



# National Transportation Safety Board

Washington, D.C. 20594

## Pipeline Accident Brief

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Accident No.:	DCA-97-FP-005
Type of System:	Transmission pipeline
Type of Accident:	Rupture and fire
Location:	Indianapolis, Indiana
Date and Time:	July 21, 1997; 2:33 p.m. CST
Owner/Operator:	Citizens Gas & Coke Utility
Property Damage and Losses:	In excess of \$2 million
Fatalities:	1
Injuries:	1
Evacuated:	75
Material Released:	Natural gas
Pressure:	310 psig
Type of Failure:	Excavation damage
Component Affected:	20-inch-diameter buried steel transmission pipeline

### The Accident

About 2:33 p.m. on July 21, 1997, a 20-inch-diameter steel natural gas transmission pipeline owned and operated by Citizens Gas & Coke Utility Company (Citizens Gas) ruptured and released natural gas near an intersection adjoining the Charter Pointe subdivision in Indianapolis, Indiana. The gas ignited and burned, killing one resident and injuring another. About 75 residents required temporary shelter. Six homes were destroyed, and about 65 others sustained damage significant enough to be documented by the local investigation team.

The pipeline had not been under full internal pressure since March 31, 1997, when the pressure was reduced to approximately 30 pounds per square inch gauge (psig) in anticipation of road construction work in the area.<sup>1</sup> On May 19, 1997, a directional drilling operation had been performed to install an 8-inch-diameter steel natural gas distribution main parallel to the transmission pipeline. About 1 hour and 40 minutes before the rupture, Citizens Gas had begun to return the 20-inch transmission pipeline to full service.

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<sup>1</sup> The road construction work required that Citizens Gas relocate an adjacent section of its 20-inch transmission pipeline. In view of the reduced seasonal demand for natural gas, the company decided to reduce the pressure on the pipeline and discontinue using it to transport gas during the period of construction.

## Postaccident Inspections

On-site inspection of the ruptured pipe revealed a near-longitudinal gaping fracture about 5.8 feet long. Along the entire length of the longitudinal fracture, the newly installed 8-inch distribution main was within approximately 4 inches of the 20-inch transmission pipeline. (See figure 1.)



**Figure 1. Postaccident excavation revealing relative positions of 8-inch distribution main and 20-inch transmission pipeline at site of rupture**

The ruptured segment of the 20-inch pipe was removed and sent to the National Transportation Safety Board's Materials Laboratory for examination. Safety Board examination revealed that the pipeline fractures contained features typical of overstress separation. The fractures contained no arrest marks, which is consistent with a crack in the pipe that, once initiated, propagated continuously. The exterior pipeline surface along the entire length of the longitudinal fracture contained circumferential gouge marks that intersected both halves of the fracture. The gouge marks typically measured approximately 4 inches long in the circumferential direction. Wall thicknesses in the deepest area of two gouge marks adjacent to the longitudinal fracture were 0.168 inch and 0.175 inch, which were 60 and 62 percent, respectively, of the original 0.281-inch wall thickness.

Safety Board investigators obtained a tooth from the reaming tool that was used in the drilling operation to install the 8-inch distribution main. Direct comparisons of the tooth with the gouge marks revealed that the size and shape of the tooth tip were

consistent with the size and shape of the gouge marks in the vicinity of the rupture. (See figure 2.)



**Figure 2. Comparison of cutting tool tooth with gouges found at rupture site**

### **Preaccident Pipeline Installation Project**

To minimize damage to the roadway and to some adjoining landscaping features, Citizens Gas decided to use directional drilling<sup>2</sup> to install an approximately 200-foot-long section of new 8-inch distribution main parallel to the 20-inch transmission pipeline. Citizens Gas contracted with Miller Pipeline Corporation (Miller), which carried out the directional drilling operation on May 19, 1997.

Citizens Gas construction plans called for the 8-inch distribution main to be installed parallel to the 20-inch pipeline with a horizontal centerline-to-centerline separation of approximately 5 feet along most of its length. Before drilling began, Citizens Gas personnel used paint to mark the approximate location of the 20-inch pipeline at intervals of 15 to 20 feet.<sup>3</sup> Two excavations, one to verify the location of some utility

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<sup>2</sup> *Directional drilling*, also referred to as *boring*, is a pipeline construction technique in which a roughly horizontal hole is drilled at the intended pipeline location and the pipeline is then pulled through it. Normally, a relatively small pilot hole is drilled first. When the pilot drill reaches the exit location, the pilot head is removed, and a larger reaming tool is attached. In this case, the pipeline was pulled back through the hole during this back-reaming process.

<sup>3</sup> Indiana State Code (IC 8-1-26-2) defines *approximate location* as “a strip of land at least four (4) feet wide but not wider than the width of the facility plus two (2) feet on either side of the outer limits of the physical plant.” See Safety Study—*Protecting Public Safety Through Excavation Damage Prevention*

cable crossings and another to serve as an exit pit for the directional drilling operation, exposed the 20-inch transmission pipeline and thus verified its location.

Miller drilling personnel stated that field measurements indicated that they could maintain an approximate 5- to 7-foot horizontal separation between the new installation and the paint marks used to indicate the location of the existing 20-inch transmission pipeline. The drilling crew intended to maintain this separation throughout the bore except for one location near the termination of the bore where, in order to avoid an underground telephone duct, the pipeline separation would need to be reduced to an edge-to-edge horizontal distance of about 1 foot.<sup>4</sup>

The Miller crew consisted of two persons, a foreman and a machine operator, utilizing a Vermeer directional drilling rig with a 5-inch-diameter drill head and a 14-inch-diameter reaming tool. The foreman said that throughout the directional drilling operation, he monitored the location and alignment of the pilot drill head every 5 to 10 feet with a “walkover” detector. He said he marked the drill head’s location at these intervals as the boring operation progressed to the east. If course corrections were needed, the foreman said, he relayed instructions to the machine operator via a headset radio. The Miller personnel reported that, because of the terrain at the entry point, the initial entry of the drill head was angled slightly toward the 20-inch natural gas transmission pipeline and that minor steering corrections were performed in the beginning portion of the drilling operation. Miller personnel did not report any difficulty in performing the drilling operation, nor did they note any other unplanned deviations from a straight line path.

During the back-reaming process, the location of the reaming tool was not tracked as it was during drilling. The presence of rocks, the characteristics of the soil, the alignment of the pilot hole, and the stiffness of the pipe material being pulled back through the hole are some factors that can affect the accuracy with which the back-reaming process follows the path of the pilot hole.

### **Actual Pipeline Locations**

After the accident, the two pipelines were excavated at points along the bore path to determine the exact horizontal centerline-to-centerline separation between the pipelines and the depth of cover over each one. These excavations revealed that the 8-inch distribution main was located at a horizontal centerline-to-centerline distance of 5.5 feet north of the 20-inch transmission pipeline at the entrance point of the bore (west end). Progressing eastward, the 8-inch distribution main veered sharply toward the 20-inch transmission pipeline. Approximately 40 feet east of the entrance point of the bore, the 8-inch distribution main was within a few inches of the existing 20-inch transmission pipeline. At the rupture site, approximately 68 feet east of the entrance point of the bore, the two pipelines were about 4 inches apart. As the 8-inch pipeline continued toward the

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(NTSB/SS-97/01) for further discussion.

<sup>4</sup> The actual separation would be greater than 1 foot, since the pipelines were to be at different depths at this particular location.

east, it veered away from the 20-inch pipeline to a horizontal centerline-to-centerline separation of 3.3 feet about 113 feet east of the entrance point of the bore. From this point eastward, the horizontal centerline-to-centerline separation ranged from 4 to 6 feet until the 8-inch distribution main angled toward the 20-inch transmission pipeline at the east end of the bore, as originally planned. (See figure 3.)

During the postaccident excavations conducted to determine the locations of the pipelines, rocks were discovered east of the rupture site. One rock, located directly beneath the 8-inch distribution main, had been scored in a manner consistent with having been struck by the reaming tool.

### **Regulatory Requirements**

Title 49 *Code of Federal Regulations* (CFR) Part 192.614<sup>5</sup> requires gas pipeline operators to develop and follow a written program to prevent damage to their pipelines from excavation activities. Excavation activities includes boring operations. Paragraph (c)(6) specifically requires operators, whenever they have reason to believe their pipelines could be damaged by excavation activities, to provide for inspections of those pipelines as frequently as necessary during and after the excavation to verify the integrity of the pipelines.

The Gas Piping Technology Committee (GPTC) publishes the *GPTC Guide for Gas Transmission and Distribution Piping Systems* to provide guidance for natural gas operators to follow to help ensure regulatory compliance.<sup>6</sup> The GPTC has informed the Safety Board that it is in the process of adding material to the guide to address safety issues specific to directional drilling and other trenchless technologies.

### **Actions Taken Since the Accident**

Citizens Gas had procedures in place at the time of the accident that were applicable to general construction activities in proximity to its pipelines, but it did not have procedures specific to directional drilling operations. Citizens Gas has provided to the Safety Board copies of procedures that it has now adopted that are specific to directional drilling in proximity to existing pipelines. These procedures include a requirement that, whenever directional drilling operations are carried out parallel to and within 10 feet of an existing transmission pipeline, spot holes will be excavated at 25-foot intervals so that the exact location of the drill head can be visually determined. These spot holes will also allow personnel to verify pipe alignment as the pipe is installed during the back-reaming process.

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<sup>5</sup> Title 49 CFR Part 195.442 contains similar provisions for operators of pipelines transporting hazardous liquids.

<sup>6</sup> The GPTC is an American National Standards Institute technical committee made up of technical specialists from both industry and government.

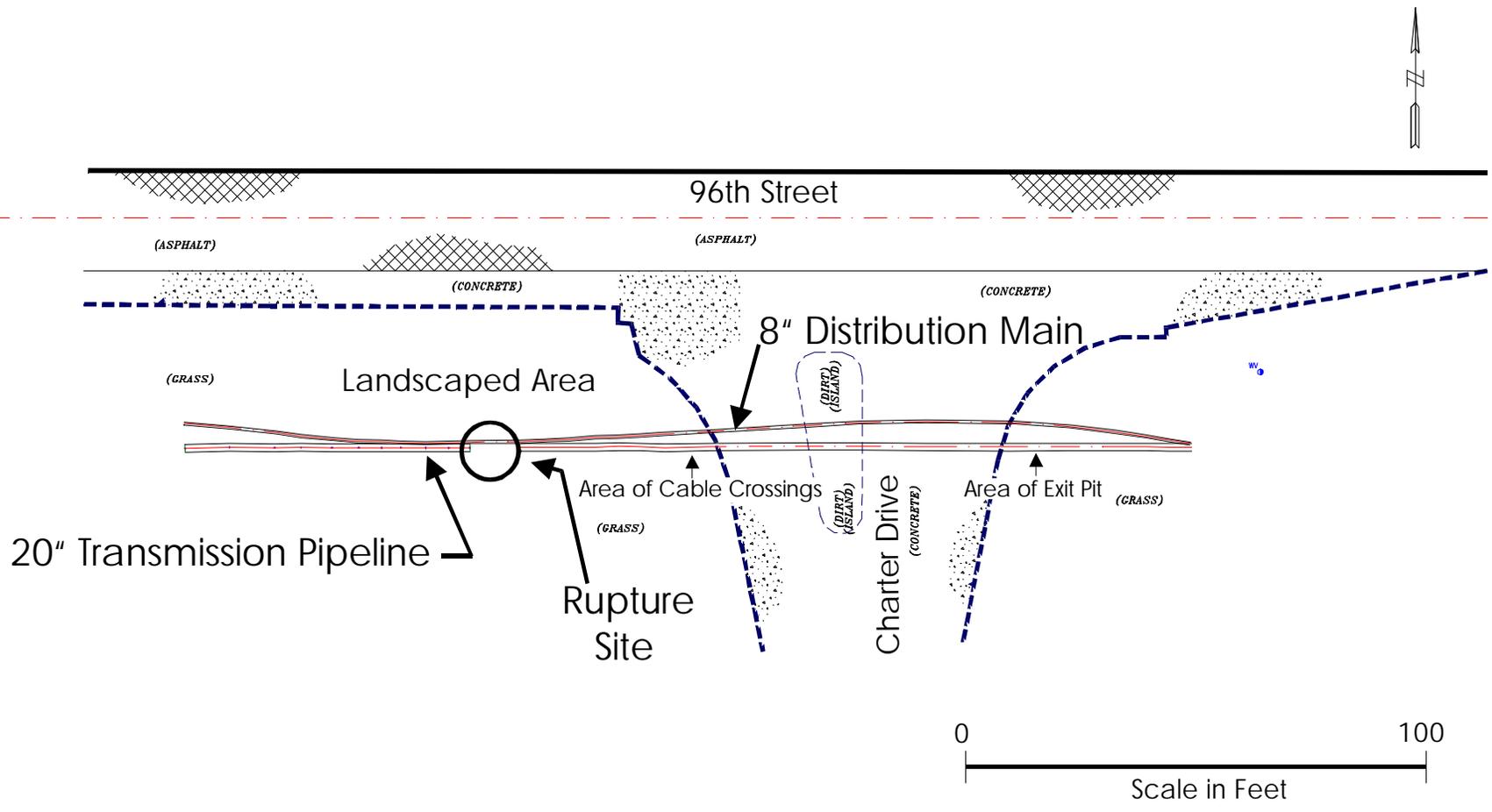


Figure 3. Relative locations of new 8-inch and existing 20-inch pipelines

Miller has also provided the Safety Board with procedures it has adopted to provide additional protection for existing facilities during the company's directional drilling operations.

**Probable Cause**

The National Transportation Safety Board determines that the probable cause of this accident was the failure of Citizens Gas & Coke Utility and Miller Pipeline Corporation to have adequate controls in place to ensure that directional drilling operations carried out in the proximity of existing underground facilities would not cause damage to those facilities.

**Adopted: April 20, 1999**