



The National Institute for Occupational Safety and Health (NIOSH)

Promoting productive workplaces
through safety and health research



Power Company Worker Electrocuted in Underground Utility vault

FACE 8816

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 March 11, 1988, an overweight, 35-year-old male cable splicer was electrocuted when he contacted an energized pipe that was connected to a 220-volt sump pump.

Contacts/Activities:

Officials of the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA), notified DSR concerning this fatality and requested technical assistance. On April 20, 1988, a NIOSH research team met with the OSHA compliance officer and discussed the incident, conducted a site visit, collected incident data, photographed the incident site, and met with employer representatives and co-workers of the victim.

Overview of Employer's Safety Program:

The victim was a lead cable splicer employed by a power company that has approximately 14,000 employees. The victim worked in the company's Network Underground Division, which has 176 workers. Most of these workers (including 24 cable splicers) perform maintenance work on the underground components of the utility system.

The company has a safety and health department, an industrial hygiene department, a written safety policy, and specific written safety procedures for electrical work and confined space entry. Division-level and local employee safety committees conduct monthly safety meetings, formal safety training sessions, and weekly "tailgate safety meetings." A formal training session on electrical and confined space safety, conducted approximately 2 1/2 months prior to the incident, was attended by the victim.

Synopsis of Events:

The incident site was an underground transformer vault located in the downtown area of a large city. The concrete vault measuring 80 feet long, 10 feet wide, and 12 feet deep, lies beneath an alley between two large buildings. The vault is covered on top with concrete and steel grating (the grating covers approximately 20% of the top) which form part of the driving surface of the alley. Located on the top (at each end and in the middle) are three 27-inch-diameter manhole openings, equipped with vertical, steel ladders attached at the top and embedded in the concrete at the bottom of the vault.

The vault houses eight 480-volt transformers. Two 220-Volt sump pumps (one at each end) were originally installed to remove water that accumulates in the vault. Each pump is designed to operate by means of a float valve switch mechanism, with water intake pipes submerged in a sump well 18 inches square and 15 inches deep below the vault bottom.

Electric power is supplied through an underground 220-volt cable. The power cable enters the vault and passes through two fuse boxes (located about half-way up the side of the vault), one serving the sump pumps and one serving lighting along the vault coiling. When the pumps were installed, an effective electrical ground was not provided. Later (about five years prior to this incident), an electrical short circuit developed inside one of the pump motors, blowing the fuses and de-energizing the pumps. The company decided not to repair the sump pumps, but to periodically pump water from the vault with truck-mounted pumps. Despite the decision not to repair the pumps, the fuse box, wiring, pumps, and piping were not removed.

Over time the "moisture-proof" fuse boxes filled with condensated water and became heavily corroded. The corrosion bridged across the blown fuses, re-energizing the sump pumps and the pump frame and water discharge pipe of the short-circuited pump at a level of approximately 120-volts. On March 11, 1988, two power company employees, a lead cable splicer (the victim) and a winch truck operator (co-worker) were inspecting the circuit protectors on the transformers in the vault. The victim and co-worker arrived at the vault at about 8:30 a.m. Since the vault had approximately 33 inches of water in the bottom, the victim put on rubber hip waders, removed the manhole cover at the east end of the vault, and entered the vault with a flashlight. While the victim was checking the circuit protectors on four transformers, the co-worker studied an electrical circuit map of the vault. The co-worker also directed vehicular traffic through the alley since there were no traffic cones or guard rails around the open manhole.

At about 8:40 a.m. the co-worker heard "a noise" inside the vault. When he looked into the manhole, he saw the victim facedown in the water, halfway between the ladder and the sump pump (a horizontal distance of about 4 feet). Although the co-worker did not observe the position of the victim immediately prior to seeing him facedown in the water, circumstantial evidence suggests that the victim contacted an energized component of the sump pump (either a metal pipe, part of the housing, or another connected apparatus) with his right hand, and the steel ladder (which was at ground potential) with his left hand. This would have provided the current a path to ground through the victim. Current may have entered his right hand, passed through his chest, and exited his left hand, resulting in his electrocution. Presumably, the victim then fell forward, breaking contact.

In a rescue attempt, the co-worker entered the manhole, descended the ladder, and stretched out one hand and pulled the victim's face out of the water. However, when the co-worker stopped off the ladder onto the floor of the vault he felt a shock, so he stopped back on the ladder. It is believed that since the co-worker was not wearing rubber hip waders his foot was at some level of ground potential when it touched the vault floor. While managing to hold the victim's face out of the water with one hand and the ladder with the other hand, the co-worker called out for help.

Several passersby responded and made several unsuccessful attempts to help the co-worker remove the victim from the vault. However, they were hampered by electric shocks they received from either structural steel beams that crossed the inside of the vault or the vault bottom. Another factor that made rescue difficult was the victim's relatively large size and weight. At least three attempts were made to hoist the victim out of the vault with a handling tied around the victim's chest. Each time, the victim slipped through the rope and fell to the bottom of the vault. One of the passersby made an emergency call on the company truck radio. A policeman arrived and then minutes later paramedics, each attempting to assist in the rescue effort, and each experiencing electric shocks in the process.

According to rescuers, the power company cut off the power to the vault approximately 35 minutes from the time the victim was first observed facedown in the water. Paramedics observed that the victim was “still breathing a little” and had a slight pulse. Shortly after the power was turned off, a manual respirator was lowered into the vault and used in an attempt to resuscitate the victim. Attempts to remove the victim from the vault were unsuccessful until the fire department rescue squad arrived.

Rescuers ultimately succeeded in putting a body harness around the victim and hoisting him out of the vault with the use of a truck-mounted winch. The total time from when the victim was observed unconscious in the vault to when he was removed was estimated at approximately 1 hour and 20 minutes .

Paramedics initiated cardiopulmonary resuscitation (CPR) after the victim was removed from- the vault, and continued to administer CPR while enroute to a local hospital. The victim was pronounced dead on arrival by the attending physician.

Cause of Death:

The cause of death is presumed to be electrocution. The exact cause of death has not yet been verified, pending receipt of the medical examiner's report.

Recommendations/Discussion

Recommendation #1: The sump pumps and pump wiring no longer in use should be disconnected from energized circuits and removed.

Discussion: Electric circuits serving equipment which is no longer operative should be de-energized and removed along with the faulty equipment. The underground circuit to supply the lighting system remained energized and also remained connected to the fuse box serving the pumps. If the company had disconnected the pumps when they first became inoperative and removed the pumps and wiring, this fatality would have been prevented.

Recommendation #2: The company should re-assess its decision to periodically pump the underground utility vault, rather than keeping the sump pumps operable. If periodic pumping is desired, the employer should establish a procedure requiring that accumulated water be pumped out prior to employee entry into vaults.

Discussion: The presence of water in the vicinity of energized electrical apparatus increases the potential for conduction of electrical energy. Also, holes, depressions, loose parts, debris, or other irregularities in the floor surface of the vault which could represent fall hazards, might not be visible to a worker stepping into or walking through standing water.

Recommendation #3: The employer should ensure that each metal piece of equipment that is not designed to conduct electricity be permanently and continuously bonded to a grounding system.

Discussion: The metal sump pump appurtenances, metal vault ladders, beams, etc. were not only installed without effectively being grounded, but also remained ungrounded for 18 years. During those years workers entered the vault numerous times under damp and wet conditions, and were needlessly exposed to this electrical hazard.

Recommendation #4: The employer should develop and implement (1) a method of detecting the existence of ground faults (i.e., a defect in an electrical circuit creating an unintentional path for current to flow to ground), and (2) procedures to follow if a ground fault is detected, prior to employee entry to wet and damp locations where energized, electrical apparatus exist.

Discussion: The victim entered an electrical vault which had energized electrical components submerged in water. The victim was unaware that a ground fault existed within the vault. If ground fault indicators had been installed on the vault circuitry, the victim would have had the opportunity to check an indicator panel for existing ground faults prior to entering the vault. Knowing a ground fault existed in the vault, the victim may have chosen not to enter the area without first pumping the water and donning additional protective insulated gear.

Recommendation #5: The company should re-evaluate, implement, and enforce its confined space rescue procedures.

Discussion: The company had written confined space entry and rescue procedures; however, they were either not practiced, unenforced, or ineffective when attempted. The written procedures outline a confined space rescue method which proved to be ineffective in this case. This rescue procedure for underground utility vaults needs to be re-examined. The vault in this incident was classified by the company as a "Class C confined space, which would not normally require auxiliary ventilation nor isolation procedures to be followed prior to entry. (NIOSH publication 80-106, "Criteria For a Recommended Standard ... Working In Confined Spaces"). The company confined space entry procedures explicitly require that the atmospheres of manholes, vaults, and other confined spaces be tested prior to entry. Hazardous atmospheres in confined spaces are a potential danger, although this did not appear to be a factor contributing to this fatality. The company confined space entry procedures did not address any method for detecting the existence of ground faults prior to entering damp and wet locations such as underground utility vaults.

[Return to In-house FACE reports](#)

Last Reviewed: November 18, 2015

Was this page helpful?