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**NATIONAL TRANSPORTATION SAFETY BOARD**  
**WASHINGTON, D.C.**

ISSUED: May 13, 1981

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Forwarded to:

Mr. William H. Dickhoner  
President  
Cincinnati Gas and Electric Company  
139 East Fourth Street  
Cincinnati, Ohio 45202

SAFETY RECOMMENDATION(S)

P-81-1 through -7

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About 11:55 a.m., on October 9, 1980, a 2-inch-diameter compression coupling located on the upstream side of a gas meter set assembly in the boilerroom of the Simon Kenton High School in Independence, Kentucky, pulled out of its connection with a 2-inch-diameter gas service line. Natural gas at 165-psig pressure escaped through the 2-inch-diameter opening and, seconds later, exploded and burned. A basement wall was blown down, an adjacent classroom was damaged, and one student was killed. About 30 minutes later, a second explosion occurred, which injured 37 persons and extensively damaged the school. The gas service line was connected to a 4-inch-diameter gas main owned by the Union Light, Heat and Power Company (gas company), a subsidiary of the Cincinnati Gas and Electric Company, which was uprating the gas main by controlled pressure increases at the time of the accident. <sup>1/</sup>

The gas main's operating pressure was being increased from 60 psig to 200 psig in increments of approximately 35 psig. The gas main had many customer service lines connected to it. In preparation for the line uprating, the gas company's pressure crew, using microfiche customer connection records, had replaced the single regulators at the gas meter set assemblies on all of the known service line connections to the gas main with double-regulator systems as mandated by 49 CFR 192.195 to protect against accidental overpressure. The double regulators were designed to handle the anticipated 200-psig line test pressure; the single regulators were not. Because the gas company's records showed that the school's service line was connected to a 2-inch-diameter gas main that ran parallel and adjacent to the 4-inch-diameter gas main, the school's single regulator was not replaced.

When the pressure crew increased the gas main's pressure to 165 psig, the 2-inch-diameter compression coupling located on the upstream side of the school's gas meter set assembly disconnected from its lower nipple, allowing natural gas to be released at an initial pressure of 165 psig into the school's boilerroom. Approximately 5 seconds later, at about 11:55 a.m., the gas exploded, demolishing a wall that separated the boilerroom from a classroom. The cement blocks blown from this wall by the force of the explosion struck and fatally injured a student who was in the classroom. The teacher and the other students in the classroom escaped unharmed;

<sup>1/</sup> For more detailed information read "Pipeline Accident Report--Union Light, Heat and Power Company, Natural Gas Explosion and Fire, Simon Kenton High School, Independence, Kentucky, October 9, 1980" (NTSB-PAR-81-1).

however, the classroom was heavily damaged by the explosion and an ensuing fire. About 12:25 p.m., another gas explosion occurred, injuring 37 persons, mostly firefighters. This explosion, described by witnesses as 10 times greater than the first explosion, damaged floors, doorways, and walls in the building.

Gas company employees arrived at the accident site within minutes of the first explosion. They immediately began searching for the lid on the curb box containing the valve that controlled the gas supply to the school's service line. However, they were unsuccessful in locating it visually or with electronic detectors and spotting bars. After the second explosion, the search for the curb box continued. The lid was finally located 8 inches below the ground surface. Gas company employees removed the lid and turned off the curb valve with a wrench, stopping the flow of natural gas to the school. The fire in the boilerroom went out at 1:40 p.m., 1 hour 45 minutes after the first explosion. If gas company employees had been able to locate and close the curb valve rapidly, the second explosion with its large number of injuries and heavy damage to the school might not have occurred.

Title 49 CFR 192.365 requires that each service line have a shutoff valve in a readily accessible location, but these regulations did not become effective until after the installation of the service line involved in this accident. However, the industry code ASA B31.8-1963, which was in effect at the time of the installation, regarding the location and accessibility of service line valves, states the following:

849.13, Location of Service Shut-Offs.

- (a) Service shut-offs shall be installed on all new services (including replacements) in a readily accessible location.
- (b) Shut-offs shall be located upstream of the meter if there is no regulator, or upstream of the regulator, if there is one.
- (c) All gas services operating at a pressure greater than 10 psig, and all services 2 inches in diameter or larger, shall be equipped with a shut-off located on the service line outside of the building, except that whenever gas is supplied to a theater, church, school, factory or other building where large numbers of persons assemble, an outside shut-off in such case will be required regardless of the size of the service or of the service pressure.
- (d) Underground shut-off shall be located in a covered durable curb box or standpipe, which is designed to permit ready operation of the valve. The curb box or standpipe shall be supported independently of the gas service line.

Kentucky Energy Regulatory Commission (KERC) regulations, under Section 22, Subsection 4(a)3, require that all curb valves be inspected annually for accessibility. The KERC also requires, under Section 22 of 807 Kentucky Administrative Regulation (KAR) 50:015, General Rules, that "at intervals not to exceed one (1) year . . . the curb box on service shall be inspected for accessibility."

The gas company stated that it conducts an annual public building inspection of all schools and churches in its service area. Company records indicated that the Simon Kenton High School was last inspected on December 3, 1979. The inspection record shown to Safety Board investigators was a computer readout sheet with minimal information on it. Nothing was provided on the inspection form to indicate that accessibility to the curb shutoff valve was checked as part of this annual inspection. The inspection form of December 3, 1979, indicated that no irregularities were found.

Gas company officials said that the accessibility to the curb valve was checked during the annual inspection of the school on December 3, 1979. However, since there is no provision on the inspection form for checking accessibility to curb valves, and since no activity that would have caused the curb box lid to become covered with 8 inches of earth was reported in the area after the inspection, the Safety Board concludes that the curb valve box had been inaccessible for some time before the December 3, 1979, inspection.

After the accident, the school's service line connection to the 4-inch-diameter gas main was fully uncovered. It was found that the service line was installed at the same level as the 2-inch-diameter gas main; however, before the service line reached the 2-inch-diameter gas main, it had been bent downward and connected to the 4-inch-diameter gas main. Gas company records did not show this connection. Instead, the gas company had a microfiche record which indicated that the school's service line was connected to the 2-inch-diameter gas main. There were no drawings or records other than the microfiche record. Because the gas company did not have a record to show that the school's gas service line was connected to the 4-inch-diameter gas main instead of the 2-inch-diameter gas main, the pressure crew did not install a double regulator on the school's gas meter set assembly in the boilerroom in preparation for the gas main uprating.

The information contained in the microfiche record was probably obtained from gas company field personnel. The gas company has a blank form which is designed for recording data to be accumulated in the gas company's computer system. A field employee enters the information on the form and sends it to the gas company's engineering department where the information is entered into a computer system. A printout of the information entered into the computer is not sent back to the originator of the information to check for errors. After this accident, five other buildings were found to be connected to a gas main other than the one shown by gas company records. The Safety Board believes that the gas company should develop a system for verifying its installation and recording them accurately in their records.

The gas company does not have a strict policy concerning the location of gas meter set assemblies; however, according to the gas company, almost all of these installations are located on the outside of the buildings they supply. Title 49 CFR Part 192 does not have specific requirements for the location of a gas meter set assembly. Kentucky Energy Regulatory Commission (KERC) regulations allow a utility company to install meters either inside or outside depending on company preference or the preference of its customers. However, the 1980 edition of the American Society of Mechanical Engineers (ASME) Guide for Gas Transmission and Distribution Piping Systems states that ". . . gas meters should not be located in confined engine, boiler, heater or electrical equipment rooms . . . or similar locations . . . ."

The Safety Board is aware that beyond the requirements of 49 CFR Part 192 concerning the location of gas meter set assemblies, the operator of a pipeline system should have the right to weigh such considerations as the probability of vandalism, sabotage, third-party damage, cost, and lack of adequate space in densely built areas. However, at a site such as the Simon Kenton High School, it would have been better to install the gas meter set assembly outside the building. The installation of the gas meter set assembly outside the building would have prevented or diminished the severity of this accident.

The compression coupling was a boltless-type coupling with a recommended working pressure of 25 psig for an unrestrained gas line and 125 psig for a restrained gas line. The piping adjacent to the compression coupling at the school was only partly restrained. The bottom nipple and piping coming through the wall were restrained from moving downward because they were supported by the wall. However, the top nipple and piping connected to the regulator, relief valve, and meter were restrained only by the weight of these units and, consequently, were not completely restrained. Compression couplings of this type are not generally designed for, nor intended to be used as, restraints against a pullout such as the one caused at the school by the increase in pressure to 165 psig.

The compression coupling separated from its connected piping when the increase in natural gas pressure pulled it free from the piping connection. The coupling was found completely separated from the nipple beneath it. An unrestrained compression coupling is not recommended by manufacturers for use when the two pipes that are inserted into the coupling can be pulled apart by longitudinal forces. Couplings should be used only when the piping which goes into them from both ends is completely restrained from separation or if the coupling itself is of the restraining type. The industry code in effect at the time of this pipeline installation, ASA B31.8 1963, Section 834.4(b), states:

If compression or sleeve-type couplings are used in exposed piping, provision shall be made to sustain the longitudinal forces noted in 834.4(a). If such provision is not made in the manufacture of the coupling, suitable bracing or strapping shall be provided; but such design must not interfere with the normal performance of the coupling nor with its proper maintenance.

Before the accident, when the pressure in the gas system was 60 psig, the existence of the compression coupling in the unrestrained line constituted an imprudent practice in view of the manufacturer's recommendations. After the increase in pressure due to the uprating project, the lack of a double regulator violated 49 CFR 192.197(c)(1).

Although Title 49 CFR 192.273 requires that pipelines be designed and installed so that the joints can sustain any longitudinal pull or thrust forces which are caused by contraction or expansion of the pipeline or by anticipated external or internal loading, these regulations were not in effect when the school's compression coupling and gas meter set assembly were installed. Many other such installations probably exist in the gas system. The Safety Board believes that the gas company should check all existing unrestrained compression couplings on gas meter set assemblies to make sure they were installed in accordance with the manufacturer's recommendations.

Title 49 CFR 192.615(a) requires that each operator establish written procedures to minimize hazards resulting from a gas pipeline emergency. Subsection 192.615(a)(6) requires that an emergency shutdown procedure be a part of these written procedures.

The subject regulations were applicable to the uprating of the gas main, but the gas company did not have such written procedures.

The gas company believes that a complete shutdown is a dangerous practice. It maintains that there is a possibility of forming a gas-air mixture with a potential for explosion. The gas company believes that air could enter a shutdown gas system by way of open home appliances and, to avoid this entry of air, it is necessary to maintain a positive pressure in the system.

The Safety Board reviewed its pipeline accident reports and found no reports indicating that an explosion had occurred as a result of a complete pipeline shutdown. The Safety Board believes that under certain conditions when a complete shutdown is performed, there is more of an economic burden to the gas companies than a potential danger to the public, because gas company employees have to shut off the gas to each customer individually, which is a major task when part of a city or town is involved. Afterwards, when service is restored, gas company personnel have to purge the lines and restore the natural gas service to each customer. The Safety Board is aware of some companies' objections to complete shutdown, but it believes that in this case the decision to shut down would have been the better one because damage to the school and injuries to persons could have been far greater if the second explosion had occurred later and involved more gas.

Therefore, the National Transportation Safety Board recommends that the Union Light, Heat and Power Company:

Improve company procedures for identifying all service lines connected to natural gas distribution systems to be uprated, and include in areas where there are more than one gas main the procedure of testing pipelines by pressure differential, which will locate those customers who cannot be located by routine procedures. (Class II, Priority Action) (P-81-1)

Include procedures for rapid and complete shutdown in an emergency in written company uprating plans. (Class II, Priority Action) (P-81-2)

Incorporate a specific requirement for curb box inspections in the company's annual gas meter/regulator inspections, in accordance with the Kentucky Energy Regulatory Commission regulations. (Class II, Priority Action) (P-81-3)

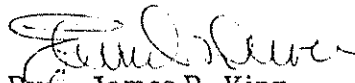
Revise installation procedures for gas meter set assemblies installed inside of a building to require that the shutoff valve is located on the outside of the building. This requirement should be carried out for new installations and routine replacements, and where possible, for priority retrofitting of installations serving schools, churches, hospitals, and other places of public assembly. (Class II, Priority Action) (P-81-4)

Provide adequate training for gas company employees who are in charge of public building inspections so that all company facilities are properly inspected. (Class II, Priority Action) (P-81-5)

Conduct a system-wide inspection of unrestrained compression couplings on gas meter set assemblies for conformance with the manufacturer's installation recommendations and all pertinent regulations. (Class II, Priority Action) (P-81-6)

Institute quality controls to increase the accuracy of company records, including verification of field reports and of written records and maps transferred to computerized records. (Class II, Priority Action) (P-81-7)

KING, Chairman, DRIVER, Vice Chairman, and McADAMS, GOLDMAN, and BURSLEY, Members, concurred in these recommendations.

  
By: James B. King  
Chairman