



National Transportation Safety Board

Pipeline Accident Brief

UGI Utilities Natural Gas-Fueled Explosion

Millersville, Pennsylvania

July 2, 2017

The Accident

On July 2, 2017, at 12:32 p.m. eastern daylight time, a natural gas-fueled explosion occurred at a single-family residence at 206 Springdale Lane, Millersville, Pennsylvania.¹ The explosion killed one person and injured three others, destroyed the residence and significantly damaged six neighboring homes, one of which was subsequently condemned.² (See figure 1.)



Figure 1. Debris field at cul-de-sac area where explosion occurred.

At 10:26 a.m., a neighborhood resident walking in the area smelled natural gas and reported it to the local gas utility, UGI Utilities, Inc. (UGI).³ About half an hour later, a UGI service

¹ All times in this accident brief are eastern daylight time.

² Local authorities condemned the residence at 202 Springdale Lane.

³ On June 1, 1882, UGI is incorporated in Philadelphia as the United Gas Improvement Company, becoming the first public utility holding company in the United States. In February 1968, the company changed its name to UGI Corporation.

NOTE: This report was reissued on October 26, 2023, with corrections to the timeline on pages 2 through 4 and corrections to the gas reading on page 4.

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technician arrived to investigate and confirm the gas leak.⁴ A Lancaster Area Sewer Authority (LASA) employee arrived on scene in response to UGI's Emergency PA (Pennsylvania) One Call to mark the location of the sewer lines.⁵ About 15 minutes prior to the explosion, UGI personnel directed the resident of 206 Springdale Lane to evacuate the residence who left in their personal automobile. About 12:15 p.m., UGI requested fire department support. The first fire truck arrived at 12:28 p.m. and assumed a stand-by position. The house exploded about 4 minutes later.

Following the accident, the natural gas main and service pipelines for the cul-de-sac homes were leak tested. All segments held pressure, except for the service line at the 206 Springdale Lane connection at the main; this segment had a Permalock mechanical tapping tee.⁶ Subsequent inspection of the Permalock mechanical tee revealed gas was leaking at the connection of the tee to the 2-inch main, and two of the four nylon bolts had fractured. At the time of the accident, the operating pressure of the line was 54 pounds per square inch, gauge (psig), as measured at the closest monitoring point that was about 0.5 mile away from 206 Springdale Lane.

The Pipeline System

The natural gas main on Springdale Lane was made from a polyethylene material that was installed on August 7, 1995. The maximum allowable operating pressure (MAOP) of the system main serving Springdale Lane was 60 psig.

The service line to the 206 Springdale Lane residence was installed in June 1998, and was constructed of 1/2-inch polyethylene pipe. The mechanical tapping tee was installed at the same time as the service line. The mechanical tapping tee and service pipe had been in service for 19 years when the accident occurred.⁷ The pipe between the main and the meter at the residence was 50 feet long. The service line to the residence was inserted inside a 1-inch polyethylene pipe that served as a protective jacket. The jacket ran from the outlet of the service tee to the meter.

UGI Actions Following the Gas Leak Report

Shortly after the gas leak report, UGI dispatched a UGI technician to respond. At 11:00 a.m., the technician arrived on scene and began his assessment to determine the presence of a leak. Consistent with UGI policy and training, the technician began implementing UGI's leak survey procedure. His investigation determined that the leak source was at an adjacent residence, which was 206 Springdale Lane.

At 11:18 a.m., the technician called the on-call UGI senior supervisor of Operations Construction and Maintenance (senior supervisor). The technician requested a response crew because he measured high-gas-concentration readings and confirmed a leak. The technician told the senior supervisor that he suspected that a mechanical tee was leaking, and that he measured a

⁴ UGI refers to its service technicians as mechanics. Each mechanic has a "grade" designation of I, II, or III, which is determined by the degree of qualifications and experience.

⁵ For additional information, see <http://www.pa1call.org/PA811/Public/>.

⁶ The *Honeywell Elster Perfection PermaLock Mechanical Tapping Tee* is a tee that can be installed on a main to supply the individual gas service to a gas customer without the need to shut down the natural gas main.

⁷ UGI *Gas Operations Manual*, section 70.20.

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reading of 80 percent gas in the sewer and 98 percent gas over the tee. Based on the gas readings, the technician classified the leak as an emergency leak. The senior supervisor contacted UGI Dispatch at 11:20 a.m. and requested that they call Emergency PA One Call to mark underground utilities because an excavation would be necessary. The Emergency PA One Call ticket was issued at 11:27 a.m.

About 11:20 a.m., the senior supervisor began looking for a crew to respond to the leak. Using the UGI duty roster of employees available to respond to emergencies, the senior supervisor made several calls between 11:25 a.m. and 11:44 a.m. to the on-call duty operator, who is required to answer all calls for response during off hours, including weekends; however, that duty operator did not respond. The senior supervisor contacted the next duty operator appearing on the on-call list, who answered and agreed to respond to the scene. By 11:50 a.m., the senior supervisor had identified a crew to respond at the site.

After identifying the response crew, the senior supervisor traveled to the scene. The senior supervisor told National Transportation Safety Board (NTSB) investigators that prior to arriving on-scene he reviewed the location of the closest shutoff valve to the site. On his way to the shutoff valve, he contacted the UGI engineer and informed her that he expected to shut down a main line. As the duty supervisor, the senior supervisor could exercise judgement to determine whether it was appropriate to either squeeze off the line or close a gas valve.⁸ After the discussion with other responding UGI employees, the senior supervisor decided to squeeze off the main line rather than closing the mainline valve, because he thought this action was the fastest way of stopping the flow of gas. Figure 2 shows the location of the valve.



Figure 2. Location of gas shut-off valve in relation to accident site.

The senior supervisor told NTSB investigators that the following factors influenced his decision to squeeze off the main: he considered that given the circumstances surrounding the leak,

⁸ To *squeeze off a line* is a method of controlling either the pressure or the flow through a plastic pipe by reducing its cross-sectional area by applying an external force.

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even if the valve were turned off, the gas would continue to flow to the leak until the system lost pressure; and the line could be quickly and successfully excavated and squeezed, as compared to the time necessary to reach the valve.

The senior supervisor stated that he received a phone call from the technician, who said that he had measured a lower explosive limit (LEL) of 11 percent in the basement at 202 Springdale Lane and that he could not gain access to the house at 206 Springdale Lane.⁹ The senior supervisor informed the technician that he should do whatever was necessary, including a forced entry, to clear the house at 206 Springdale Lane.

Shortly after noon, the senior supervisor arrived at the scene and continued making calls from his vehicle to his management and others to keep them abreast of the situation. Within 10 minutes of arriving, the senior supervisor made an assessment that the fire department was needed. At 12:14 p.m., he called UGI Dispatch to request that they call 9-1-1, which was accomplished 1 minute later. A second UGI technician arrived on the scene at 12:19 p.m.

The senior supervisor and the duty operator began excavating the gas main pipeline. The first UGI technician on the scene had twice visited the residence (202 Springdale Lane) to the left of the accident house and had talked with the residents. The LEL measurement on the first visit was 10 percent. Returning 30 minutes later, he advised the residents of 202 Springdale Lane that there was no need to evacuate as the LEL measurement was at 11 percent, which is less than UGI's 20 percent LEL threshold for resident evacuation.

While the main line was being excavated, the occupant of 206 Springdale Lane responded to the first UGI technician's knocks on the door. Based on the gas concentration readings of 10 to 11 percent gas in air in the house, which would represent about 200 percent LEL concentration (well above UGI's 20 percent LEL threshold for resident evacuation), the technician decided to evacuate the house.¹⁰ The occupant requested permission to leave in her personal vehicle that was stored in the garage. Although the technician did not allow the occupant to use her powered garage door opener, he allowed the occupant to start her vehicle in the garage and depart the area. The electrical power to the neighborhood remained energized at the time of the accident.¹¹

The UGI technician, who had first arrived on the scene, was near the gas meter for 206 Springdale Lane when the explosion occurred. The two gas employees, who were digging at the main in front of the house, had fully excavated the plastic main and were ready to squeeze-off the plastic main line when the explosion occurred. The representative from LASA was walking in the cul-de-sac when the explosion occurred. The technician located near the gas meter was killed and three others were injured.

⁹ *Lower explosive limit* (LEL) is the minimum concentration of vapor (percentage by volume) in air below which propagation of a flame does not occur in the presence of an ignition source.

¹⁰ Atmospheres containing gas concentrations between 5 to 17 percent will support ignition and are considered highly flammable.

¹¹ At 12:59 p.m., the UGI Dispatch contacted the local electric power provider, PPL Electric Utilities (PPL), and requested that they shut off the power to the area. At 1:08 p.m., PPL confirmed that the electric power was shut off and that its personnel were on site.

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Technician Experience and Qualifications

The technician, who was killed in the explosion, had over 16 years of utility experience. In 2001, he started working at UGI. He was a technician in the Construction and Maintenance department. Since April 2003, he held an Investigating Leak and Odor Complaints qualification. He held 73 operator qualification tasks that covered all aspects of gas utility work, including emergency response, pipe joining, repair and maintenance, and inspection activities. Since 2013, he had responded to and resolved 446 emergency calls. Of those 446 calls, 238 were gas leaks. Of those 238 leaks, 27 were hazardous underground gas leaks.

Mechanical Tapping Tees

NTSB's examination of the tee assembly involved in the accident revealed the assembly was incorrectly installed because a locking sleeve, an important piece of hardware that served as an attachment between the tee and the main, was not attached to the main. The tee is also secured to the main by four nylon bolts. Although four nylon bolts were installed, two of them were fractured. Since the locking sleeve was not attached to the main, additional tensile stress was placed on the four nylon bolts, which then become the fail-safe feature holding the tee assembly in place. The NTSB determined two of the four nylon bolts fractured when in service in a manner consistent with slow crack growth. The incorrect installation of the tee, combined with the in-service fracture of the two nylon bolts, allowed gas to escape from the tee assembly. See Safety Recommendation Report PSR-18/01 *Installation of PermaLock Mechanical Tapping Tee Assemblies*, including Safety Recommendations P-18-001 through -004, for details pertaining to examination and testing of tee assemblies.

Postaccident Actions

UGI took the events of July 2, 2017, as an opportunity to reinforce and enhance the procedures and programs specifically revolving around emergency response to ensure employee preparedness, competence, and confidence when responding to emergency situations. The following summarizes the emergency response improvements UGI implemented across departments and job functions:

1. System Improvement Initiatives

Immediately following the accident, UGI instituted the following initiatives to manage the integrity of the system on Springdale Lane from the intersection of Burr Oak Drive west to the end of the cul-de-sac. UGI implemented the following improvements:

- Conducted a daily driving leak survey of the main in the neighborhood
- Remediated or replaced all known mechanical tees
- Replaced the entire gas main

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- Took actions to manage the integrity of the surrounding neighborhood defined by the boundaries of North Duke Street, Blue Rock Road, Letort Road, and Little Conestoga Creek

2. Pipeline and Public Safety Improvements

The UGI Pipeline and Public Safety department undertook several training initiatives to emphasize the incident command system. Outreach efforts with external emergency response departments was increased to strengthen the awareness of natural gas pipeline safety.

3. Training and Field Compliance Improvements

UGI updated its training to improve the skill set of its employees when responding to an emergency.

4. Pipeline Facility Improvements

UGI implemented pipeline facility enhancement to ensure the safe and reliable delivery of natural gas to its customers. This enhancement included the increased remediation activity of mechanical tees throughout its distribution system, by either remediating or replacing 2,577 total mechanical tees since the accident [through October 4, 2018]. UGI continues to examine the main and service facilities to determine the mechanical tees that must be replaced.

5. Dispatch Improvements

UGI modified its dispatch procedures and protocols. UGI streamlined dispatch processes to proactively identify the need for electrical shutdown and additional help.

6. Standard and Procedure Improvements

UGI created an emergency plan that is separate from its Gas Operations Manual (GOM). UGI's emergency plan contains similar content as previously included in GOM 60.50– Emergency Plan; however, the procedures have been revised to add further clarity to the emergency response situations and the actions undertaken.

7. 9-1-1-Related UGI Initiatives

To enhance safety and to ensure 9-1-1 emergency responders are timely notified, UGI:

- Developed a first-hour checklist for first responders that provides guidance on when to (1) contact the local emergency response agencies: 9-1-1 and Emergency Medical Services, (2) shut off electrical power in the area, and (3) conduct an evacuation
- Updated its response procedures to include “safety perimeter” criteria
- Reinforced the discretion that UGI's first responders must shut down a pipeline

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- Created checklists for leak investigations
- Identified in its emergency response procedures specific emergency situations where immediate 9-1-1 notification is required by UGI personnel
- Reviewed and updated its dispatch procedures to include a decision matrix
- Identified situations and keywords where immediate 9-1-1 notification is required

8. Safety Culture Assessment Project

In June 2018, UGI contracted DuPont Sustainable Solutions (DSS) to assess the UGI safety culture and the efficacy of UGI safety-related initiatives and incident investigation process to create a unified safety brand. The assessment included a comprehensive evaluation that provided a baseline to understand the current state and the development of an improvement strategy to advance the culture, systems, and processes as part of a world-class safety program.

Pennsylvania Public Utility Commission Enforcement Action

On October 4, 2018, the Pennsylvania Public Utility Commission Bureau of Investigation and Enforcement, issued a formal complaint against UGI that proposed a cumulative civil penalty of \$2,090,022. This complaint, which was an enforcement action of that regulatory agency, alleged several safety violations that occurred during the gas leak response on Springdale Lane.

Previously Issued Safety Recommendations

As a result of this natural gas-fueled explosion on June 25, 2018, the NTSB issued the following four safety recommendations:

To the Pipeline and Hazardous Materials Safety Administration:

Work with state pipeline regulators to incorporate into inspection programs, a review to ensure that gas distribution pipeline operators are using best practices recommended by the manufacturer in its distribution integrity management programs, including using the specified tools and methods, to correctly install Permalock mechanical tapping tee assemblies. (P-18-001)

Safety Recommendation P-18-001 is classified *Open—Initial Response Received*.

Reference the use of external sources of information for threat identification in your frequently asked questions for preparation of distribution integrity management programs. (P-18-002)

Safety Recommendation P-18-002 is classified *Closed-Acceptable Action*.

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To Honeywell International, Incorporated:

Update your Permalock mechanical tapping tee assembly installation instructions to specify the exact tools that should be used during installation and explain what an installer should sense while using those tools throughout the installation process. (P-18-003)

Safety Recommendation P-18-003 is classified *Open—Initial Response Received*.

Specify in your Permalock mechanical tapping tee assembly installation instructions a not-to-exceed torque limit for Nylon bolts and have that value checked and adjusted with a torque wrench immediately after installation. (P-18-004)

Safety recommendation P-18-004 is classified *Open—Initial Response Received*.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the natural gas explosion at 206 Springdale Lane was an improperly installed mechanical tapping tee that leaked and allowed gas to migrate into the house where it ignited.

For more details about this accident, visit www.nts.gov/investigations/dms.html and search for NTSB accident identification number DCA17FP006.

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The NTSB has authority to investigate and establish the facts, circumstances, and cause or probable cause of a pipeline accident in which there is a fatality or substantial property damage, or significant injury to the environment. (49 U.S. Code, Section 1131 - *General authority*)

The NTSB does not assign fault or blame for an accident or incident: rather, as specified by NTSB regulation, “accident/incident investigations are fact-finding proceedings with no formal issues and no adverse parties...and are not conducted for the purpose of determining the rights or liabilities of any person.” Title 49 *Code of Federal Regulations*, Section 831.4. Assignment of fault or legal liability is not relevant to the NTSB’s statutory mission to improve transportation safety by investigating accidents and incidents and issuing safety recommendations. In addition, statutory language prohibits the admission into evidence or use of any part of an NTSB report related to an accident in a civil action for damages resulting from a matter mentioned in the report. 49 U.S. Code, Section 1154(b).
