The National Institute for Occupational Safety and Health (NIOSH)

Promoting productive workplaces through safety and health research

Two Supervisors Die in Manhole in South Carolina

FACE 8801

Introduction:

The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR) is currently conducting the Fatal Accident Circumstances and Epidemiology (FACE) Project, which is focusing primarily on work-related fatalities. The purpose of the FACE program is to identify and rank factors that influence the risk of fatal injuries for selected employees.

On August 11, 1987, a city wastewater treatment plant supervisor (victim) entered a manhole that had an oxygen deficient atmosphere and collapsed. The victim's two supervisors entered the manhole in a rescue attempt. One of the victim's supervisors was soon overcome and also collapsed (rescuer victim). The other supervisor managed to climb back out and call for help. Both victims were pronounced dead at a local hospital.

Contacts/Activities:

Officials of the Occupational Safety and Health Program for the State of South Carolina (State OSHA) notified DSR concerning this fatality and requested technical assistance. This case has been included in the FACE Project. On October 15, 1987 a DSR research team (a research industrial hygienist and an epidemiologist) visited the site of the accident, photographed the site, met with the assistant city manager and the public utilities superintendent, and conducted interviews with workers.

Overview of Employer's Safety Program:

The employer in this incident is a small municipality which has 208 employees. The victims worked for the public works department which has 36 employees. This department is mainly responsible for the city water system, sewer system, wastewater treatment plants, garbage collection, streets, and general city maintenance. The victims in this incident were the wastewater treatment plant supervisor and the public works director.

The city had a written safety policy and written confined space entry procedures at the time of the incident which, if followed, would have prevented the two fatalities. A monthly safety meeting is conducted among the public works department employees. The public works director and public utilities superintendent are both responsible for safety training. Safety training, which includes safe work practices for confined space entry, is well documented in the training that wastewater treatment plant operators received at a local technical college (in order to become certified as wastewater

treatment plant operators). The wastewater treatment plant supervisor had received the highest level of certification possible (Class A certification). Some employees in the public works department had been trained in the use of self-contained breathing apparatus (SCBA's) one week prior to the incident. (The public utilities superintendent, however, had not received this training.) SCBA's are available at the wastewater treatment plants and ventilating fans and hydrogen sulfide direct reading detector tubes are available at the sewer system pump stations.

Since the incident, the city has been sponsoring regular training in confined space safety at the local technical college for public works employees.

Synopsis of Events:

Six days prior to the accident, the public works director met with the city manager to discuss problems with the effluent quality at one of the city's two wastewater treatment plants. Subsequent discussions with the city's consulting engineering firm, the public utilities superintendent and wastewater treatment plant supervisor led to a decision to collect a water sample from a horizontal pipe that connects two manholes located approximately 100 yards apart at a wastewater treatment plant. Between the manholes is a series of sand filtration beds. Both manholes are eight feet deep, five feet in diameter and have a 24 inch diameter covered "manway" opening at ground level.

On August 11, 1987, the director (age 38) met the plant supervisor (age 27) at the wastewater treatment plant. Although there were no eye witnesses of the events preceding the accident, information available suggests that the director entered the manhole at the north end of the filter beds while the plant supervisor stood by observing. While at the bottom of the manhole, using a sampling jar attached to the end of a sewer rod, the director fished the jar into the pipe to a probable distance of 50 to 100 feet. While performing this task, the director observed an accumulation of sand in the pipe. Upon exiting the manhole the director called for the sewer vacuum truck to come to the plant to clean the sand from the pipe. The superintendent, (who was away from the plant at the time) hearing the call on his radio and thinking that he was being summoned, drove to the plant.

After the superintendent arrived at the plant the three men drove to the manhole at the south end of the sand filtration beds. A decision was made to enter that manhole in order to determine if there was also sand at that end of the pipe. The manhole cover was removed and remained off for several minutes. Then the plant supervisor entered the manhole with a flashlight to look into the horizontal pipe at the bottom. At that time the director and the superintendent heard a splash, so they looked down into the manhole and saw that the plant supervisor had collapsed. The director said, "Quick, we need to get down there and get him out." The two men descended into the manhole, grabbed the plant supervisor and lifted his head out of approximately six inches of water. Within seconds the director shouted, "Get out, get out quick!" The superintendent managed to ascend the manhole ladder rungs and as he reached the top felt slightly light-headed. He looked back and saw that the director had also collapsed. .

The superintendent called the city fire department rescue squad and then summoned two plant operators (operators #1 and #2 who were working nearby at the plant) to come help. The superintendent directed operator #1 to retrieve an SCBA located at the plant chemical building. Upon arrival at the manhole, the superintendent and operator #2 helped operator #1 put on the SCBA and enter the manhole. While operator #1 descended into the 24 inch diameter "manway" opening, the air hose on the SCBA was somehow damaged and, as a result, when he reached the bottom, the air hose disconnected from the air tank. Because of the damaged hose, operator #1 climbed back out and the three of them (the superintendent and operators #1 and #2) waited until fire department personnel arrived, which was approximately five minutes after the director collapsed. Upon arrival, two fire department rescuers donned SCBA's and entered the manhole. Using ropes and harnesses the fire department rescuers removed the director and plant supervisor (victims) from the manhole and began administering cardiopulmonary resuscitation (CPR). County EMS personnel then arrived and continued CPR for approximately ten minutes at the accident site. The victims were transported to a local hospital where the plant supervisor was pronounced dead on arrival and the director was pronounced dead one hour later by the attending physician.

The following day while conducting an investigation of the incident (and also several days later), personnel from the State OSHA tested the atmospheres inside both manholes for oxygen (02), hydrogen sulfide (H2S), and flammable atmosphere, and obtained the following results:

North Manhole South Manhole (Tested several days after (Site of Fatalities, tested incident) one day after incident)

02 12.8% 11% H2S Negative Negative Flammable Negative Negative atmosphere

Cause of Death:

The coroner listed the cause of death for both victims as asphyxiation.

Recommendations/Discussion

Recommendation #1: The employer should implement a comprehensive safety review program of the existing safety policy and procedures.

Discussion: Although the municipality had a written safety policy and written confined space entry procedures, they were not followed. The fact that three supervisors (the public works director, the public utilities superintendent, and the wastewater treatment plant supervisor) entered a manhole (resulting in the death of the public works director and wastewater treatment plant supervisor) without regard to basic confined space safe work practices underscores the importance of assuring that workers and supervisors who are engaged in the operation and maintenance of sewer systems and wastewater treatment plants are trained sufficiently in the recognition and awareness of confined space hazards they may encounter in the daily performance of their duties. One paragraph from the municipality's confined space entry procedures states:

"In all confined spaces the atmosphere shall be tested with the gas monitor prior to anyone descending into the confined space. Do not descend into the confined space unless you get a clean test."

However, State OSHA interviews with public utility personnel revealed a common belief in a false notion that regular manholes are not a problem because of the sewer vent pipes provided at each home and building in the city. An effective training program directed at dispelling such dangerous misconceptions is imperative in order to promote worker safety. The established written safety policy and procedures were sufficient to have prevented the incident if they had been followed, but they were not fully implemented and practiced. Implementation of a program for confined space safety should minimally include the following:

1. Posting of confined spaces and confined space procedures where they will be noticed by employees.

2. Regularly scheduled safety policy meetings (bi-weekly or monthly) to reinforce the safety policy and confined space entry procedures.

3. Review process for allowing employees to make recommendations or improving written policies and procedures.

4 Employer monitoring of tasks assigned to employees to assure the implementation of safety policies.

5. Emergency rescue procedures.

6. Availability, storage and maintenance of emergency rescue equipment.

Recommendation #2: Employers should enforce safety procedures.

Discussion: Supervisors in the Public Works Department of this municipality did not routinely follow the established confined space entry procedures. Employers must enforce established procedures and continuously monitor work practices. Minimally, employers should insure that the following confined space safe work practices are not only addressed in the company safety policy, but also implemented on the job:

I. Is confined space entry necessary? Can the task be completed from the outside?

2. Has a company safe entry permit been issued?

3. If entry is to be made, has the air quality in the confined space been tested?

- oxygen supply at least 19.5%
- Flammable range less than 10% of the lower flammable limit
- Absence of toxic air contaminants

4. Have employees and supervisors been trained in selection and use of personal protective equipment and clothing?

- Protective clothing
- Respiratory protection
- Hard hats
- Eye protection
- Gloves
- Life lines
- Emergency rescue equipment

5. Have employees been trained for confined space entry?

6. Have employees been trained in confined space rescue procedures?

7. If ventilation equipment is needed, is it available and/or used?

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

The two fatalities would have been prevented if these recommendations had been followed. Specific recommendations regarding safe work practices in confined spaces can be found in NIOSH publications 80-106, “Working In Confined Spaces”, and 87-113, “A Guide to Safety in Confined Spaces”.

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