

Police Officer Drowns After Being Overcome by Hydrogen Sulfide While Attempting Rescue of Construction Worker

SUMMARY

On August 26, 1992, a 30-year-old male police officer drowned after being overcome by hydrogen sulfide gas when he attempted to rescue a construction worker who had been overcome by the gas in a 27-foot deep excavation. Hydrogen sulfide was released when construction company workers drove a piling into marshy ground near the ocean. New Jersey FACE investigators concluded that, in order to prevent similar occurrences in the future, the following recommendations should be followed:

- **All excavations with the potential to contain an oxygen deficient or hazardous atmosphere should be monitored by the company controlling the site before personnel entry and periodically during the job to ensure that the atmosphere remains safe.**
- **Employers controlling the excavation site should provide, and ensure that employees use, fall protection and safety harnesses with retrieval lines.**
- **Police, rescue and fire departments should implement a general safety program designed to help rescuers recognize, understand, and control hazards affecting them in accordance with 29 CFR 1910.120(q).**

INTRODUCTION

On August 26, 1992, NJDOH FACE personnel learned about this work-related death from a NJDOH staff member. Investigations of the incident were conducted that day by a federal OSHA compliance officer, a NJ Department of Labor, Public Employees Occupational Safety and Health (PEOSH) safety inspector, and several other enforcement agencies. A NJDOH FACE staff member and NJ Department of Health, PEOSH industrial hygienist visited the site on August 27, 1992.

The victim's employer was a municipal police department that employed 22 police officers plus other full and part time workers. During the summer months the department doubles in size. The 30 year-old police officer had been with the department for nine years. There was no safety officer; one officer was in charge of emergency response. Emergency response did not include excavation rescue procedures; no one on the staff had this type of training.

Information for this report was derived from federal OSHA, NJDOH PEOSH, NJDOL PEOSH, the police department's report, county medical examiner's report, newspaper articles, and interviews with witnesses.

Although, in terms of enforcement, the site of this fatality was defined as an excavation, it also meets the NIOSH definition of a confined space. NIOSH defines a confined space as a space which has any one of the following characteristics: limited openings for entry and exit, unfavorable natural ventilation which

could contain or produce dangerous air contaminants, and which is not intended for continuous employee occupancy. Because of this, a FACE investigation was conducted.

INVESTIGATION

The site of the fatality was on a coastal barrier island on which a sewer pumping station was being built. A pit 27 feet deep and 15 feet wide by 15 feet long had been dug in marshy ground to accommodate this. Due to the nature of the land, pockets of hydrogen sulfide gas are common and are generally referred to as swamp gas, marsh gas, or meadow gas.

The pit was shored with vertical steel sheeting that extended above the excavation from ground level to three feet above the earth. A ledge (a 14 inch horizontal steel beam) called a "wale" was constructed about a foot from the top (See diagram). An unsecured ladder was used to gain access from the top wale to a second wale, about ten feet from the bottom of the excavation. Another unsecured ladder connected the second wale with the bottom of the pit, which was lined with gravel. The ladders were located at the east and north sides of the excavation. A pump was activated to continuously pump water out of the hole; turning the pump off would result in the hole filling with water. Construction at this site had been on-going for more than four months.

On August 25, the day before the fatality, a construction company worker fell 27 feet to the bottom of the pit and was severely injured. Police officers and rescue personnel who responded to the incident site, used ladders to descend to the bottom of the dry pit, treated the victim, and successfully removed him from the pit using a stokes basket hoisted by the crane at the site. None of the construction workers wore fall protection or were attached to retrieval lines to facilitate evacuation. The company had no form of rescue equipment at the site. The victim was air lifted to the regional trauma center.

On August 26, a hot, humid day, construction work at the site began around 7 a.m.. Workers were driving the test piling into the base of the pit for the foundation of the sewage pumping station. They first used a water jet to dig the hole and then set the piling in place. They then attached hammering equipment, planning to hammer the piling into the ground. Workers were in and out of the excavation and reportedly described "boiling" of water and sand at the base of the piling (presumably from the release of gases). They noticed that they became short of breath at times and smelled gas as they went into the bottom of the pit. Two construction company members left the site to try to obtain a blower to attempt to ventilate the 27-foot pit. A foreman remembered he had a gas detection badge in his personal vehicle. He had worked for the company in May, 1992, when badges were allegedly distributed (See recommendation # 1). He put on the badge and a cartridge respirator that was in his personal vehicle; he later noticed that the badge contained no paper, so he took it off.

Around 9 a.m., realizing that the boiling (which could lead to collapse of the excavation) was serious, the foreman alerted the crew. The hammering equipment was removed and workers were summoned out of the pit. The water pump was turned off to allow the pit to fill with water to attempt to hold the bottom of the excavation. A laborer (worker #1) returned to the pit bottom to retrieve the water jet that was tied to the lower wale and was overcome by the gas. Reportedly, he had been warned by another worker to be careful because of the gas. Worker #2 went into the pit to rescue him and was also overcome and became unconscious when he reached the second wale. A third worker (a foreman) rode the ball of the crane to rescue the first worker from the bottom of the pit. He attached the crane hook to him and he and the unconscious laborer were lifted from the pit.

The sequence of events of the rest of the morning is unclear. Apparently another construction company member had descended to the second wale to attempt to help worker # 2 but was forced by his own physical symptoms to leave the excavation. Someone dropped a two-inch jack hammer air hose, powered by a compressor pump, into the excavation to attempt to assist this victim.

A 911 call was received by the police department stating that a man had "collapsed in the hole again." No mention was made of a gas release. The police dispatcher alerted police officers to respond and then dispatched the rescue squad. A rescue squad officer immediately requested a call for fire equipment, remembering the rescue in the "hole", as they referred to the excavation, the day before. They thought that this was the same type of event.

A police officer was the first responder to the scene, followed by two other policemen and other municipal employees. The three officers, including the victim, and many of the other rescuers were at the site the previous day. The first responding officer observed an unconscious construction worker being hoisted out of the pit by the crane and his co-worker. Attending to the worker, who quickly responded to CPR, the officer directed an emergency medical technician (EMT) to stay with him. The officer then observed another laborer lying unresponsive on the lower wale in the excavation. The site apparently was one of great confusion. The police officer-victim, who was the second responder to the scene, descended to the second wale using an unstable, aluminum ladder. The first officer made a hurried radio transmission that there was gas in the area and then, after his fellow officer was off the ladder, he too climbed down the ladder to the second wale. A third officer steadied the ladder because they remembered its instability during the previous day's rescue.

No one at the site attempted to stop the officers from entering the pit. The foreman who had saved his co-worker was now also ill and incoherent from inhaling the gas. The man who entered the pit to assist the fallen worker was also ill. The other laborers had left the area. One member of the construction company reportedly did try to tell people that there was gas present; the rescuers may have already descended into the pit and there was a great deal of confusion at the area.

On the lower wale, the police officers used the air hose to supply air to worker # 2, who was unconscious on the ledge. A third rescuer started to descend into the excavation but, before reaching the ledge, smelled gas and recognized it from other sites as hydrogen sulfide. He immediately warned the others, directed them to evacuate, and climbed out of the pit. It was not until this point that they were aware of the gas and realized they needed to get out. Another rescuer realized that symptoms being displayed by so many persons were caused by gas inhalation and began yelling loudly to alert others that there was gas present.

The two officers realized they could not do any more for the unconscious worker and that they needed to save themselves. One police officer was able to successfully ascend the ladder but needed a lot of assistance to climb out of the excavation because he was experiencing physical symptoms of weakness and lack of coordination from inhaling the gas. The victim delayed a few seconds, holding the air hose to the face of the unconscious construction worker. He attempted to climb the ladder but, also experiencing weakness from the gas, he fell, missed the ledge, and landed on the bottom of the excavation. By then there was about four inches of water in the pit. As co-workers and rescuers watched helplessly, the victim attempted to respond to their shouted directions to attach the chain of the crane around his waist. Progressively more disoriented and weak, the victim was unable to do so. Water was rising in the pit (the pump was turned off) and the officer turned over and drowned. He was evacuated from the pit by fire fighters wearing air-packs who attached him to the crane. The unconscious construction worker was also evacuated by the crane after fire fighters attached the chain around him.

CPR on the police officer was unsuccessful. The rescue teams were met by paramedics on a highway and the police officer and the seriously injured construction worker were administered advanced life support in separate ambulances. The police officer was further treated at the local emergency room but without success; he was pronounced dead at the hospital. The unconscious construction worker was admitted to the hospital where he remained in a coma for five days. He was transferred for further treatment to a hospital in another state. In addition to the victims who were seriously injured or killed, many of the rescuers were also ill, experiencing weakness and vomiting. Although symptomatic, they continued to assist with the rescue. Four others were hospitalized for at least one night. Several police officers and rescue workers were treated and observed in the hospital emergency room. More than thirty area residents were observed in the emergency room.

Hydrogen Sulfide (H₂S) is a colorless, extremely toxic gas that has the odor of rotten eggs. The odor is detectable at levels as low as 0.13 parts per million (ppm), but there is a temporary loss of smell (olfactory fatigue) at levels of 100 to 150 ppm. The olfactory fatigue can lead to the mistaken belief that the gas has cleared. Exposure to levels above 300 ppm can cause coma in less than 20 minutes while 500 ppm can cause staggering and unconsciousness within 5 minutes. Exposure to levels over 1,000 ppm can result in nearly instant coma and death. Inhalation of hydrogen sulfide may also cause pulmonary edema (a buildup of fluid in the lungs) 24 to 72 hours after exposure. Heavier than air, it tends to accumulate in low areas, such as the bottom of an excavation.

It is unknown what gases and their concentrations existed at the time of the fatality. To ensure the safety of investigative personnel at the site, air monitoring was performed by a member of the NJ Department of Environmental Protection and Energy four hours after the event. Monitoring was done by remote instrumentation at the surface of the three feet of water in the pit. Twenty-two ppm of hydrogen sulfide was detected. The oxygen level was detected slightly below normal. The methane concentration was not determined.

CAUSE OF DEATH

The medical examiner determined that death was caused by asphyxiation due to drowning associated with cerebral hypoxia and environmental anoxia.

RECOMMENDATIONS/DISCUSSIONS

Recommendation #1: All excavations with the potential to contain an oxygen deficient or hazardous atmosphere should be monitored by the company controlling the site before personnel entry and periodically during the job to ensure that the atmosphere remains safe.

Discussion: In May, 1992, while installing a manhole in the road in front of the construction site, a complaint was made by a resident to the county department of health because of a smell of "rotten eggs and ammonia" in the area. The county health inspector noted a slight smell of rotten eggs, that he called typical of hydrogen sulfide. A construction company representative assured the inspector that air monitoring equipment would be used on-site. An OSHA compliance officer presented a training session to the company on excavations and their hazards but on the day of the fatality, no monitoring equipment was in use, and had not been in use, at the site. One worker who had been with the company in May had

a badge used to detect hydrogen sulfide in his vehicle. He was not wearing it but was able to locate the badge during this event and put it on. However, it did not contain any of the gas-detectable paper media. It appears that few of the other construction workers, many of whom had limited use of the English language, had received any training in excavation hazards.

If air monitoring had been on-going, hydrogen sulfide and other gases would have been detected before reaching dangerous levels. Workers could have been removed from the excavation along with any tools, which would have prevented the need to have any rescuers on the site. According to 29 CFR 1926.651(g)(i), this was an area in which a hazardous atmosphere could be expected to exist, and as such, air testing should have been performed.

The standard 29 CFR 1926.651(g)(2) requires emergency rescue equipment such as breathing apparatuses or safety harnesses and lines to be available. If construction workers wore safety harnesses and retrieval lines, it would have facilitated immediate rescue of the workers from the excavation.

Recommendation #2: The employer controlling the excavation site should provide, and ensure that employees use, fall protection and safety harnesses with retrieval lines.

Discussion: If adequate fall protection had been provided by the construction contractor, the serious injury of the construction worker on the previous day could have been prevented. If safety harnesses with attached retrieval lines had been worn by workers in this 27-foot deep excavation with limited means of entrance and exit, the stricken laborer could have been rescued and immediately removed from the hazardous area of the pit. There would have been no need for police officers and other emergency responders to have entered the excavation.

Recommendation #3: Police, rescue, and fire departments should implement a general safety program designed to help rescuers recognize, understand, and control hazards affecting them in accordance with 29 CFR 1910.120(q).

Discussion: Although the police officer radioed that there was gas present, it appears that the officers did not recognize what type of gas was present, nor did they have knowledge of the hazards of toxic gases. They apparently were not informed about the gas by the construction laborers and no one attempted to stop them from entering the pit. Others who could have warned them were too ill at the time to do so.

All rescue personnel should have thorough training in the potential hazards of excavations or confined spaces. Because police officers and other rescuers must often respond to situations that are uncontrolled and chaotic, their training should be thorough enough that they are able to immediately recognize the dangers of the situation. Rescuers are trained to help others but they should be able to recognize environmental situations in which they must overcome their urge to act immediately and instead first assess the danger to themselves as well as others.

The NJDOH PEOSH program recommended that the NJDOL cite the police department with allegedly being in violation of 29 CFR 1910.120(q)(8)(i). Employees did not receive first responder awareness refresher training.

REFERENCES

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FATALITY ASSESSMENT CONTROL AND EVALUATION (FACE) PROJECT

Staff members of the FACE project of the New Jersey Department of Health, Occupational Health Service, perform FACE investigations when there is a work-related fatal fall, electrocution, or confined space death reported. The goal of these investigations 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.

To contact [New Jersey State FACE program personnel](#) regarding State-based FACE reports, please use information listed on the Contact Sheet on the NIOSH FACE web site. Please contact [In-house FACE program personnel](#) regarding In-house FACE reports and to gain assistance when State-FACE program personnel cannot be reached.