



The National Institute for Occupational Safety and Health (NIOSH)

Promoting productive workplaces
through safety and health research



Three Construction Supervisors Die from Asphyxiation in Manhole

FACE 8836

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 August 19, 1988, a 31-year-old male assistant construction supervisor (victim) entered an oxygen-deficient manhole to close a valve and collapsed at the bottom. In a rescue attempt a labor foreman (male, age 34) and the victim's supervisor (male, age 36) also entered the manhole and also collapsed. All three workers were pronounced dead at the scene by the county coroner.

CONTACTS/ACTIVITIES

State health department officials notified DSR of this fatality and requested technical assistance. On September 1, 1988, a DSR research industrial hygienist and a medical officer from the Centers for Disease Control conducted a site visit, met with employer representatives, discussed the incident with the OSHA compliance officer, and photographed the incident site.

OVERVIEW OF EMPLOYER'S SAFETY PROGRAM

The employer, a construction company with 225 employees, employs approximately 145 laborers and 80 supervisory and clerical employees. The company is the prime contractor on large construction projects and subcontracts most of the excavation, concrete, and paving work.

The company has a written safety program but does not have any policy or procedures on confined space entry. New employees receive a brief orientation on the company safety program from the foremen. Construction superintendents are required to conduct weekly safety "tool box" meetings with workers.

SYNOPSIS OF EVENTS

The company had been contracted to construct an industrial park consisting of an office complex and decorative landscaping with a large plastic-lined pond. The pond was designed so that the water level in the pond could be controlled by opening or closing a gate valve in a 12-inch diameter drain pipe. The drain pipe with the gate valve was installed on a concrete pad at the bottom of a manhole near the edge of the pond. The manhole, measuring 24 feet deep with an inside diameter of 4 feet and a 24-inch opening, was completed in January, 1988.

By early July 1988, the company had almost completed construction of the industrial park; however, some general clean-up and repair work continued until August 19, 1988, which was to be the company employees' last day at the construction site.

At approximately noon on the day of the incident a laborer working on the pond heard the construction supervisor tell the victim to enter the manhole and close the gate valve in preparation for filling the pond. The laborer noticed the labor foreman standing above the manhole as the victim entered. The manhole atmosphere had not been tested or ventilated before entry. Shortly after reaching the bottom the victim collapsed in about 12 inches of water. As observed by the laborer, the labor foreman yelled to the superintendent (who was about 100 feet away) that something was wrong with the assistant superintendent (victim), and that he (the labor foreman) was going down into the manhole. The labor foreman entered the manhole and was followed into the manhole by the superintendent who had rushed over to help. Presumably, some time after entering both the labor foreman and superintendent also collapsed.

The laborer who had witnessed the supervisors enter the manhole continued working inside the pond until about 40 minutes later when he became concerned and went to the manhole. When he looked into the manhole he saw the three men collapsed at the bottom.

The police and fire departments were immediately notified and a rescue squad arrived within approximately 15 minutes. Firefighters, wearing self-contained breathing apparatus (SCBA), entered the manhole and removed the workers. The three workers were later pronounced dead at the scene by the county coroner.

Four hours after the incident, the manhole atmosphere was tested by a private analytical laboratory. Results of the tests showed oxygen levels from 18.5% to 20% and methane at 300 to 600 parts per million (ppm) at depths from 12 to 15 feet. Decomposing organic material in the water at the bottom of the manhole may account for the methane production and oxygen consumption.

On September 1, 1988, (after the manhole had been closed for 8 days) the manhole atmosphere was tested for oxygen (O₂), hydrogen sulfide (H₂S), and combustible gases (percent of the lower explosive limit or % LEL) during the investigation by the DSR industrial hygienist. Results of these tests are as follows:

| Depth | O ₂ | H ₂ S% | LEL |
|-------|----------------|-------------------|----------|
| 10' | 18.4% | negative | negative |
| 14' | 16.7% | negative | negative |
| 18' | 16.1% | negative | negative |
| 22' | 15.2% | negative | negative |

CAUSE OF DEATH

The medical examiner listed the cause of death for all three workers as asphyxiation due to lack of oxygen. The initial victim (assistant construction superintendent) and the first rescuer victim (labor foreman) showed signs of being submerged in water.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: The employer should develop and implement specific procedures for confined space entry.

Discussion: According to the employer, company employees are not usually required to enter manholes. However, as illustrated in this incident, the assistant construction superintendent did enter a manhole under the direction of his supervisor. In addition to manholes, it is reasonable to expect that the employer could encounter other types of confined spaces in the construction business. The company should therefore develop and implement a confined space entry program as outlined in NIOSH publications 80-106, "Working in Confined Spaces," and 87-113, "A Guide to Safety in Confined Spaces." Minimally, the following items should be addressed:

1. Is confined space entry necessary? Can the assigned task be completed from the outside?
2. Has a confined space safe entry permit been issued by the company?
3. Are confined spaces and confined space procedures posted where they will be noticed by employees?
4. If entry is to be made, has the air quality in the confined space been tested for safety?
 - Oxygen supply at least 19.5%
 - Flammable range less than 10% of the lower explosive limit
 - Absence of toxic air contaminants
5. Have employees and supervisors been trained in the selection and use of personal protective equipment and clothing?
 - Protective clothing
 - Respiratory protection
 - Hard hats
 - Eye protection
 - Gloves
 - Life lines
 - Emergency rescue equipment
6. Have employees been trained for confined space entry?
7. Are confined space safe work practices discussed in safety meetings?
8. Have employees been trained in confined space rescue procedures?
9. If ventilation equipment is needed, is it available and/or used?

10. Is the air quality tested when the ventilation system is operating?

Three company supervisors entered a manhole without regard to basic confined space safe work practices. As a result, all three died. This underscores the importance of ensuring that supervisors as well as laborers engaged in the construction, operation, and maintenance of manholes and other confined spaces are adequately trained. This training should focus on the recognition and awareness of confined space hazards that construction workers may encounter, as well as confined space safe work practices. The three fatalities could have been prevented if these recommendations had been followed.

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