TO: Director, National Institute for Occupational Safety and Health

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

SUBJECT: Student Worker (Laborer) is Electrocuted When Street Light Standard Makes Electrical Contact in California

SUMMARY

California FACE Report #96CA002

A 30-year old male student worker (victim), performing the functions of a laborer, died after the metal combination street light and traffic signal standard (support pole and attachments) he was positioning contacted an overhead high voltage power line. The standard was suspended from a truck-mounted crane and he was attempting to position it over a foundation so it could be secured in place. As he was positioning the standard, it twisted and the street light mast arm contacted the overhead power line. His co-worker, who was helping him position the standard, was seriously burned. The CA/FACE investigator concluded that, in order to prevent future occurrences, employers should:

- Always contact the local power company when working in close proximity to energized high voltage power lines.
- Assure the "10-foot" rule is observed when working near energized high voltage power lines.
- Allow the standard to become stable before being handled by employees.
- Use non-conductive pole positioning devices to handle standards when working near energized power lines.
- Ground the pole or bond the pole to an effective ground.

INTRODUCTION

On February 16, 1996 at 1102 hours a 26-year old male student worker, performing laborer duties, was positioning a metal combination street light and traffic signal standard (support pole and attachments) when the street light mast arm contacted an overhead high voltage power line, and he was electrocuted. The CA/FACE investigator learned of this fatality on February 21, 1996 through the local Cal/OSHA district office. The CA/FACE investigator inspected the site of the incident on February 26, 1996 to take photographs of the scene. Two CA/FACE investigators traveled to the company's main yard on February 27, 1996 to meet with two representatives of the safety office, a chief electrical supervisor, and two additional crew members who were present at the time of the incident. Copies of the Cal/OSHA form 36, coroner's report, death certificate, and police report were obtained by the CA/FACE investigator.

The company, a governmental agency, has been in business for more than 50 years, but was reorganized in 1987 to consolidate several departments into one. The four-person crew had

been working at the site only on the day of the incident. The decedent had been working for the agency for six years in this job capacity. The crew supervisor has been doing this type of work for 14 years.

The agency employs 3,700 people. There are seven employees in the unit with the same job title who do work corresponding to that of the decedent. There is a safety officer, who devotes all work time to safety, assigned to the employees in the major work group. The safety officer was not at the site at the time of the incident. Although there was no specific written safety rule or procedure for the particular task being performed at the time of the incident, there were safety rules and procedures in place. Training was done mostly on the job. Manuals were provided and video training was also included as part of the training program. General safety meetings were held every two weeks. The decedent had attended six of the forty-two training sessions. None of the six sessions he attended dealt with electrical safety**.** No crew safety meeting (tailgate, e.g.) was held prior to the start of the job on the day of the incident since it was considered a routine operation.

INVESTIGATION

The CA/FACE investigator made an unescorted visit to the site of the incident to photograph the layout. The site is the intersection of a six-lane, high speed north/south street with that of a four-lane street which dead ends into it from the east. The actual work site is a triangular island which separates northbound traffic from traffic turning right (eastbound). The island is concrete curbing around the perimeter with asphalt fill up to the level of the curbing. The west side of the triangle, which runs the same direction as the north bound lanes, is 42 feet long and is the area where the truck-mounted crane was parked during the incident. All of the work was done on the island itself, the apex of which was pointing east.

There were a number of power lines above the northern side of the triangle. There was a 120/240 volt AC power line 12-feet, 8-inches above the level of the island. Directly above that, at a height of 32-feet, 6-inches was a 34,500 volt, three phase, AC power line. At approximately the same level, was a guy wire which ran from a wooden power pole located on the west side of the six-lane street to a wooden pole approximately 75 feet east of the apex of the triangle. All of the above wires and lines ran in an east and west direction. At a greater height, 54-feet, 6-inches, a 300,000 volt AC line ran north and south.

There was a combination street light and traffic signal standard and a temporary street light standard located on the island. Both were located along the west side of the triangle, the temporary street light standard on the northern end and the combination standard on the southern end. They were 33 feet apart. After an initial meeting at the main yard the following day, the CA/FACE investigators were accompanied by two representatives of the agency's safety department, the chief electrician supervisor, and the electrical supervisor who was present during the incident to the area where the truck-mounted crane, equipment and materials were impounded. The CA/FACE investigators examined all of the equipment and materials related to the incident and took photographs.

About a month before the incident, the two original poles located on the triangular island were noted by a district supervisor to have been hit and bent by traffic on previous occasions. The district supervisor issued a report through normal channels to the traffic signal construction crew that these two poles needed to be replaced. The supervisor for the crew which was subsequently assigned the replacement job did a site survey. He later assigned the job to a four-

person crew which consisted of a journeyman electrician, acting as the supervisor, a technician and two laborers.

On the day of the incident, the crew arrived at the site and proceeded to cone off the right hand lane of the northbound street. The recently certified 13.45-ton truck-mounted hydraulic crane was parked along the curb of the island, pointing north, in the coned-off lane. The truck's outriggers were fully extended to about one-foot out and two-feet down. The first job was to replace the bent pole on the south side of the island. The pole was removed and the street light mast arm and luminaire detached. The bent pole was loaded on to the truck, and the new pole laid out on the island. The existing mast arm and luminaire, as well as several traffic signs, were attached to the new pole. It was raised into place and secured with four bolts and nuts.

The second pole was located near the north end of the island. At 1000 hours, the bent pole was rigged, unbolted from its foundation, lifted by the journeyman electrician at the crane's turret controls, and placed on the island. The traffic signal head, street light mast arm and luminaire were disconnected and laid aside. The bent pole was lifted onto the truck and the new pole laid out on the island along a north/south direction. The crew reattached the street light mast arm, luminaire and the traffic signal head to the new pole as it laid on the ground. The new pole was then rigged with an 18-foot long wire rope sling having a hook on one end and an eye on the other. A continuous, padded 3-foot synthetic sling was placed through the eye of the wire rope sling in a double basket configuration. The padded sling was then placed around the new pole at about an 18-foot level from the base. The load hook of the truck-mounted crane was then attached to the padded sling. The hook at the other end of the wire rope sling was inserted into the hand hole which was about one foot above the base of the pole. The hand hole is an opening in the pole approximately 8-inches by 6-inches. The sling was made taut by two of the crew members.

While the uninjured laborer was holding the luminaire off the ground, the 28-foot, 6-inch pole was lifted off the ground by the journeyman electrician at the truck-mounted crane's turret controls. The mast arm was pointing along an east/west direction. The boom was pointing northeast and the base of the pole had to be moved north and slightly west to mate with the existing foundation. The uninjured laborer proceeded to the area near the pole foundation to straighten up the wiring and prepare the attaching hardware. When the pole began to clear the ground, the second laborer (the decedent) and the technician began to push it into position by grabbing the pole near the base. As they were pushing it, the pole began to twist. The street light mast arm swung around in a northerly direction and contacted the "C" phase of the high voltage power line located at the 32-foot, 6-inch height. The time was reported as 1102 hours by the power company's dispatcher. There was what was described as a tremendous flash and both workers burst into flames. The decedent fell to his back and his co-worker fell onto his side toward the truck, both still in contact with the pole. A bystander who was stopped at a red light ran over to help. He quickly slapped the hand of the technician and received a jolt which blew holes in his socks. Before the bystander began his next move, the journeyman electrician who was protected from shock by the crane's non-conducting, synthetic load line, lowered the pole away from the power line by lowering the boom and the load line simultaneously from the turret controls. According to some witnesses, the street light mast arm apparently got hung up on the lower guy wire. Fortunately, the pole had been removed from contact with the high voltage power line before the bystander made his next move which was to grab the injured co-worker by both hands and pull him free. No rescue attempt of the decedent was made because it was apparent to the rescuers that he was fatally injured.

The high voltage power line apparently was never de-energized because of the contact. Although the line relayed (opened a circuit breaker) on the high side, the low side circuit breaker did not relay because of the high resistance fault (circuit failure which prevents current flow along intended path). The line would have remained energized by backfeeding through the other high voltage lines connected to the buss (a common connection for multiple electrical circuits). The high side circuit breaker, as is normal, reclosed in 5 seconds and remained closed.

The two crew members who were not injured were somewhat unsure of what actions took place after the high voltage contact. After collecting his wits, the uninjured laborer remembers going under the pole over to the injured and attempting to put out the fire on the clothes of the injured. The journeyman electrician went to his phone to call in a "code three" to his dispatcher, who, in turn, called emergency services. Paramedics were dispatched at 11:05 a.m. and arrived at 11:08 a.m. They found the decedent to have no pulse or spontaneous respiration and pronounced him dead at 11:12 a.m. The decedent had burn marks on both hands, more pronounced on his left hand, with a large hole in his left heel. There also was a large hole in the asphalt where the current had exited his left heel. The co-worker who was helping position the pole had current enter his left hand and exit his right foot. He was seriously burned. Also evident on the asphalt were burn marks from the bodies of both men.

CAUSE OF DEATH

The coroner's report stated the cause of death to be high voltage electrocution.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Always contact the local power company when working in close proximity to energized high voltage power lines.

Discussion: The employer did not contact the power company prior to beginning work, specifically hoisting metal poles, near energized, high voltage power lines. Title 8 of the California Code of Regulations, Section, 2948 states: "When any operations are to be performed, tools or materials handled, or equipment is to be moved or operated within the specified clearances of any energized high-voltage lines, the person or persons responsible for the work to be done shall promptly notify the operator of the high-voltage line of the work to be performed and shall be responsible for the completion of the safety measures as required by Section 2946(b) before proceeding with any work which would impair the aforesaid clearance." The local power company, if contacted, could have dispatched a line crew to either protect or de-energize the high voltage power lines. Had the power company performed this service, the fatality and serious injury most likely would not have occurred.

Recommendation #2: Assure the "10-foot" rule is adhered to, using an observer, when working near energized high voltage power lines.

Discussion: When working near energized, overhead high- voltage power lines rated 50,000 volts (50KV) or below, any part of the crane or its load must maintain a distance of at least 10 feet at all times. Title 8 of the California Code of Regulations, Section, 2946(b)(2) states: "The operation, erection, handling, or transportation of tools, machinery, materials, structures, scaffolds, or the moving of any house or other building, or any other activity where any parts of the above or any part of an employee's body will come closer than the minimum clearances from energized overhead lines as set forth in Table 1 shall be prohibited. Operation of boom-type equipment shall conform to the minimum clearances set forth in Table 2 ...." Since the voltage

involved in this incident was 34,500 and boom-type equipment was being used, Table 2 applies. Table 2 specifies that a distance of 10 feet must be maintained when exposed to voltages between 600 and 50,000. An observer, qualified to give signals, should have been watching the lifting and positioning operation to assure the truck-mounted crane operator that he was maintaining the specified 10-foot distance. Had an observer done this, and a distance of 10-feet from the energized, overhead power lines was maintained at all times, this incident would most likely not have happened.

Recommendation #3: Allow the standard to become stable before being handled by employees.

Discussion: The combination street light and traffic signal standard had not been lifted vertically to a point of maximum stability before the workers began to try to manually position it over the existing foundation. With the traffic signal head attached about the middle of the new pole and the street light mast arm and luminaire attached to the top, the pole was inherently unstable. The highest degree of stability would have been when the pole was most vertical. The workers did not wait for this to occur and when they tried to position the new pole in the still unstable state, it twisted and contacted the overhead high-voltage power line. If the rigging had been placed higher on the pole, the standard would have been more stable. The use of an 18 foot sling limited how high the rigging could be placed on the pole. An alternate method of rigging could have been used involving a synthetic sling with eyes on both ends. It could be adjusted to any position on the pole depending on the pole height, weight, attachments and any other factors that dictate stability during a lift. After it is determined where the sling is best placed on the pole, the end of the sling nearest the bottom of the pole could have been wrapped around the pole in a choke manner. The sling would then be stretched toward the top of the pole and the other end of the sling also wrapped around the pole in a choke fashion. To keep tension on the sling so it does not slip, a small line could be tied to the eye of the sling nearest the bottom of the pole and then secured at the bottom. The lift then could be made by placing the load hook in the eye of the sling nearest the top of the pole. Additionally, the luminaire could have been installed on the mast arm after the pole had been set in place. The removal of the weight of the luminaire would have added to the stability.

Recommendation #4: Use non-conductive pole positioning devices to handle standards when working near energized power lines.

Discussion: Non-conductive tag lines or other non-conductive pole positioning devices could have been used to handle the combination street light and traffic signal standard instead of positioning it by use of bare hands. The truck-mounted crane's operators manual refers to electrocution hazards when handling poles and states: "Contact with vehicle and other equipment attached or connected to the vehicle shall be avoided by personnel standing on the ground." It also states, as does Title 8 of the California Code of Regulations, Section, 2940.8 (d) that tag lines used near energized conductors shall be of a non-conductive type. Rubber protective gloves and leather keepers could have been used during this operation as an additional protective measure. Because of the voltage involved, they would only have been used as secondary protection. The operators manual states: "All personnel shall wear suitable insulating gloves, sleeves, and hard hats. Personnel shall not allow any un-insulated part of their body to come in contact with pole, vehicle or other equipment." Had the workers handling the pole used

non-conductive pole positioning devices and, as secondary protection, rubber protective gloves, the fatality and serious injury most likely would not have occurred.

Recommendation #5: Ground the pole or bond the pole to an effective ground.
Discussion: The pole itself could have been grounded or bonded to a suitable ground. Such a suitable ground would be a ground rod. If the pole was grounded directly, or if it was bonded to an effective ground, an alternate pathway for current would have been established. Had this been done, the fatality and serious injury most likely would not have occurred.

References

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FATALITY ASSESSMENT AND CONTROL EVALUATION PROGRAM

The California Department of Health Services, in cooperation with the Public Health Institute and the National Institute for Occupational Safety and Health (NIOSH), conducts investigations of work-related fatalities. The goal of this program, known as the California Fatality Assessment and Control Evaluation (CA/FACE), is to prevent fatal work injuries in the future. CA/FACE aims to achieve this goal by studying the work 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. NIOSH-funded, state-based FACE programs include: Alaska, California, Iowa, Kentucky, Massachusetts, Michigan, Minnesota, Nebraska, New Jersey, New York, Oklahoma, Oregon, Washington, West Virginia, and Wisconsin.

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Additional information regarding the CA/FACE program is available from:

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