

NATIONAL TRANSPORTATION SAFETY BOARD  
WASHINGTON, D.C. 20594

Pipeline Accident Brief No. DCA90FP001

System Type:	Distribution	<b>6AUG 1991</b>
Accident Type:	Explosion and Fire	
Location:	421-423 North Fifth Street Allentown, Pennsylvania	
Date:	August 29, 1990	
Time:	0513 local daylight time	
Owner/Operator:	UGI Corporation (UGI)	
Property Damage:	\$300,000	
Injuries:	1 Fatal 9 Nonfatal	
Material Released:	Natural Gas	
Pressure:	0.32 psig. (9 inches water column)	
Type Failure:	Overstress	
Component Affected:	Cast-Iron Main	

#### Description of the Accident

A natural gas explosion and fire destroyed two row houses at 421-423 North Fifth Street and damaged two adjacent houses and three parked cars in Allentown, Pennsylvania. Two of the injured were fire fighters.

Three hours before the accident, a police officer advised the Allentown after-hours dispatcher that water was leaking through pavement cracks in front of 421 North Fifth Street. The officer said that he believed that repairs could be deferred until the next day. Minutes after 5 a.m., a North Fifth Street resident notified the city of a gas odor in the area of 421 North Fifth Street and at 5:09 p.m., police and fire personnel arrived at the location. Four minutes later, the explosion occurred. Fire fighters and police evacuated residents from houses in the danger zone, and to eliminate potential gas leaks from piping in adjacent residences, they entered houses to close the gas valves at inside meter sets. When UGI employees arrived at 5:30 a.m., they began searching for leaking gas and discovered that several gas valves had not been turned off. They then shut off gas to the residences at the key-operated curb valves and then at meters where valves had not previously been closed. The UGI employees then continued their search for the source of the gas leak and discovered a broken cast-iron main beneath the street.

Investigation disclosed that water leaking from a cracked 6-inch cast-iron municipal water main had eroded the soil foundation beneath a 4-inch cast-iron UGI gas main. The gas main subsequently cracked due soil loads from above, releasing natural gas beneath the pavement. The gas migrated

through the soil and into the basement of 423 North Fifth Street, where it was ignited, exploded, and burned.

Excavation after the accident revealed that both the 6-inch cast-iron municipal water main and the 4-inch cast-iron UGI gas pipeline had cracked circumferentially. Sections of each of the pipelines were sent to the Safety Board's laboratory for metallurgical analysis. Analysis revealed that both mains contained areas of significant graphitic corrosion that weakened them. The failure of the gas pipe was inevitable even had the water not eroded its soil foundation because one area of the gas pipe wall was fully graphitized.

Numerous factors, individually and/or synergistically, have contributed to the integrity reduction and failure of Allentown, Pennsylvania's cast-iron gas and water mains, most of which were installed in the late 1800s and early 1900s. These include: leaks from storm and sewer lines, water migrating or percolating through the soil, karst development, sinkholes, graphitization, shifting and cracking pavement, increased traffic load, and overburden stress.

#### Probable Cause

The National Transportation Safety Board determines that the probable cause of the natural gas explosion and subsequent fire, involving the overstress fracture of an undermined and weakened segment of cast-iron gas main, was the failure of the UGI Corporation to adequately monitor the condition of its gas system and to timely replace cast-iron segments weakened by graphitic corrosion.

#### Recommendations

As a result of its investigation, the National Transportation Safety Board made the following recommendations:

--to the Research and Special Programs Administration:

Require each gas operator to implement a program, based on factors such as age, pipe diameter, operating pressure, soil corrosiveness, existing graphitic damage, leak history, burial depth, and external loading, to identify and replace in a planned, timely manner cast-iron piping systems that may threaten public safety. (Class II, Priority Action)(P-91-12)

--to the UGI Corporation:

Provide initial and recurrent training to local government emergency response personnel on how to control natural gas in emergency situations, including how to locate, identify, and operate outside key-operated shutoff valves. (Class II, Priority Action) (P-91-13)

Implement a comprehensive gas system surveillance program that: (1) identifies the type of data to be collected on gas system failures, gas leakage surveys, changes in corrosion protection levels, and abnormal operating and maintenance conditions; (2) establishes the type and frequency of analyses to be performed for identifying potentially unsafe conditions; and (3) specifies the corrective action to be taken. (Class II, Priority Action) (P-91-14)

Implement a cast-iron pipe replacement program, based on factors such as age, pipe diameter, operating pressure, soil corrosiveness, existing graphitic damage, leak history, burial depth, and external loading, to identify and replace in a planned, timely manner cast-iron piping systems that may threaten public safety. (Class II, Priority Action) (P-91-15)

Document the location of underground voids discovered during excavations and coordinate with the City of Allentown to develop systematic procedures for centrally reporting, documenting, and exchanging information on the location of underground voids. Class II, Priority Action) (P-91-16)

--to the National Association of Regulatory Utility Commissioners:

Encourage its member states to require that each gas operator implement a program, based on factors such as age, pipe diameter, operating pressure, soil corrosiveness, existing graphitic damage, leak history, burial depth, and external loading, to identify and replace in a planned, timely manner cast-iron piping systems that may threaten public safety. (Class II, Priority Action) (P-91-17)

--to the City of Allentown:

Coordinate with the UGI Corporation to obtain initial and recurrent training for emergency response personnel on controlling natural gas in emergency situations, including how to locate, identify, and operate outside key-operated shutoff valves. (Class II, Priority Action) (P-91-18)

Coordinate with known underground facility operators in the immediate Allentown vicinity to develop systematic procedures for centrally reporting, documenting, and exchanging information on the location of underground voids discovered through excavations or other means. (Class II, Priority Action) (P-91-19)