The National Institute for Occupational Safety and Health (NIOSH)

Promoting productive workplaces through safety and health research

Construction Laborer Electrocuted After Handling Damaged Energized Extension Cord in Virginia

FACE 91-05

SUMMARY

A 19-year-old male construction laborer (victim) was electrocuted after handling a damaged extension cord that was energized. The victim, a second laborer, and a foreman were constructing a waterfront bulkhead for a residence at the edge of a lake. Electric power was supplied from an exterior 120-volt, grounded AC receptacle located at the back of the residence. On the day of the incident, the victim plugged in a damaged extension cord and laid it out towards the bulkhead. There were no eyewitnesses of the incident. However, evidence suggests that while the victim was handling the damaged and energized extension cord, he provided a "path to ground," and was electrocuted. The victim collapsed into the lake and sank 4½ feet to the bottom. NIOSH investigators concluded that, in order to prevent future similar occurrences, employers should:

- **ensure that the electrical service for construction sites complies with OSHA standards, NEC standards and local regulations**
- **conduct a jobsite survey before starting any job to identify potential hazards, and implement appropriate control measures, including safety training that specifically addresses all identified site hazards**
- **develop and implement a safety program to help workers recognize and control hazards.**

INTRODUCTION

On October 11, 1990, a 19-year-old male construction worker was electrocuted while handling a damaged electrical extension cord that was energized. On October 22, 1990, officials of the Virginia Occupational Safety and Health Administration notified the Division of Safety Research (DSR) of the death, and requested technical assistance. On December 5, 1990, a research industrial hygienist from DSR traveled to the incident site and conducted an investigation. The DSR investigator reviewed the incident with the company owner, the medical examiner, and the Virginia OSHA compliance officer assigned to this case. Photographs of the incident site were obtained during the investigation.

The employer in this incident is a construction company that has been in business for 10 months. The company builds docks, piers and waterfront bulkheads for private residences. The company employs three full-time employees who are construction workers. The victim had been employed by the company for 3 months. The company has no safety policy, and no written safety program or safe work procedures.

INVESTIGATION

The company owner had assigned a construction crew consisting of a foreman, a laborer (victim), and a second laborer (co-worker) the task of installing a waterfront bulkhead for a private residence. The bulkhead would serve as an erosion control retaining wall (150 feet long) along the rear of the property which bordered a lake (Figure 1).

The workers constructed much of the bulkhead from a floating work platform. The bulkhead consisted of squared timbers stacked horizontally at the water's edge, and secured in place with 6-inch-diameter wooden posts which were driven into the lake bottom against the outboard side of the timbers at 5-foot intervals. The bulkhead was further secured with several pilings 20 feet back from the bulkhead. The workers had planned to drill ½-inch-diameter holes through the bulkhead timbers and posts from the outboard side. Galvanized rods with threaded ends would then be installed and bolted in place, tying the bulkhead to the pilings (Figure 2).

After the bulkhead timbers had been set in place, the workers drilled ½-inch-diameter weep holes (for drainage) in the bulkhead about 6 inches above the surface of the water (Figure 2). To do this, the workers used a 6-amp electric drill.

Electric power for the construction project was supplied from an exterior 120-volt, grounded AC receptacle (with a 20-amp breaker) located at the back porch of the residence (Figure 3). The workers plugged in two 100-foot electrical extension cords to reach the bulkhead where they were using the drill and a circular saw. The receptacle at the back porch was not equipped with a ground-fault circuit interrupter (GFCI), nor did the workers use a portable GFCI device for any of the electric work at the construction site.

One of the extension cords being used had been previously damaged. In an effort to repair the damaged cord, someone had replaced both the original equipment manufactured female receptacle and male plug with splice-on-type units. An examination of the extension cord revealed that the noncolor-coded extension cord wires in the receptacle were cross-wired, thus establishing a reversed polarity condition. In addition, the ground wire inside the plug had pulled loose from its connection. The power tools used at the construction site had been plugged into the receptacle end of this extension cord (Figure 4).

The victim and co-worker had previously complained to the foreman that they had received electric shocks while using the damaged extension cord. In response to these complaints, the foreman removed the cord and placed it in the back of the construction utility truck. However, a few days before the incident the workers resumed using the damaged cord.

The day of the incident occurred about two weeks after the bulkhead construction started. By this time most of the bulkhead had been installed, and the workers were preparing to drill the holes in the bulkhead for the anchor rods. The foreman had previously told the victim to set out the tools and equipment, and that he (the foreman) and the co-worker would join the victim at the site later that morning. At 9:30 a.m. the victim arrived at the construction site and placed the power tools near the bulkhead. The homeowner witnessed the victim plug the good extension cord into the residential outlet. After this, the homeowner went to bed. From this moment on, there were no eyewitnesses of the incident. However, evidence suggests the following sequence of events:

1. The victim plugged the connector end of the damaged extension cord into the receptacle end of the good extension cord.

2. The victim laid out the damaged extension cord (now energized) as he walked toward the bulkhead.

3. As the victim was handling the damaged extension cord, he presumably contacted the receptacle end of the cord. This provided a path to ground for the electrical current, and the victim was electrocuted.

4. The victim collapsed, fell into the lake, and sank 4½ feet to the bottom.

The co-worker and foreman arrived at the site at 10:30 a.m. They noticed the victim's car at the site, and that the tools and extension cords had been set out. The foreman saw the receptacle end of the extension cord in a water-filled hole on the inboard side of the bulkhead. He removed it from the water by pulling on the cord several feet away. The foreman radioed the company owner that the victim was missing. The owner left his office to look for the victim. The foreman and co-worker began working on the bulkhead, thinking that the victim would show up later.

While standing on the floating work platform, the foreman moved the platform along the edge of the bulkhead by pushing off the lake bottom (about 4½ feet deep) with a pole. The pole contacted the submerged victim and he floated to the surface. By this time, the owner had arrived at the site. He assisted the foreman in removing the victim from the water.

The co-worker called the emergency number (911) from a phone at the residence. Two police officers responded to the emergency call and arrived in about 5 minutes. The police officers started cardiopulmonary resuscitation (CPR) on the victim. Rescue squad personnel from the volunteer emergency medical service (EMS) arrived about 3 minutes later and continued CPR on the victim, but were unsuccessful in their attempt to revive him. The local coroner pronounced the victim dead at the scene. It is estimated that the victim had been submerged in the water for about 30 minutes.

CAUSE OF DEATH

The medical examiner listed the cause of death as electrocution.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should ensure that electrical service supplied to a construction site complies with all OSHA standards, the National Electric Code, and local regulations.

Discussion: OSHA Standard 29 CFR 1926.404(b)(1)(ii) states, “All 120-volt, single-phase, 15- and 20-ampere receptacle outlets on construction sites, which are not a part of the permanent wiring of the building or structure and which are in use by employees, shall have approved ground-fault circuit interrupters for personnel protection.” A similar requirement is stated in Article 305-6(a) of the National Electrical Code. Also, OSHA Standard 29 CFR 1926.404(a)(2) states, “No grounded conductor shall be attached to any terminal or lead so as to reverse designated polarity.” Additionally, 29 CFR 1926.404(f)(6) states, “The path to ground from circuits, equipment, and enclosures shall be permanent and continuous.” Compliance with these electrical standards at construction sites is imperative for worker protection. A NIOSH Alert entitled “Request for Assistance in Preventing Electrocutions Due to Damaged Receptacles and Connectors” provides additional information and recommendations pertaining to the use and maintenance of power cords and similar electrical equipment. (A copy of this Alert was provided to the employer.)

Recommendation #2: Employers should conduct a jobsite survey before starting any job to identify potential hazards, and implement appropriate control measures, including safety training that specifically addresses all identified site hazards.

Discussion: Once potential jobsite hazards have been identified, appropriate control measures can be implemented prior to the start of any work. Control measures include the use of GFCI’s, for all power connections, cutting off the receptacle and connector ends of damaged extension cords when they are removed from service, prompt replacement of damaged extension cords with approved extension cords, and using appropriate circuit testing devices to ensure that all power equipment and tools are properly wired. Workers should also be trained in electrical safety, specific to the above hazard control measures.

Recommendation #3: Employers should develop and implement a safety program designed to help workers recognize, understand, and control hazards.

Discussion: OSHA Standard 29 CFR 1926.21(b)(2) states, “The employer shall instruct each employee in the recognition and avoidance of unsafe conditions and the regulations applicable to his work environment to control or eliminate any hazards or other exposure to illness or injury.” Even small companies should evaluate the tasks performed by workers, identify potential hazards, develop and implement a safety program addressing these hazards, and provide worker training in safe work procedures.

REFERENCES

1. Office of the Federal Register, Code of Federal Regulations, Labor, 29 CFR Part 1926.404(b)(1)(ii), 29 CFR Part 1926.404(a)(2), and 29 CFR Part 1926.404(f)(6), U.S. Department of Labor, Occupational Safety and Health Administration, Washington, D.C., July 1989.

2. National Fire Protection Association, National Electrical Code, 1990 edition, Article 305-6(a).

3. National Institute for Occupational Safety and Health, Request for Assistance in Preventing Electrocutions Due to Damaged Receptacles and Connectors, DHHS (NIOSH) Publication Number 87-100, October 1986.

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