



The National Institute for Occupational Safety and Health (NIOSH)

Promoting productive workplaces
through safety and health research



Mechanic Asphyxiated Within Steam Service Passageway

FACE 8764

Introduction:

The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), performs Fatal Accident Circumstances and Epidemiology (FACE) investigations when a participating state reports an occupational fatality and requests technical assistance. The goal of these evaluations is to prevent fatal work injuries in the future by studying the working environment, the worker, the task the worker was performing, the tools the worker was using, the energy exchange resulting in fatal injury, and the role of management in controlling how these factors interact.

On July 25, 1987, while a 35-year-old male mechanic was working (in a concrete vault) in an attempt to regulate the pressure in an 8-inch steam line, a strainer on the steam line ruptured. The victim was trapped in a blocked passageway by the escaping hot steam and died as a result of asphyxiation.

Contacts/Activities:

State officials of the Occupational Safety and Health Program notified DSR of this fatality and requested technical assistance. On September 11, 1987, a safety specialist from DSR conducted a site visit, met with the OSHA compliance officer, a police department official, and company officials, and photographed the incident site.

Overview of Employer's Safety Program:

The company which employed the victim manages a small utility operation which generates and distributes steam. The company, which employs 61 full-time and 5 part-time workers, does not have a formal written safety program nor written confined space entry procedures. Training is provided on-the-job and employees are told to "work safely."

Synopsis of Events:

There were no eye witnesses to this incident. The following scenario was developed from an evaluation of the incident site, and from discussions with the vice-president and other management personnel of the company, co-workers, and the state OSHA compliance officer assigned to the case.

On July 25, 1987, a mechanic (the victim) in the company's customer service department was dispatched to complete a service call. The victim was to reduce the pressure in an 8-inch steam line from approximately 150 pounds per square inch (psi) to 30 psi (the customer's specifications). The steam line is located in a concrete vault measuring 10 feet deep by 9 feet wide by 15 feet long. The top of the vault is covered with removable sections of steel grating. At one end of the vault, a 200-foot passageway leads to the basement of the customer's establishment. A louvered door used for ventilation is located approximately 75 feet into this passageway. Part of the doorway can be opened from the customer's side.

The victim arrived at the site and removed several sections of grating from the top of the vault. A ladder was lowered into the vault for entry. Once inside the vault the victim apparently opened a hand-operated valve on the 8-inch steam line. As the steam (366 degree F) started surging through the line, the 4-inch strainer, located approximately 1 foot downstream of the 8-inch valve, ruptured.

When the strainer ruptured, hot steam escaped and filled the vault area. In an attempt to escape the steam, the victim proceeded down the passageway until he encountered the louvered door. Unfortunately, the door could only be opened from the customer's side. The victim apparently tried to break through the door, but died as a result of asphyxiation.

Employer, fire department, police department, and rescue squad personnel responded. The steam line was deactivated and the fire department used two fans to vent the passageway. The victim was located approximately 30 minutes after the fans had been started. Firefighters carried the victim to the customer's basement area where he was pronounced dead. A subsequent investigation disclosed that faulty engineering design, due to erroneous expansion and flexibility calculations, was a contributing factor in the rupture of the strainer.

Cause of Death:

The medical examiner reported the cause of death as asphyxiation.

Recommendations/Discussion:

Recommendation #1: Employers should develop and implement comprehensive safety programs. As part of this written safety program, the employer should develop procedures for entry and work in or around confined spaces.

Discussion: Since the employer does not have a written comprehensive safety program, rules and procedures addressing the hazards associated in work of this nature should be developed, implemented, and enforced. Procedures for entry and work in confined spaces should also be developed, implemented, and enforced. One procedure which may have prevented this death is having a designated standby person. This person could have alerted others to open the louvered door to allow the victim to escape. Another relevant procedure is having rescue and emergency procedures established if a worker is in immediate danger of injury or death while in the confined space. The worker should have been provided a self-contained breathing apparatus prior to his entry into the confined space. Use of an alternate air source would probably have prevented this death.

To aid in the development of confined space entry procedures, the vice-president of the company was provided the following:

- A Guide to Safety in Confined Spaces. DHHS (NIOSH) Publication No. 87-113.
- A NIOSH Alert on Confined Spaces. "Request for Assistance in Preventing occupational Fatalities in Confined Spaces," DHHS Publication No. 86-110.
- Braddee, R.W., Pettit, T.A. "Warning-Posting of Confined Spaces." Professional Safety, February 1987.

Recommendation #2: Employers should maintain equipment in proper operating condition.

Discussion: Steam traps are designed to remove excessive water condensate from piped steam. A steam trap located upstream from the strainer which ruptured was found to be partially plugged. A poorly operating steam trap might have contributed to the generation of pressure due to water condensate buildup. The employer should institute a preventive

maintenance program based on periodic inspection to ensure that all equipment is fully functional.

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