The National Institute for Occupational Safety and Health (NIOSH)

Laborer Electrocuted While Working at Bottom of Dry Well at Sewer Pumping Station

New Jersey Case Report: 90NJ014 (formerly 90NJ010)

October 11, 1991

SUMMARY

On August 28, 1990, a 31-year-old male laborer was killed, apparently as a result of contact with equipment thought to be deenergized. Working at the bottom of a 24-foot deep dry well at a sewer pumping station, the victim backed into the frame of a disconnected heater and apparently received an electric shock of a least 0.53 volts AC, sufficient to have caused an electric shock. Careful monitoring of electrical components in the area revealed ground faults which caused the wall heater frame to be energized. FACE investigators concluded that, in order to prevent similar occurrences in the future, employers should:

- ensure that electrical equipment within pumping stations are periodically inspected and repaired by a licensed electrician conduct a job site survey before starting any job to identify potential hazards and implement appropriate control measures;
- develop and implement an electrical safety program to help workers recognize and control hazards;
- ensure that workers entering a confined space, such as the dry well at the pumping station, observe appropriate safety measures;
- have at least one person assigned the responsibility for overseeing safe work practices and safety education;
- provide training in basic CPR.

INTRODUCTION

On August 29, 1990, a fatal work-related electrocution of a public employee was reported to New Jersey Department of Health FACE personnel by a county medical examiner's office. On August 30, 1990, representative officials from the NJDOH contacted the victim's employer and requested technical assistance from the NIOSH Division of Safety Research. On September 6, 1990, a joint investigation was conducted at the incident site with technical assistance from two FACE investigators from NIOSH. The joint investigation team reviewed the incident with the employer, the victim's co-workers, including the only witness to the fatal incident, and the medical examiner. Photographs and diagrams of the incident site were obtained during the investigation. The employer is a medium size utility authority which employs 13 people and has been in operation for 30 years. The authority maintains eight pumping stations, two treatment plants, and 100 miles of lines. There is no person who has safety management as his or her primary responsibility. The utility authority sends employees to safety and health courses conducted by a larger utility company. Some classes are mandatory for all

workers, such as confined space entry, and some are provided to selected men who are expected to disseminate that knowledge to co-workers. No electrical hazard training is available. There were no written safety procedures applicable to this incident. All field workers, except laborers, are certified or licensed in their specific fields.

No specific emergency response plan was in effect. Each truck is equipped with a two-way radio, which has a range of more than thirty miles. A few portable two-way radios are available. These are used to summon assistance.

INVESTIGATION

On August 28, 1990, a clear, hot, and slightly humid day, the victim and his co-worker, both laborers, were working at the bottom of a 24 foot deep cylindrical dry well at a sewer pumping station (see attached figure). The well is equipped with an automatic ventilator that supplies fresh air to the well. The men did not test the air in the well prior to entry, nor did they wear any equipment to facilitate rescue. They were in the well to assemble a 110 volt sump pump and replace a water line bushing. They used no power tools.

The dry well is 12 feet in diameter at its bottom, with an alcove 10 feet high around the entire circumference. The dry well housed two main water pumps and, a portable sump pump. The electrical power system for the dry well consisted of a main power panel with branch circuit conductors running through flexible electrical metallic conduits to two main pumps, a portable sump pump, hydraulic greasers, a ventilation blower, and a wall-mounted heater (see figure). During the initial interview, the utility authority representative stated that the heating element in the wall heater had been disconnected two years prior to the incident because of an unspecified malfunction. The floor contained no water but the entire area was coated with condensation.

The portable sump pump was lowered into the dry well and installed in its working location. The work of replacing the bushing had been completed; however, the first worker was unable to manually realign and rejoin the water pipes. The first worker, while still bending forward, pivoted to enter the center of the well, where he could stand erect to allow the victim to get in the area. The victim rejoined the water pipes and bent forward to back out of the area. While backing up, the victim pivoted in an opposite direction from the first worker onto a wall heater. The wall heater was supposedly not connected to a power source. He screamed and fell to his side, moaning. His co-worker attempted to move him from the immediate area by grabbing him by his shirt collar. He reported seeing no sparks. The victim, a large man, had been sweating heavily, causing his skin and clothes to be wet. The co-worker immediately climbed out of the dry well and called for help using the two-way radio in their truck parked nearby. Two other utility workers were in the vicinity, responded immediately and turned off the main power source to the well, using above ground controls. This eliminated all ventilation to the interior of the dry well. The two workers entered the well and found the victim lying on his side, moaning and twitching. They were unable to detect a pulse or heart beat and, believing he was breathing, began chest compressions without breathing assistance. A third rescuer, an Emergency Medical Technician (EMT), arrived in about three minutes and began full CPR with chest compressions and rescue breathing. The rescue squad arrived about 4 minutes after receiving the call, followed shortly by the paramedic unit. It was necessary to apply and use a body harness to hoist the victim, who weighed about 300 pounds, out of the well. The opening of the well is 30 by 36 inches. Attempts to defibrillate the victim, after he was removed from the moist environment of the well, were unsuccessful. He was taken to the local hospital emergency room where he was pronounced dead. Extrication from the well was reported to have been completed about 20 minutes after the incident had occurred.

On August 31, an electrician from a private company descended into the dry well and inspected the pump station, checking for voltage, continuity and ground. He found no defect in the electrical systems or equipment.

On September 6, two NIOSH Division of Safety Research investigators descended into the dry well to inspect its interior, including the electrical system.

The investigation at the dry well, initially using a Bert Adams Enterprises ground fault detector (GFD), detected an intermittent ground fault to the rail heater frame and connecting conduit. Further examination of the electrical circuits leading to the wall heater revealed that the Type-T junction electrolet at the branch circuit for the hydraulic greasers was severely corroded. The insulated throat compression connector on the branch conduit to the lip unit/wall heater had separated form the Type-T junction electrolet. At the point of separation, the insulation on the conductors housed by the conduit had been damaged. Cumulative fault voltage of 0.53 volts AC from three separate conductors was detected flowing to the Type-T junction electrolet. Also, a slight surface electrical charge was detected on the conduit leading to the wall heater and on the heater frame.

The electrician who conducted the August 31 examination of these same electrical circuits had reportedly removed the heater core form the wall heater and disturbed the Type-T junction electrolet as part of his examination. An examination of the wall heater core during this investigation detected arcing burn marks on the sides of the white phase conductor and on the interior wall of the wire nut connector. Due to the changes to the wall heater components caused by its removal, the point within the wall heater to which the electrical current was arcing, or when the arcing occurred, could not be determined.

The current flowing from the conductors to the conduit could not be quantified due to the difficulty of introducing probes into the area for such measurements and due to the intermittent nature of the current flows.

The exact condition of the electrical system on the day of the incident could not be determined during this investigation. However, the presence of positive GFD readings, measurable fault voltages, and heater component arcing burn marks indicated that a ground fault existed in the examined electrical equipment within the dry well.

CAUSE OF DEATH

The medical examiner initially listed the cause of death as ventricular defibrillation due to electrical injury. He later stated that the cause of death could not be determined.

RECOMMENDATIONS/DISCUSSIONS

Recommendation #1: Ensure that electrical equipment within pumping stations are periodically inspected and repaired by a licensed electrician.

Discussion: Inspection of all facilities is necessary to ensure the safety of employees who work in these areas. Replacement or repair should be done by an electrician who is qualified by licensure and experience. This should be done on a scheduled, periodic basis.

Recommendation #2: The employer should conduct a Job site survey before starting any job to identify potential hazards and implement appropriate control measures.

Discussion: A job site survey focuses attention on work to be done and on the potential hazards associated with that work. As much as possible, employees should be included in this process. Their inclusion at this level allows incorporation of the workers' point of view which will help make changes understood and acceptable. Planning should be based on results of the job site hazard analysis.

Recommendation #3: The employer should develop and implement an electrical safety program to help workers recognize and control hazards.

Discussion: This employer offered a variety of courses that were pertinent and important to the workers' safety but the list of courses did not include electrical safety. Courses which focus on electrical safety should be included. Testing for ground faults and other safety defects should be a part of such a course and should be offered to workers in all job categories. All workers should be equipped with a ground fault detector to check for ground faults.

Recommendation #4: The employer should ensure that workers entering a confining space, such as the dry well at the pumping station, observe the appropriate safety measures.

Discussion: If the victim had worn, on entry to the well, a body harness with a safety line attached to a winch. rescue and life support would have been easier and quicker. N.J.A.C. 12:100, Subchapter 9, requires that rescue equipment be available nearby. If is not mandated that it is worn.

Recommendation #5: The employer should have at least one person assigned the responsibility for overseeing safe work practices and safety education.

Discussion: Responsibility for safety education and safe work practice that is vested in a specific individual increases the likelihood that appropriate safety training and enforcement of safety and health standards for public employees takes place.

Recommendation #6: Employers should provide training in basic cardio-pulmonary resuscitation (CPR).

Discussion: In the event of an electrical shock, the greatest danger is the disruption of the normal heart rhythm with cessation of breathing and cardiac arrest. Until advanced life support is available, properly administered CPR is the only method of sustaining vital functions.

FATAL ACCIDENT CIRCUMSTANCES AND EPIDEMIOLOGY (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 or electrocution 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.

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