



# National Transportation Safety Board

Washington, D. C. 20594

Safety Recommendation

Log P-291

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In reply refer to: P-88-4 through -9

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On January 18, 1988, a natural gas explosion destroyed the building housing the K&W Cafeteria and the lobby of the Sheraton Motor Inn at 380 Knollwood Street, Winston-Salem, North Carolina. Two adjoining motel wings suffered structural damage. Of the four persons in the lobby/cafe building at the time of the explosion, three sustained minor injuries. The fourth person sustained a fractured ankle. One motel guest also sustained minor cuts but refused treatment.<sup>1</sup>

If the gas meter had not been located in a pit that also opened directly into the boiler room, the accident likely would not have occurred. When the meter installation was designed in 1964, the Piedmont Natural Gas Company (Piedmont) recognized some danger of placing the meter in the pit by using a security valve rather than a pressure relief valve to protect against overpressurization and possible rupture of customer piping. The security valve stops the flow of gas to the customer whereas the pressure relief valve vents gas to the atmosphere. In the case of a catastrophic failure upstream of the security valve, gas would be released directly into the pit until a valve on the distribution line was closed.

Current Federal regulations, 49 CFR 192.353(b), published in 1970, require that inside meters be located in a well-ventilated place and not less than 3 feet from any source of ignition. The direct openings in the basement wall into the pit effectively placed the gas meter within the boiler room. Other than the squirrel cage fan, the gas meter and piping likely were not within 3 feet of any potential ignition source. Section 192.355(b) requires that a customer's service regulator and relief valve be located where gas from the vent can escape freely into the atmosphere and away from any opening into the building. Section 192.357(d) also requires that each regulator that might release gas in its operation be vented to the outside atmosphere.

<sup>1</sup>For more detailed information, read Pipeline Accident Report--Piedmont Natural Gas Company, Natural Gas Explosion and Fire, Winston-Salem, North Carolina, January 18, 1988 (NTSB/PAR-88/01).

The Safety Board recognizes that the pit and meter arrangement at the Sheraton likely satisfied both provisions. The top of the pit, being covered by a metal grate, was open to the atmosphere. Natural gas, being less dense than air, normally rises and would be expected to vent through the top of the pit, away from the ventilation openings into the boiler room. Since the squirrel cage fan was drawing air into the boiler room from the pit, sufficient dispersion of leaking gas into the atmosphere is questionable at best. Consequently, the Safety Board believes that the placement of the gas meter set in a pit with openings directly to the boiler room was a poor engineering design and was inherently dangerous. The Safety Board believes that Piedmont should have recognized at the time the gas meter was installed the dangers such an arrangement presented and, therefore, should have installed the meter in a safer location.

The maintenance crews, the meter test crew, and the meter reader all had entered the pit between May 1986 and December 1987 but had failed to observe and note conditions within the pit that affected the gas piping and equipment. Although the steel reinforcing plate and channel beam had not yet been installed in May 1986, the deterioration of the north pit wall should have been apparent to the meter test crew conducting the prover tests. Two annual maintenance inspections were conducted after the steel plate to reinforce the north pit wall had been installed in July 1986. Yet neither maintenance report sheet had any notations about the steel plate, the channel beam extending directly over the gas meter, or the condition of the north wall of the pit. The maintenance crews apparently did not question why the plate was installed, did not inspect the condition of the pit to determine if Piedmont equipment was affected, and did not report the presence of the plate to anyone in the district office. Despite the meter reader being the one employee who entered the pit at regular intervals, he had little awareness of the conditions of the pit. He was aware of the channel beam only because it interfered with reading the meter. He too did not recognize the possibility that gas piping might be adversely affected by the crumbling wall. The failure of these employees to observe and recognize conditions that adversely affected the gas piping constitutes serious deficiencies in Piedmont's maintenance and inspection program. If these employees had reported the conditions to a supervisor, a thorough followup inspection of the pit likely would have uncovered the corroding area of the service line at the pit wall and the accident could have been prevented.

Although the corrosion control and leakage survey programs are the responsibility of the Corrosion and Leakage Department in the general office, the two programs are independently run without any meaningful coordination, analysis, or oversight. The Corrosion and Leakage Department has implemented effective data collection and recordkeeping practices, relying heavily on computerized records. The department, however, has not been innovative in using this capability to analyze the data and to evaluate the effectiveness of the cathodic protection and leakage survey programs. For example, the department does not routinely evaluate leakage survey results for cathodically protected pipe as a check on the effectiveness of the cathodic protection for the pipe. Similarly, the department does not use substandard pipe-to-soil potential readings to identify areas that may have inadequate cathodic protection and, therefore, may be more susceptible to leakage.

While the Corrosion and Leakage Department has responsibility for the corrosion and leakage programs, it has not initiated a structured oversight program that has well-defined procedures and objectives. Although Piedmont has defined categories of service areas and corresponding leakage survey frequencies, the Corrosion and Leakage Department does not routinely review the service area

classifications of each district to confirm that service areas are being properly and consistently classified. The department has not developed written procedures that delineate the responsibilities of the leak technicians and the district superintendents concerning the classification of service areas. In the absence of written procedures, there is no guidance to resolve differences in evaluations between the district superintendent and the leak technician.

There is no mechanism currently in place that enables the Corrosion and Leakage Department to follow up on repairs made to reported leaks. Although the department receives reports of leak repairs from each district, the department does not, as a matter of practice, have the leak technicians spot-check repairs. The department does not have a program in place to ensure that district servicemen who conduct leak tests on repairs are qualified and performing satisfactorily. While the department has an effective program for reporting leaks, the department has not effectively initiated measures to determine that leaks have been repaired.

The department exercises even less oversight for the cathodic protection program. Corporate management has determined that cathodic protection programs, from supervision of the corrosion technicians to estimating budgets, should be the responsibility of the district superintendents. With the exception of reviewing each district's budget and notifying the districts monthly of the test points to be checked, the Corrosion and Leakage Department has no assigned role in the districts' performance of corrosion protection. To provide effective oversight of the cathodic protection program, the department should establish written criteria for selecting test points, their number, and designating the points for testing each year. The department should evaluate test readings taken over a period of time to assess the effectiveness of the cathodic protection programs within each district. The department should monitor the performance of the corrosion technicians and the districts to enhance the effectiveness of the program.

Piedmont does not have an effective atmospheric corrosion control program. Its traditional approach to atmospheric corrosion control has been to paint exposed piping and equipment on an as-needed basis. Without a structured program, Piedmont's current approach is not sufficient. The lack of a structured and well-defined atmospheric corrosion program led to the difference of expectations between the general office and the Winston-Salem district office manager regarding the use of meter readers to inspect for atmospheric corrosion. Since the accident, Piedmont has indicated that meter readers have been instructed to inspect for atmospheric corrosion. However, without well-defined goals and objectives and adequate training for meter readers, the fundamental problem remains.

Technical training of employees, both for initial qualification and recurrent training, is conducted using technical schools, consultant-prepared short courses, in-house training lectures, video tapes, and on-the-job training (OJT). The designation of a training manager in the general office and the formation of a joint management/union committee to formulate and maintain an employee training program are positive indications of Piedmont's efforts. Although resources and the organizational structure apparently exist for a coordinated training effort, the lack of written policy regarding training goals and training needs has compromised to a considerable extent several aspects of Piedmont's training efforts. Other than the apprenticeship program for entry level service department employees, training goals and needs have not been defined.

Among the shortcomings observed by the Safety Board was the lack of continuity and purpose to the different training programs. With the exception of the apprenticeship program for entry-level service employees, the overall training program uses several types of educational and training resources without discernible reasons for their selection or implementation. For example, position descriptions for nonunion employees do not specify training and education qualifications, nor is that information otherwise available. Consequently, there is no apparent effort to schedule training to meet initial qualifications or to maintain current qualifications. Training for the leak and corrosion technicians is often left solely to the initiative of the employee. For union employees, there has been no corporate assessment of the training needs of union employees beyond the apprenticeship program. Although training lectures about the engineering letters, Federal regulations, new equipment, and safety practices are given to union employees, there is no discernable indication that the company coordinates the lecture content, documents the information discussed, or provides followup for absent employees. The training lectures may be used for certain training areas, but the lack of written direction undermines their usefulness.

Piedmont also has not made a concerted effort to assess the effectiveness of the training offered. The company conducts mock emergency drills in each district to evaluate the emergency response performance of the district operations department. However, the drills could be more realistic if they were conducted at times other than normal business hours and if municipal emergency response agencies participated. Graded examinations were given for certain technical courses; however, minimum passing grades were not normally required or expected. The effectiveness and benefits of other types of training have not been evaluated in a systematic manner, such as in terms of improved employee performance or system operations.

The principal qualification and training for union employees is OJT. Although extensive use of this method is not unusual in the pipeline and natural gas industries, the Safety Board has pointed out in other accidents<sup>2</sup> that reliance on OJT has shortcomings for preparing employees to deal with emergencies and for ensuring standardization in the level of knowledge or work skills among employees. This is not to say that OJT does not have a useful place in a comprehensive training program. OJT, as conducted in the apprenticeship program, permits entry-level service employees to learn about more advanced jobs while earning basic pay and serving as productive employees for the company. OJT included in a program for training of more advanced employees, including nonunion employees, is a valuable method to ensure site-specific knowledge of an installation. However, the Safety Board is concerned that the OJT practices at Piedmont have been used in place of other training activities that are less dependent upon low employee turnover for effectiveness. The Safety Board also is concerned that the lack of written goals and objectives for the OJT program does not identify performance standards for the employee and does not otherwise promote a consistent level of performance throughout the company. The success of Piedmont's current OJT program requires the retention of key personnel, something that Piedmont so far has been able to do.

Piedmont's use of outside schools and consultants offers the potential to improve significantly the effectiveness of employees when general education can upgrade

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<sup>2</sup>Pipeline Accident Reports--*Lonestar Gas Company Gas Explosion and Fire, Fort Worth, Texas, March 12, 1986* (NTSB/PAR-87/03); and *Williams Pipeline Company, Liquid Pipeline Rupture and Fire, Mounds View, Minnesota, July 8, 1986* (NTSB/PAR-87/02).

work performance. This potential cannot be fully realized until Piedmont's management provides a systematic plan to guide the use of these outside resources. Ideally, the plan should correlate the subject matter of these instructional resources with the specific technical work and task needs of employees.

Although Piedmont has attempted to implement an active training program, the company's efforts have been compromised through a failure to integrate the elements of its training activities. First and foremost, the company has not identified initial qualifications and recurrent training needs for its employees. Consequently, the training program cannot be directed systematically to the needs of individual employees. Secondly, without written and structured employee performance standards, Piedmont has no means of evaluating the effectiveness of the training as it is used on the job. Therefore, the Safety Board is concerned that the company has not demonstrated enough familiarity with basic training principles.

Although Piedmont has made a concerted effort to offer training to the Winston-Salem Fire Department and other fire departments within the company's operating area, the training has emphasized the properties and hazards of natural gas. While the training has provided important information, it has not educated the fire departments about the capabilities Piedmont can provide in pipeline emergencies. To establish proper liaison with public officials, operators need to identify and explain what specialized equipment and expertise their personnel can provide in emergency situations. Pipeline operators also need to determine what fire department officials view as important for firefighters to know. Pipeline operators and public officials will only then be able to know and expect what the other can provide in emergency situations.

Beyond providing basic information about natural gas, Piedmont did not ensure that the Winston-Salem Fire Department knew and understood what capabilities Piedmont could provide. Had Piedmont done so, it is unlikely the incident commander would have used firefighters to survey adjacent buildings for gas or delayed the gas detection tests along the service line.

Piedmont has contended that it did not report the accident earlier than March 1 to the Office of Pipeline Safety (OPS) of the U.S. Department of Transportation because the investigation by the Winston-Salem Fire Marshal's Office determined the source of gas to be within the basement, as announced on January 27. Since gas leaking from piping within the basement would not be within the jurisdiction of Federal regulation, Piedmont concluded that this accident was not a reportable incident under 49 CFR 191.3 and that there was no need to comply with the telephonic notification requirements of 49 CFR 191.5. A reportable incident is defined under 49 CFR 191.3 as "an event that involves a release of gas from a pipeline" and other specified criteria, including estimated property damage of \$50,000 or more. According to Piedmont's interpretation, telephonic notification is not required unless the operator has determined that the release of gas from a regulated pipeline caused the injury, fatality, or property damage. However, Piedmont's interpretation is inconsistent with longstanding policy of the OPS and its predecessor, the Office of Pipeline Operations (OPSO). The OPSO stated in Advisory Bulletin No. 77-3 dated March 1977:

Although information provided in a telephonic notice may be relevant to determining fault of the leak . . . , the act of giving notice merely indicates that an accident occurred and a gas leak may have been involved.

In Advisory Bulletin No. 77-6, dated June 1977, the OPSO further stated :

It is necessary that telephonic notice of leaks . . . be made promptly in order to determine the need for an investigation in a timely manner . . . OPSO recognizes that information available during the early stages of an accident may not be complete and that specific cause of the leak may not be known. However, the telephonic notice should be made if there is reason to believe that gas is involved.

The telephonic notification requirements are intended to facilitate timely investigations for the protection of persons and property. The interpretation offered by Piedmont does not facilitate the investigative process, but in fact requires an investigation to simply determine whether an accident meets the definition of a reportable incident. Since the advisory bulletins were mailed to all pipeline operators and certified State enforcement agencies, Piedmont, as a responsible operator, should have been knowledgeable of the interpretations.

Additionally, several facts should have caused Piedmont to suspect that gas had been released from the service line. The platoon supervisor from engine company 7 was able to hear a loud hissing noise over the noise of the diesel engine on his truck even though a Piedmont employee stated that he could not hear anything when standing 15 feet from the pit. This same Piedmont employee also obtained the one positive gas reading when conducting the bar-hole tests. Despite that a second reading was taken immediately without gas being detected, the fact that one positive reading was obtained after the gas had been off for 3 1/2 hours at a location nearly 90 feet from the pit should have caused Piedmont to question how and why the one positive reading occurred. With the recovery of the gas meter on January 21 and examination of the pit, Piedmont knew that the service line in the pit had ruptured. During testing of the security valve on January 27, a comment made by a Piedmont serviceman about recording a decrease of 2 psi in the gas pressure for the distribution line between 2:30 a.m. and 4 a.m. is another indication that Piedmont was aware of a problem on the gas system. Certainly with the discovery of the corroded section of the service line in the pit on February 1, Piedmont must have recognized the corroded service line as a possible source of the leak and should have made the proper telephonic notification.

The Safety Board believes that notwithstanding Piedmont's inconsistent interpretation of the definition for reportable incident, Piedmont had sufficient information on the day of the accident to strongly indicate that the incident should be reported. The positive bar-hole test reading indicated a leak and should have prompted Piedmont to conduct more extensive testing. With the subsequent recovery of the gas meter, regulator, and particularly the cracked and corroded section of the service line, Piedmont had very strong evidence that a reportable incident occurred and yet did not make the proper notification. The Board believes that an operator should provide telephonic notification if there is the slightest possibility that an accident meets the definition of a reportable incident, one that involves the release of gas.

Therefore, the National Transportation Safety Board recommends that the Piedmont Natural Gas Company:

Relocate gas meters installed in pits that are adjacent to building openings. (Class II, Priority Action) (P-88-4)

Develop comprehensive operating and maintenance procedures that define employee responsibility, accountability, evaluation, and coordination for: inspection and maintenance of meter sets and corrosion control, leakage surveillance, and atmospheric corrosion control programs. (Class II, Longer Term Action) (P-88-5)

Develop written operational policy and objectives for employee training. (Class II, Priority Action) (P-88-6)

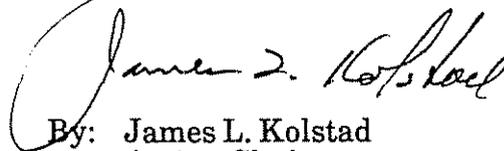
Conduct a review of all existing training and, consistent with established training policy and objectives, develop and implement training programs that enable employees to correctly carry out each assigned responsibility which is necessary to comply with the requirements of 49 CFR Part 192. (Class II, Priority Action) (P-88-7)

Develop and coordinate emergency response preparedness plans with local emergency response agencies that identify the capabilities to the gas company to assist in an incident that involves natural gas. (Class II, Priority Action) (P-88-8)

Revise emergency action plans to include Federal notification procedures for incidents that involve releases of natural gas and that meet U.S. Department of Transportation criteria. (Class II, Priority Action) (P-88-9)

Also, as a result of its investigation, the Safety Board issued Safety Recommendations P-88-10 to the city of Winston-Salem, North Carolina; P-88-11 and -12 to the North Carolina Utilities Commission; P-88-13 to the Research and Special Programs Administration of the U.S. Department of Transportation; and P-88-14 to the American Gas Association.

KOLSTAD, Acting Chairman, and BURNETT, LAUBER, NALL, and DICKINSON, Members, concurred in these recommendations.



By: James L. Kolstad  
Acting Chairman