TO: Director, National Institute for Occupational Safety and Health

FROM: California Fatality Assessment and Control Evaluation (FACE) Program

SUBJECT: Facilities Journeyman Electrician Electrocuted While Doing Electrical Maintenance Work in California

SUMMARY

California FACE Report #92CA016
November 15, 1993

A 35-year-old white male facilities journeyman electrician (victim) was electrocuted while doing electrical maintenance work on a power mound (transformer) in a shipyard. The power mound provided power to numerous essential power activities including shipboard activities, confined spaces, lighting, and power handtools. The incident site (south power mound) was located outside in the southern portion of the shipyard. This area was wet due to rain on the night of the incident. The maintenance work the victim was doing that evening exposed him to high electrical voltage (12-thousand kilovolts and 600 amps). There was no ground provided for the power mound at this location. The victim was not using any personal protective equipment (PPE). The California FACE investigator concluded that, in order to prevent similar future occurrences, employers should:

- have an Injury and Illness Prevention Plan (IIPP) which addresses electrical safety training for supervisors and employees working with electrical equipment.
- have an standard operating procedure (SOP) that states that all high voltage work be done by a licensed electrician.
- have a proper ground in place for all electrical power mounds and equipment.
- have a standard operating procedure (SOP) which addresses the procedures for a lockout/tagout system.
- have all power panels and mounds (transformers) labeled so that it is evident where electricity is provided and from which panels.
- train employees in the proper use of personal protective equipment (PPE).

- have a standard operating procedure (SOP) which addresses the necessary environmental conditions for certain types of work activities, such as high voltage electrical work.
- have a standard operating procedure (SOP) stating that there be an employee (either a qualified electrician or an employee in training) located within a short distance of any employee working with high voltage equipment in case of an emergency.

INTRODUCTION

On October 28, 1992 a 35-year-old white male facilities journeyman electrician (victim) died after being electrocuted while doing maintenance work on a high voltage electrical power mound. The incident occurred at approximately 10:10 P.M.. The California FACE investigator was informed of the incident on October 29, 1992 by a Cal/OSHA safety engineer. A site investigation was conducted by the California FACE investigator on October 29 and photographs were taken. A copy of the Cal/OSHA Report and the Medical Examiner's Autopsy Report were obtained by the California FACE Investigator.

The employer in this incident was a ship repair yard. The company had been in business for 15 years, and had worked at the incident site for the past 13 years. There were 1300 employees working at the time of the incident and between 40 and 60 had the same job title as the victim. A safety program and safety meetings were conducted on a regular basis according to management. Employees were given several types of safety training including on-the-job, classroom, manuals, videos, and guest speakers. There were also weekly safety meetings which were called "gangbox meetings". There were no written safety rules available for the California FACE investigator to look at during the time of the site investigation.

The victim's electrical experience had been primarily working with low voltage equipment however, on occasion, as stated by the victim's co-workers' and supervisor he (victim) had worked with high voltage equipment. On the evening of the incident he (victim) had been given two tasks by his supervisor, the first being to trouble shoot and repair a ground fault in the center yard, and the other to perform maintenance service on the high voltage power mounds. High voltage work in the shipyard had also been done by a local electrical company.

INVESTIGATION

The employer in this incident was a ship repair yard. The company had employees working on different shifts around the clock. The victim was working the night shift (4:00 pm - 12:00 am) on the evening of the incident. He had been instructed by his supervisor to inspect the electrical power mounds throughout the shipyard. The inspection included ensuring the high voltage wires in the power mounds were properly insulated. A local electrical company had been to the shipyard on several occasions earlier in the month to conduct similar inspections.

The victim's co-workers and supervisor stated that earlier in the evening on the night of the incident, the victim had accidentally turned off the power to a dry dock. That event left a large number of employees without power and in the dark until the power was restored. That event occurred at approximately 9:00 p.m. Co-workers when interviewed hinted that the victim may have been reprimanded after this initial event, thus causing him to act hastily with regard to his other tasks later on that evening.

There had been a shift change around the time of the initial event and the victim had been given instructions from a new supervisor. The new supervisor instructed the victim to cancel the job he was working on and to complete two other tasks. These two tasks included trouble shooting to repair a ground fault in the center yard, and to perform maintenance service on the high voltage power mounds. The supervisor had no electrical training except for what he stated as being training, which was having watched the victim restore power during the first power outage.

The incident occurred at approximately 10:10 p.m. when the victim was working alone doing maintenance work on the south power mound. The environmental conditions at the site were very poor due to a recent rain and inadequate lighting. The victim was not wearing any PPE and was lying down on a wet surface in front of the power mound. Co-workers and the victim's supervisor stated that there was a power outage at approximately 10:10 p.m. The supervisor was able to restore the power after having watched the victim restore it earlier that same evening.

The victim was discovered lying unconscious and unresponsive at approximately 10:20 p.m. in front (south side) of the south power mound by a co-worker. Emergency help was summoned to the scene. Cardiopulmonary resuscitation (CPR) was initiated by co-workers and continued until the arrival of paramedics at approximately 10:26 p.m. The victim did not have a pulse and was absent of blood pressure and respiration at the time of their arrival. The victim was also asystolic on the cardiac monitor. An esophageal obturator airway (EOA) was placed and he was administered intravenous normal saline, epinephrine, and atropine. No clinical response was noted and he was transported to the local hospital. Upon arrival at the hospital emergency room at 10:54 p.m. the victim was unconscious and unresponsive with CPR in progress. Despite aggressive resuscitative efforts, including six defibrillation attempts, no clinical response was noted and death was pronounced.

A pair of protective gloves were found on the north side of the power mound by the victim's supervisor. There were also several tools (crescent wrench on top of the power mound and small hand tools in the victim's tool belt) and a can of aerosolve found inside the power mound where the victim had been working. Neither co-workers nor the victim's supervisor could state exactly what

the aerosolve was being used for, although it was speculated it may have been used to detect cracks in the wire insulation.

The power panels in the power supply room were not labeled. There was also no label or warning sign at the incident site (south power mound). The power panel which provided electrical current to the south power mound was found in the "Open" position (position which de-energizes the mound) when observed by company officials after the incident. Although the conductors in the power mound had been de-energized by the victim there may still have been backfeed or stored energy remaining in the conductors. There was no testing equipment located in the immediate area making it appear that no tests had been made by the victim to ensure that all the cables were de-energized before the victim's work that evening. There was also no ground in place at the south power mound. The victim did not try to install a ground to the power mound, possibly because it grounding the mound prior to beginning his work could have exposed him to an increased electrical hazard.

CAUSE OF DEATH

The Coroner's Autopsy Report stated the cause of death to be high voltage electrocution.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should have an Injury and Illness Prevention Plan (IIPP) which addresses electrical safety training for supervisors and employees working with electrical equipment.

Discussion: This incident may have been prevented if an Injury and Illness Prevention Plan had been developed and implemented. The plan should address specific guidelines for supervisors on their instructions to employees regarding safe electrical work practices. A communication system should be implemented which gives employees the opportunity to express their concerns regarding electrical hazards in the workplace. Under Title 8 of the California Code of Regulations (CCRs) section 3203 (3) employers should include a system for communicating with employees in a form readily understandable by all affected employees on matters relating to occupational safety and health, including provisions designed to encourage employees to inform the employer of hazards at the worksite without fear of reprisal; and 3203 (7) (f) employers should provide a plan which states supervisors

should familiarize themselves with the safety and health hazards to which employees under their immediate direction and control may be exposed.

Recommendation #2: Employers should have a standard operating procedure (SOP) stating all high voltage work be done by a licensed electrician.

Discussion: This incident may have been prevented if the employer had a SOP that stated only licensed electricians work on high voltage electrical equipment.

Recommendation #3: Employers should have a proper ground in place for all electrical power mounds and equipment.

Discussion: This incident may have been prevented if a ground had been in place at the south power mound. Excess electrical energy in the cables at the power mound that evening may have been the reason the victim was electrocuted. Under Title 8 of the CCRs section 2943 (f) suitable grounding devices shall be used. They shall be first connected to a ground before being brought into contact with any de-energized conductors or equipment to be grounded. The other end shall be attached and removed by means of insulated tools or other suitable devices. When removed, they shall be removed from all conductors or equipment before being disconnected from the ground.

Recommendation #4: Employers should have a standard operating procedure (SOP) which states the guidelines for a lockout/tagout system.

Discussion: This incident may have been prevented if lockout/tagout system had been in place. Employers should instruct supervisors and employees in the operation of such a system. The individual doing the electrical work should de-energize and lock the power panel before beginning to do any electrical work. A single key to the lock should be kept by this individual until all electrical work is completed. Under Title 8 of the California Code of Regulations (CCRs) section 4413 De-Energizing and Lockout; employees shall be instructed to retain possession of the key(s) to the lock(s) and personally remove the lock(s) or, if used, blocking means upon completion of work.

Recommendation #5: Employers should have all power panels and mounds (transformers) labeled so that it is evident where electricity is provided and from which panels.

Discussion: The power panels and mounds were not labeled in this incident. Proper labeling may

have acted as a visual reminder to the victim with regard to which panels control which equipment. A warning label on the power mound (transformer) may have also reminded the victim to take safety precautions when working with high voltage electricity. Under Title 8 of the CCRs section 2811 permanent and conspicuous warning signs shall be posted on all doors or gates that provide access to enclosures containing exposed energized parts and conductors. Such signs shall be legible at 12 feet and shall read substantially as follows: "WARNING - HIGH VOLTAGE - KEEP OUT."

Recommendation #6: Employers should have a standard operating procedure (SOP) which addresses the necessary environmental conditions for certain types of work activities, such as electrical maintenance work done in the outdoors.

Discussion: The victim in this incident was working under wet conditions and with poor lighting. This incident may have been prevented if there had been a SOP which stated that no electrical work was to be done outdoors in adverse weather or without sufficient illumination when working at night.

Recommendation #7: Employers should train employees in the proper use of personal protective equipment (PPE).

Discussion: The victim in this incident was not wearing gloves or any other type of personal protective equipment. Employers should have adequate personal protective equipment at the workplace. They should also provide training for employees on the proper use of such equipment.

Recommendation #8: Employers should have a standard operating procedure (SOP) stating that two employees should work together when working with high voltage electrical equipment.

Discussion: The victim in this incident was working alone. A co-worker may have reminded the victim to wear personal protective equipment (PPE) or may have suggested that the victim not continue to work under the poor environmental conditions in existence that evening. Under Title 8 of the CCRs section 2940 (c) (Qualified Electrical Workers) only qualified electrical workers shall work on energized high-voltage system. Except for replacing fuses, operating switches, or other operations that do not require the employee to contact energized high-voltage conductors or energized parts of equipment, clearing "trouble" or in

emergencies involving hazard to life or property, no such employee shall be assigned to work alone. Employees in training, who are qualified by experience and training, shall be permitted to work on energized conductors or equipment connected to high-voltage systems while under the supervision or instruction of a qualified electrical worker.

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