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NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

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Forwarded to:

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SAFETY RECOMMENDATION(S)

P-85-18 and -19

At 3:30 a.m. on September 25, 1984, an explosion followed by an intense natural gas-fed fire destroyed two apartments at 3022 North 37th Street in Phoenix, Arizona. Of the 12 persons injured in the fire, 5 persons later died. After the fire was extinguished, the 1 1/4-inch-diameter plastic gas main supplying gas to the destroyed apartments was excavated and a 3-inch-long longitudinal split was discovered in the bottom of the pipe 18 feet from the gas meters on the apartment building. Gas at 30 psig had escaped through the longitudinal split, migrated into and under the apartments, ignited, exploded, and burned. 1/

The pipe involved in the accident was designated as type I grade II, new service thermoplastic pipe in the Plastic Pipe Manual for Gas Service published by the American Gas Association (AGA) and was manufactured by Kerona. The pipe was a blend of acrylonitrile, butadiene, and styrene (ABS). ABS pipe is resistant to alcohols, mineral oils, and aliphatic (nonaromatic) hydrocarbons, but can be damaged by contact with acids, aldehydes, ketones, esters, and chlorinated hydrocarbons.

The Arizona Public Service Company (gas company) received all of its natural gas from one gas transmission company, El Paso Natural Gas, at five major town border stations and other smaller receipt points; the gas was neither filtered, scrubbed, nor dehydrated as it entered the gas company's distribution system. The gas company did not "fog" 2/ its system at any location. The gas company routinely drained liquids entrapped in the natural gas entering its distribution system at its city gate stations and other system low points; the presence of such liquids in a natural gas pipeline system is not unusual.

1/ For more detailed information read Pipeline Accident Report--"Arizona Public Service Company Natural Gas Explosion and Fire, Phoenix, Arizona, September 25, 1984" (NTSB/PAR-85/01).

2/ "Fogging" is a process of adding liquid vapor to the natural gas in a distribution system to increase its moisture content to prevent the dehydration of joint packing materials; steam or hot oils are commonly used.

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The results of tests made on the pipe fracture found in the ABS plastic pipe at the accident site revealed that the pipe had deteriorated from a chemical reaction between the ABS plastic pipe and a liquid that had settled along the bottom of the pipe. It was not possible to tell how long the pipe had been deteriorating because it was not possible to determine either what the specific liquid was or how long the liquid had lain in the bottom of the pipe. The deteriorated pipe resulting from environmental stress cracking in the bottom of the pipe finally ruptured through the remaining pipe wall allowing natural gas to escape. Therefore, the pipe failure resulted from several conditions: first, a chemical action which deteriorated the pipe and produced internal cracks, and later, the internal cracks propagated through the pipe wall until finally the remaining pipe wall thickness could no longer contain the internal pressure. Without these conditions, the accident would not have occurred at that time.

Since 1970, Federal regulation 49 CFR 191.5 has required operators of natural gas distribution systems of 100,000 meters or more to submit written reports of pipeline accidents that result in ignition, deaths, injuries, or other reportable criteria within 20 days after the detection of the leak. In the more than 14 years that the leak reporting system has been in operation, thousands of leak reports have been received and filed by the Materials Transportation Bureau (MTB) of the Research and Special Programs Administration (RSPA) of the U.S. Department of Transportation (DOT), and the data have been entered on computers. While the leak reports are categorized by the type of pipe involved (steel, cast-iron, plastic, copper, etc.), the category of plastic pipe is not defined further as to the type of plastic pipe (PE 3306, PE 2036, PVC, ABS, CAB, or other). Consequently, in searching the DOT data for plastic pipe failure rates, it is impossible to segregate ABS failures from any other plastic pipe failures unless a gas company voluntarily has listed the type of plastic pipe, which is rarely done.

In a 1980 evaluation of the MTB's pipeline data system, 3/ the Safety Board stated:

> The evaluation found that Materials Transportation Bureau staff resources are limited, and that, consequently, use of the data to direct and focus resources is essential for the effective and efficient administration of the Pipeline Safety Act. The Safety Board concluded, however, that the data currently collected are often inaccurate and are not representative of gas pipeline operators and gas pipeline accidents.
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> Furthermore, the system is seldom used by MTB offices in carrying out their regulatory and enforcement functions, and there is little coordination regarding the system between the Safety Data Management Branch and the regulation and enforcement offices. The study found that the MTB does not have a pipeline data analysis plan, which the Safety Board believes is necessary to coordinate and direct the MTB offices in the use of the data system as a management tool.

As a result of this evaluation, the Safety Board issued the following Safety Recommendations to the MTB of the RSPA on August 20, 1980:

3/ Special Study--"Safety Effectiveness Evaluation of the Materials Transportation Bureau's Pipeline Data System" (NTSB-SEE-80-4).

P-80-61

Develop and publish for public comment a formal data analysis plan for the pipeline data system.

P-80-63

Postpone promulgation of proposed, revised pipeline data forms until development of a data analysis plan and coordination of the forms with the plan.

P-80-65

Train existing personnel to more effectively validate incoming leak report forms.

The RSPA has not developed and published for public comment a formal data analysis plan. In its final rulemaking promulgating changes to its annual reports and incident reports, published in the Federal Register at 49 FR 18956, the RSPA stated that the new annual reports and accident report forms and procedures for data collection "... will adequately monitor trends and provide indicators of potential problem areas..." The RSPA stated further that "... by mid-1985, MTB plans to initiate such a study of pipeline safety reporting requirements and the uses of the data, and will invite specific input from the public and industry, in addition to NTSB."

The Administrator of RSPA now believes that it would no longer be in RSPA's best interest to "develop and publish for public comment a formal data analysis plan for the pipeline data system" as recommended because the RSPA already has issued new incident report forms and annual report forms for gas distribution systems (RSPA F7100.1 (3-84) and RSPA F7100.1-1 (3-84), effective July 1, 1984). The Safety Board had classified Safety Recommendation P-80-61 as "Open--Acceptable Action" based on the RSPA statement that it would publish such a data analysis plan. This recommendation, however, now will be classified as "Closed--Unacceptable Action."

Although the RSPA initially postponed promulgation of proposed, revised pipeline data forms, so that the Safety Board classified Safety Recommendation P-80-63 as "Closed--Acceptable Action," the RSPA issued the new forms effective July 1, 1984, without undertaking the data analysis plan recommended by the Safety Board. Based on the change in position by RSPA on the need for a data analysis plan, this recommendation will now be classified as "Closed--Unacceptable Action."

The RSPA has instituted improved quality control procedures, and the Safety Board has classified Safety Recommendation P-80-65 as "Open--Acceptable Alternate Action" pending the full implementation of statistical sampling.

The MTB has been using the revised accident report forms since July 1, 1984. If the operator accurately fills out the accident report form and if the data contained therein are filed accurately in the MTB data storage bank, the type of plastic pipe involved (ABS, PE, PVC, etc.) and the mode of failure (outside damage, material failure, etc.) now can be identified. However, the accident report form still does not require any reporting of the causes of material failures.

The Safety Board is concerned that the problem with ABS plastic pipe revealed in this accident may exist in many other natural gas distribution systems nationwide. The DOT records of gas company accident report forms, which are compiled to identify industry problems and accident trends, are of no help in determining the extent of the ABS plastic pipe problem because, other than polyethylene plastic pipe, the specific type of plastic pipe involved in a failure usually is not recorded, nor are all material failures required to be reported. Therefore, the DOT is unable to analyze the problem, to establish conditions for the continued use of ABS pipe, or even to warn the gas industry about the problems already encountered. The DOT's new incident report forms, which became effective on July 1, 1984, refer specifically only to polyethylene plastic pipe. Therefore, an operator who experiences an ABS plastic pipe failure must check a box on the form designated as "other" and describe the specific type of plastic pipe elsewhere on the incident report form; this does not encourage reporting and provides an opportunity for errors.

The identification of volatile chlorinated hydrocarbons and other chemicals in liquids collected in the gas distribution system raises the issue of the compatibility of any type of plastic pipe with chemicals that may be introduced into a natural gas pipeline system. The Safety Board is concerned with the possibility that other types of plastic pipe currently in use in gas distribution systems may have incurred material failures similar to the failure in this accident. The Board is aware that there have been material failures in the other types of plastic pipe, but how many, where, and what the causative factors were cannot be determined because the DOT's incident report forms, particularly those in effect prior to July 1, 1984, do not include this information.

The AGA commissioned a special task force in 1982 to review plastic piping performance and to communicate the results of the review to gas companies. The task force developed a questionnaire to collect information from gas distribution companies on plastic piping system performance. Statistical data used with the questionnaire were derived from the 1981 leak history as reported annually by utilities to the DOT. In asking the gas companies to respond, the AGA suggested that the information collected, which was sensitive, be destroyed after the questionnaire was completed. Responses were received from 100 distribution utilities, including the Arizona Public Service Company, which destroyed its information after completing the questionnaire.

The task group report, "Plastic Pipe Performance," was presented at the AGA's 1984 Distribution/Transmission Conference in San Francisco, California. The report concluded:

- o No significant problems are indicated with current plastic gas piping materials.
- o Plastic piping is shown to have provided excellent service.
- o Leaks per mile of main and service for plastic are significantly lower than for other distribution system materials.
- o Plastic installation costs are less than half of the installation costs for other materials in 2" and smaller sizes.
- o The use of plastic is increasing both in size and quantity.

- o PE 2306 polyethylene was the predominant type of plastic being installed in 1981.

- o Isolated material and installation problems related to use of plastic pipe have been identified and have been or are being corrected by reporting companies.

- o No major problems were identified.

The leak report records recently requested from the gas companies by the AGA and which it analyzed in its report on the safety of plastic pipe gas distribution systems were for a 1-year period. That time span is not long enough to establish a meaningful trend and certainly is insufficient to support the generally positive conclusions presented. Moreover, while the thrust of the AGA report is that there are no plastic pipe problems, the report's first conclusion stated that "no significant problems are indicated with current plastic gas piping materials" (emphases added). The report does not define "significant problems" and does not state if any significant problems were found with previously installed plastic gas piping materials still in use even though the report acknowledges that some companies have replacement programs for some types of plastic pipe.

The Safety Board believes that the sparse data available on plastic pipeline safety are insufficient to show that there are no problems, and concludes that the AGA report raises more questions than it answers: e.g., who were the companies with the problems, where were they located, are the problems continuing, what caused the problems, have the plastic pipe systems been replaced entirely, and have the gas pressures been lowered in the affected systems? The Safety Board concludes that the DOT should place a high priority on the identification and analysis of plastic pipe material failures to determine the extent of any problem which may exist. It may be that ABS plastic pipe material failures are not epidemic, but the analysis of 1 year's accident statistics from some AGA member companies is not sufficient to put the issue to rest. An extensive evaluation by the DOT in cooperation with the natural gas industry is necessary.

Therefore, the National Transportation Safety Board recommends that the Research and Special Programs Administration of the U.S. Department of Transportation:

> Establish a program to determine whether the problem of chemically induced ABS plastic pipe failure is nationwide. Include a review of the data maintained by the Plastic Pipe Institute, the American Gas Association, the Gas Research Institute, and others on ABS plastic pipe material failures. (Class II, Priority Action) (P-85-18)
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> Publish and distribute ABS plastic pipe failure data to gas operators nationwide, and develop recommended methods of eliminating or mitigating such failures. (Class III, Longer-Term Action) (P-85-19)

BURNETT, Chairman, GOLDMAN, Vice Chairman, and BURSLEY, Member, concurred in these recommendations.

By: Jim Burnett
Chairman