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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-83-31 through -37

At 12:04 p.m., mountain daylight time, on May 26, 1983, natural gas at 815 pounds/square inch gage (psig) began to escape through a failed gasket in a compressor at the El Paso Natural Gas Company's Blanco Gasoline Plant near Bloomfield, New Mexico. The compressor station operator heard a loud noise, ran to the valve manifold outside the compressor building, and tried to shut off the gas supply to compressor No. 14. Another employee, who also heard the noise, ran into the compressor building and tried to shut down the compressor engine. Before either person succeeded, the escaping gas ignited, exploded, and burned. The two employees were burned severely, one compressor was destroyed, another compressor was damaged, the windows and doors of the compressor building were blown out, and other structural damage resulted. 1/

The National Transportation Safety Board determined that the probable cause of the accident was the improper tightening of compressor head bolts resulting in the rupture of a compressor head gasket and the escape and ignition of natural gas. Contributing to the accident was the failure of El Paso Natural Gas Company to prescribe proper bolt tightening procedures in its Maintenance and Operations Manual and to assure that maintenance personnel are trained in proper bolt tightening procedures. Contributing to the extent of damage and to the duration of the emergency was the failure by plant personnel, due to inadequate training in emergency procedures, to relieve promptly gas pressure in the piping by activating the blowdown system.

Maintenance Records.—Maintenance records for compressor No. 14 showed a marked increase in the need for maintenance and a marked decrease in the number of hours of operation between required maintenance, indicating that there was some problem with the compressor piston rings and valves. For example, before December 1980, compressor No. 14 was maintained an average of once every 320 days of operation. After December 1980, compressor No. 14 was maintained an average of once every 89 days of operation. The gas company should have been alerted to a problem by the increasingly frequent need for maintenance and should have determined and corrected the cause of the problem, which would have eliminated the necessity for repeated maintenance activity on

1/ For more information read, Pipeline Accident Report: "El Paso Natural Gas Company Compressor Station Explosion and Fire, Bloomfield, New Mexico, May 26, 1983," (NTSB/PAR/83/4).

this compressor. Maintenance records for compressors are kept so that the operating condition of plant equipment can be readily assessed and any detrimental operating conditions can be diagnosed and remedial actions taken. In this case, there was ample warning in these maintenance records of the need for a careful, complete investigation to determine why the compressor valves and rings were burning out so frequently. Detection and analysis of the black residue in the compressor gas passages would have provided a clue that led to the elimination of the problem rather than simply replacing the failed parts. This also would have put an end to the repeated removal and replacement of the compressor head. Reducing the number and frequency of compressor head removals and replacements would have decreased the chances for incorrect torquing.

Torquing Procedures.—After the accident, a team of investigators, including a Safety Board investigator, checked the compressor piping and compressor No. 14 for leakage. The nuts were loosened and removed from the No. 2 compressor cylinder using a torque wrench and the torque, measured in foot-pounds, was recorded for each bolt removed. 2/ On compressor cylinder No. 2, the torque required to loosen the nuts ranged from a low reading of 0 foot-pounds (loose) at the area of the failure to a high reading of more than 400 foot-pounds on the internal nuts. On the external nuts of the same cylinder head, the torque readings ranged from a low of 0 foot pounds (loose) to a high reading of 390 foot-pounds below the loose nut. After the compressor head was removed, a failed gasket was discovered.

The gas company does not have written procedures specifically detailing torquing operations for compressor head bolts. However, at unspecified intervals, gas company maintenance personnel are required to view a 2-hour video tape on proper maintenance procedures, a portion of which discusses proper torquing procedures. In addition, the gas company has specifically prohibited the use of air wrenches on cast iron engines or compressor heads.

Very recently, the Compressor Committee of the American Gas Association has recognized the importance of properly torqued bolts and nuts and has proposed guidelines to the gas industry "for selecting and using threaded fasteners in natural gas pipeline service." These guidelines specifically recommend against attempting to "tighten down" a leaking gasket under pressure. Had these guidelines been issued at the time of the accident and adhered to by the gas company, the Safety Board believes that this accident would have been avoided. Consequently, the gas company needs to incorporate into its Maintenance and Operations Manual concise instructions for correctly tightening and torquing compressor bolts as well as for prohibiting the practice of tightening such bolts on any portion of compressors while pressurized. Moreover, the gas company needs to instruct and test maintenance personnel in these procedures to reduce the potential of similar hazardous conditions.

Emergency Plant Plan - Blanco Plant.—The gas company manual was prepared to inform gas company personnel of the procedures and assignments of responsibility to be followed in case of an emergency in a plant area. All the compressor station operators, attendants, and other personnel have access to copies of the Emergency Plant Plan which are located in various offices throughout the plant. The operating plant personnel are required to read and understand the manual and sign a statement that they have done so; all operating personnel had signed the statement in November 1982. El Paso does not give written or oral tests to check the plant personnel on their understanding of the manual.

2/ Torque: The amount of twisting force, expressed in inch-pounds or foot-pounds, applied to the nut, when a nut is used, or applied to the head of a cap screw (threaded into a tapped hole). Twelve-inch pounds or one-foot pound of torque would be created by exerting a one pound pull on a point of a wrench handle exactly 12 inches from the center line of a bolt.

Title 49 CFR 192.615, Emergency Plant Plan, states:

(a) Each operator shall establish written procedures to minimize the hazard resulting from a gas pipeline emergency. At a minimum, the procedures must provide for the following:

* * * * *

(1) Receiving, identifying, and classifying notices of events which require immediate response by the operator.

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(6) Emergency shutdown and pressure reduction in any section of the operator's pipeline system necessary to minimize hazards to life or property.

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American Society of Mechanical Engineers (ASME) Guide for Gas Transmission and Distribution Piping Systems, Guide Material for 192.615 Federal Standard, states:

1. Written Emergency Procedures (192.615(a))

Written procedures should state the purpose and objectives of the emergency plan and provide the basis for instructions to appropriate personnel. The objectives of the plan should be to assure that personnel who could be involved in an emergency are prepared to recognize and deal with the situation in an expeditious and safe manner. . . .

Therefore, the Safety Board believes that the gas company should revise its Emergency Plant Plan to conform with these guidelines and should train, drill, and test its personnel in its execution.

Emergency Blowdown.—Emergency blowdown systems for compressor stations are designed to provide a rapid, safe means of relieving gas pressure in an affected area of piping by venting the gas to a flare pit or to the atmosphere at a location outside of the station. Activation of the blowdown system reduces both the gas pressure and the gas volume in the affected area of piping, and thus reduces the duration and the intensity of the fire.

Since A Plant was not blown down until about 30 minutes after the complete plant was shut down, gas at an initial pressure of 815 psig fueled the fires at the blown gasket on compressor No. 14 and at the broken 1/2-inch nipple near compressor No. 10. Although immediate blowdown would not have prevented the explosion, fire, and injuries that took place suddenly and immediately upon ignition, activation of the blowdown system probably would have prevented the intense flames which were fueled by gas under pressure for more than 30 minutes leading to damage to the No. 12 compressor and complete destruction of the No. 14 compressor. As the gas company Emergency Plant Plan states, "The most critical period for confusion, mistakes, economic loss and personnel safety is from the time of failure until the containment of the failure." In this case, the time of containment was unnecessarily extended by 30 minutes; the system should have been blown down when it was shut down. The A Plant, built prior to Federal regulations, does not have blow down valves located at the plant exits. In view of the consequences of the accident, the Safety Board believes that the gas company should bring A and B Plants into compliance with 49 CFR 192 and locate blow down valves near the plant exits.

Emergency Response.—When the Bloomfield Volunteer Fire Department responded to the Blanco Plant, the firefighters were not familiar with the physical layout of the entire plant, they did not know the location of the fire hydrants, and they did not know the capacity of the plant's water pump. The firefighters had never been to the plant before, they had not been given prints or plans of the Blanco Plant and, therefore, had not had an opportunity to study or discuss how to fight a fire at the Blanco Plant during their training sessions. Familiarity with a facility by the local fire department is important, is mandatory under the Federal Regulations, may well prevent the total loss of a burning facility, and may keep firefighter injuries to a minimum. The Safety Board believes that the gas company was imprudent when it chose to exclude the fire department from its firefighting plan, and further believes that it should familiarize the Bloomfield Fire Department with Blanco Plant facilities.

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

> Review periodically the maintenance records of its compressors and other machinery in critical service to detect in a timely manner potential problems and determine the cause(s) of equipment malfunction so that appropriate corrective action can be implemented. (Class II, Priority Action) (P-83-31)
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> Include in its Maintenance and Operations Manual torquing specifications for machinery in critical service as well as the correct sequence of bolt tightening and prohibit the practice of tightening bolts under pressure. (Class II, Priority Action) (P-83-32)
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> Instruct and test its maintenance personnel in the correct method of tightening head nuts and bolts on machinery in critical service, emphasizing the importance of the correct use of torque wrenches and of uniformly tightening these fittings in the prescribed sequence. (Class II, Priority Action) (P-83-33)
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> Revise its Emergency Plant Plan to describe the various potential emergencies, to explain the intended use and operation of the emergency shutdown and blowdown facilities, and to delineate the circumstances under which they should be activated. (Class II, Priority Action) (P-83-34)
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> Train, drill, and test employees periodically in the execution of the Emergency Plant Plan. (Class II, Priority Action) (P-83-35)
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> Install emergency blowdown system activators for compressor plants A and B so that they can be operated from at least two plant exits. (Class II, Priority Action) (P-83-36)
>
> Incorporate within its emergency plans for its Blanco Plant and other plants the use of emergency response resources, such as the Bloomfield Volunteer Fire Department, and familiarize each with the layout and firefighting facilities of applicable plants. (Class II, Priority Action) (P-83-37)

The National Transportation Safety Board is an independent Federal agency with the statutory responsibility ". . .to promote transportation safety by conducting independent accident investigations and by formulating safety improvement recommendations"

(P.L. 93-633). The Safety Board is vitally interested in any actions taken as a result of its safety recommendations. Therefore, it would appreciate a response from you regarding action taken or contemplated with respect to the recommendations in this letter.

BURNETT, Chairman, GOLDMAN, Vice Chairman, McADAMS, BURSLEY, and ENGEN, Members, concurred in these recommendations.

By: Jim Burnett
Chairman