jersey Edition, and Addendum*. In this handbook, Section D, Chapter II, “Recognizing and Avoiding the Hazards of Natural Gas and Carbon Monoxide,” describes the properties of natural gas, the natural gas delivery system, natural gas detection, and the response to natural gas emergencies. In the section, “Secure the Site,” the manual has the following recommendation:

When the presence of gas is strong, the best rule is to evacuate people from the dwelling and move them across the street or a distance far away that would prevent injuries if the structure were to explode.

The video *Natural Gas: Recognizing and Avoiding the Hazards*, which was produced with the cooperation of several companies and government agencies in New Jersey, including the PSE&G, is also included as part of the Firefighter I course.

As a result of a July 1999 accident in Fairlawn, New Jersey, and a March 2006 agreement with the Board of Public Utilities, the PSE&G agreed to expand its emergency response training, which is coordinated with the Bergen County Fire Academy. As a result of the Bergenfield accident and a March 2006 agreement between the Board of Public Utilities and the PSE&G, the Board of Public Utilities obtained permission to distribute a PSE&G-produced video for firefighters and first responders in the State of New Jersey. This video includes information on how to handle gas leak emergencies, and when to check the building, and when to evacuate.

In October 2006, the PSE&G mailed a computer disk containing electric and gas hazard awareness information to police departments, fire departments, and emergency management officials within the PSE&G's service area to help them to develop standard operating procedures for electrical and gas emergencies.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the December 13, 2005, natural gas explosion and fire in Bergenfield, New Jersey, was the failure of the American Tank Service Company to adequately protect the natural gas service line from shifting soil during excavation, which resulted in damage to the service line and the release and migration of natural gas into the apartment building. Contributing to the accident was the failure of the Public Service Electric and Gas Company to conduct effective oversight of the excavation activities adjacent to the gas service line and to be prepared to promptly shut off the flow of natural gas after the service line was damaged. Contributing to the casualties in the accident was the failure of the Bergenfield Fire Department to evacuate the apartment building despite the strong evidence of a natural gas leak and the potential for gas to migrate into the building.

Recommendations

As a result of its investigation of the Bergenfield, New Jersey, pipeline accident, the National Transportation Safety Board made the safety recommendations listed below. For more information about these recommendations, see the safety recommendation letters¹⁴ to the recipients.

To the Pipeline and Hazardous Materials Safety Administration:

Provide a summary of the lessons learned from the Bergenfield, New Jersey, accident to recipients of emergency planning and response grants. (P-07-1)

To the New Jersey Department of Community Affairs:

Establish a requirement that all career and volunteer firefighters receive recurrent training on natural gas safety and incident response. (P-07-2)

To the Borough of Bergenfield:

Establish and implement written operating procedures for responding to natural gas incidents and emergencies. (P-07-3)

To the American Tank Service Company:

Establish and implement written procedures for safe excavation near pipelines, and provide initial and recurrent training on these procedures to employees. (P-07-4)

To the Public Service Electric and Gas Company:

Modify your excavation damage prevention program and emergency plan to require site-specific risk assessments of excavators' plans, and implement procedures to effectively manage the risk, such as increased surveillance of excavator actions to protect the pipeline and ensuring that gas shut-off valves are tested so that they can be closed promptly if the pipeline is damaged. (P-07-5)

To the International Association of Fire Chiefs:

Notify your members of the circumstances surrounding the December 13, 2005, accident in Bergenfield, New Jersey, and urge them to establish and implement procedures for emergency responders to rapidly assess situations involving natural gas leaks and to determine whether prompt evacuations are warranted. (P-07-6)

¹⁴ These letters are available on the National Transportation Safety Board's web site.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

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Member

Adopted: May 1, 2007

Kathryn O'Leary Higgins, Member, filed the following concurring statement on May 8, 2007.

I concur in the accident brief and safety recommendation letters issued on the natural gas service line break and subsequent explosion and fire in Bergenfield, New Jersey, that occurred on December 13, 2005. I believe the recommendations that resulted from this investigation will help prevent other similar accidents in New Jersey.

As I noted in the board meeting, however, I believe we should go further to prevent similar accidents in other states and communities. I believe we should have issued a recommendation to the Pipeline and Hazardous Materials Safety Administration (PHMSA) to share the lessons learned in this investigation with the rest of the country. Our investigation found serious deficiencies in practices and procedures followed by the excavation contractor, the utility company, and the community of Bergenfield. We make recommendations to the State of New Jersey concerning recurrent training for firefighters in dealing with gas leaks. We ask the contractor to implement written procedures. We make similar and appropriate recommendations to the Borough of Bergenfield, the Public Service Electric and Gas Company, and the International Association of Fire Chiefs.

I am concerned that we could see a similar accident in another community. I believe the best way to prevent a similar tragedy is to ask PHMSA, the Federal agency with regulatory and enforcement responsibility for pipeline safety, to take a leadership role in helping all states and communities understand the mistakes that led to this accident so they can be addressed.

I am pleased that the Board voted to adopt a recommendation to PHMSA to spread the word about this accident to emergency planning and response grant recipients so that training funded by these grants will incorporate the lessons learned from the Bergenfield tragedy.

Member Hersman joined Member Higgins in this statement.