



The National Institute for Occupational Safety and Health (NIOSH)

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# 33 Year-Old Apprentice Substation Electrician Fatally Injured

FACE 8610

## INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR), is currently conducting the Fatal Accident Circumstances and Epidemiology (FACE) Project, which is focusing primarily upon selected electrical-related fatal injuries and confined space fatalities. By scientifically collecting data from a sample of fatal accidents, it will be possible to identify and rank factors which influence the risk of fatal injuries for selected employees.

On November 6, 1985, a 33 year-old electrician came in contact with electrical energy while cleaning a substation switch. He died on November 8, 1985, from injuries sustained as a result of falling from the aerial bucket from which he was working.

## CONTACTS/ACTIVITIES

Officials of the responsible Occupational Safety and Health Program notified DSR of this fatality and requested technical assistance. This case has been included in the FACE Project. On January 10, 1986, a member of the DSR research team (a physician) met with representatives of the company and the Occupational Safety and Health Program compliance officer, who investigated this case. The site of this fatality was visited and photographed. Interviews were conducted with two workers with essentially the identical job classification as the victim. A next-of-kin interview was conducted on January 9, 1986.

## OVERVIEW OF THE COMPANY AND SAFETY PROGRAM

The victim worked for a large utility company employing over 5000 employees. This company provides both electrical and natural gas services to approximately one-third of the state. The victim worked for the electricity distribution division, which has 178 employees. These employees are classified as either journeyman or apprentice substation electricians. The training program for a substation electrician is approximately 6 years. Five and one-half years consist of both classroom and on-the-job training. Formal testing is done to ensure adequate understanding of classroom work. The last six months of the training is used for final evaluation, prior to attaining journeyman status. The victim was an apprentice substation electrician in his final six months of training. The victim would have been made journeyman substation electrician in March of 1986.

The company has a budgeted safety department and a program which emphasizes three functions: (1) to formulate and communicate a safety program for the entire company; (2) to deal with workman's compensation claims; and (3) to provide industrial hygiene services for the company.

The safety department has six full-time employees and is headed by a safety engineer with eleven years of experience in occupational safety and health, in addition to formal training in safety management. The safety staff also employs an industrial hygienist and a specialist in worker's compensation claims.

A written safety policy and safety program exist for this company. Several safety committees exist involving various levels of management and union employees. Formal task training is provided by a department whose only function is training. Safety rules are communicated to new employees at the time of initial orientation. Each new employee is given a written safety manual and formal classroom instruction in safety. New employees are formally tested within ninety days of being hired to ensure adequate understanding of the safety rules.

## SYNOPSIS OF EVENTS

The four-man crew consisted of two journeyman substation electricians and two apprentice substation electricians. The apprentice substation electricians (one of whom was the victim) were both in their final six months of training. The crew was cleaning high voltage disconnect circuits at a large substation. This is considered to be routine maintenance, is performed using established procedures, and had been done by all members of the crew for at least five years.

The crew was to clean five circuits (15 switches) on the day of the accident. Each circuit consists of three switches (one for each phase), located 40 feet above ground on a steel frame structure. The switches are cleaned with solvents, steel wool, and occasionally filed to remove corrosion. The crew was using an aerial bucket to access the switches. The three switches for each circuit are operated by a single control lever and are either all open or all closed. The control lever is operated from ground level. Prior to cleaning switches, the system must be de-energized. The crew foreman is ultimately responsible for this activity. Once the incoming lines are de-energized, the line is tested using a method called "fuzzing". "Fuzzing" consists of wrapping insulating material around one end of a metal object and holding it close to the incoming power line. If no noise is heard, the line is assumed to be dead and grounds are placed from the incoming line to the steel support structure. The system is also grounded on the outgoing side of the circuit so that there is no possibility of feedback into the three switches. The switches are to remain in the open position during this maintenance procedure.

On the day of the accident, several crews were working at the substation site. One crew was removing obsolete equipment and had placed grounds on the outgoing side of the circuits that were to be cleaned. After lunch, this crew left the substation removing their grounds. These grounds were not replaced. The victim had completed cleaning the fourth circuit shortly before 3:00 p.m. He left the 4th circuit closed to drain off any static charge that may have built up in the system. (There would have been no static charge had the outgoing side of the circuit been grounded.) The victim was asked if he wanted the fourth circuit opened by two different crew members. He supposedly told them he would do it himself. The victim moved the truck so that the aerial bucket could be positioned for cleaning the fifth circuit. The fourth circuit was re-energized. The crew foreman de-energized the incoming line to the fifth circuit. The line was "fuzzed" and grounds were placed on the incoming line. At 3:14 p.m. the victim was in the process of cleaning the switches when he contacted both sides of one of the three switches. This action completed the connection, as if the switch itself were closed and current flowed through the victim's body and to ground by way of the ground on the incoming line. The system was energized by feedback through the fourth circuit. The victim fell from the aerial bucket approximately forty feet to the ground. The victim had extensive burns of both arms and hands. It is estimated that the victim completed a single-phase circuit of approximately 20,000 volts. First aid was administered at the accident site by co-workers and subsequently paramedics. The victim was transported to a local hospital approximately 20 minutes after the accident occurred. He was later transferred to another medical center and died two days later on November 8, 1985.

Standard operating procedure was not followed by the crew while cleaning the switches. The fourth circuit should have been left open. The crew was aware of this. The outgoing side of the circuit was not grounded as required by the company. The victim did not have himself belted to the aerial bucket as required. This would have prevented his fall and the injuries sustained in the fall.

## CAUSE OF DEATH

Following an autopsy, it is the opinion of the medical examiner that the victim “died as a result of cerebral injuries when he fell from a height of 40 feet.” The victim’s contact with electricity is noted in the medical examiner’s report as the cause of the fall.

## RECOMMENDATIONS/DISCUSSION

**Recommendation #1: Standard operating procedures and hazard awareness should be routinely presented and reviewed at safety meetings. Employers should enforce strict adherence to company policy. Employees should follow all standard operating procedures.**

Discussion: The crew did not follow standard operating procedure while providing maintenance to the substation. Three violations of standard operating procedure occurred that contributed to this fatality: 1)the switches on the fourth circuit were left closed when they should have been open; 2)the outgoing side of the circuits were not grounded; and 3)the victim was not secured to the bucket from which he was working. Had standard operating procedure been followed, this fatality would not have occurred.

**Recommendation #2: De-energization of both sides (incoming and outgoing) of the substation circuit should be verified.**

Discussion: The incoming line to the circuit is “fuzzed” as part of the standard operating procedure to verify that the line is de-energized. The outgoing side of the circuit should also be checked to verify that no voltage is present (from feedback). Additionally, the absence of low voltage (not detected by “fuzzing”) should be verified by a low voltage testing device, prior to grounding. Had both sides of the circuit been tested, the victim would have been alerted that the system was not de-energized.

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