

## Lineman Dies When He Contacts Energized Power Line in Puerto Rico

### SUMMARY

A construction crew consisting of a supervisor, three class A linemen (including the victim), a first class lineman, a groundman, and two truck drivers were assigned the task of correcting a malfunction in a de-energized three-phase powerline. When the crew arrived at the worksite, they found that one of the three phases had broken and fallen to the ground. The supervisor instructed the victim to relocate the damaged phase on the crossarm of the pole to better balance the load on the crossarm. As the victim began to climb the pole he was assured by the supervisor that the powerlines had been de-energized. When he attempted to relocate the damaged line he contacted another phase, was shocked, and slumped backwards, prevented from falling by his safety belt. The powerlines at the worksite had been energized by backfeed electrical energy from a portable gas generator being used on the circuit. NIOSH investigators concluded that, in order to prevent future similar occurrences, employers and employees must:

- ensure that established procedures for powerline maintenance work are followed at all times
- take special precautions to guard against feedback electrical energy, including testing and grounding powerlines prior to the initiation of work.

### INTRODUCTION

On September 29, 1989, Commonwealth of Puerto Rico officials notified the Division of Safety Research (DSR) of a 42-year-old male lineman with 19 years of experience that was electrocuted while attaching a 2400-volt powerline to a pole-mounted insulator. The powerline had been de-energized two days earlier and the supervisor assured the lineman that the powerline was still de-energized. During the week of October 2-6, 1989, a DSR research team (two occupational safety and health specialists, a safety engineer, and an epidemiologist) conducted an investigation, met with the Commonwealth Epidemiologist and his staff, the Secretary of Health, representatives of the Medical Examiner's office, and power company officials to obtain information concerning the circumstances surrounding the incident. Video tapes and photographs were taken to document storm damage to the electrical transmission and distribution system. This investigation was one of five separate investigations (90-02 through 90-06) conducted by DSR staff. All five of the investigations involved workers who were electrocuted while restoring electrical power to the island of Puerto Rico as a result of damage caused by Hurricane Hugo (1).

The employer is a major utility company with more than 10,500 employees. The company has been in operation for the past 41 years. The company has a comprehensive safety program with written policies and procedures for all routine operations. The corporate staff consists of a supervisor of industrial safety, six safety engineers, and seven safety advisors. Apprentice linemen undergo a 6-month training program in which they spend half of each day in the classroom and the other half day on the job. At the end of this 6-month period, the apprentice transmission and distribution linemen are classified as first, second, or third (highest) class linemen, depending on their level of competence. Apprentice construction linemen are classified as either class A (highest), B, or C linemen. All workers receive classroom and on-the-job training, and periodic retraining. Workers that perform line work are certified in cardiopulmonary resuscitation.

## INVESTIGATION

On September 17, 1989, the day before the area was struck by Hurricane Hugo, a malfunction occurred in a main electrical feeder line that served one region of the Commonwealth. Power company engineers identified a group of three phases of powerline that branched off of the feeder line as the cause of the malfunction and decided to de-energize these phases and repair them at a later date. The hurricane struck the island the following day causing massive damage to the electrical utility network and power company workers did not return to correct the malfunction at the feeder line until September 21, 1989. A crew consisting of a third class lineman, a first class lineman, and a cable splicer were assigned the task of identifying and correcting the cause of the malfunction. When they arrived at the site, the crew found that one of the three phase lines had broken and fallen to the ground. The crew decided to temporarily eliminate the broken phase and restore power to the other two phases in an attempt to restore electrical service to their customers.

A construction crew in the area, consisting of a supervisor, three class A linemen (including the victim), one groundman, and two truck drivers arrived at the site. The supervisor decided to relocate the damaged phase on the crossarm of the pole located before the damaged portion of the phase to better balance the load on the crossarm. The victim was to attach the damaged phase to an insulator located at a position on the crossarm that was congested with other conductors and communication lines.

As the victim climbed the pole to relocate the damaged phase, he asked the supervisor if the lines had been de-energized. The supervisor assured him that the lines had been de-energized 2 days earlier. The victim was wearing his work gloves when he grasped the line and began to position it on the insulator. The victim contacted one of the other lines, received a shock, and slumped backward. He was prevented from falling by his safety belt. One of the construction linemen climbed the pole and brought the victim to the ground. Co-workers immediately initiated cardiopulmonary resuscitation (CPR), and continued to administer CPR as they transported the victim to the hospital. The victim was pronounced dead on arrival at the hospital.

Power company investigators discovered that the lines had been de-energized at a pole-mounted service transformer. However, incorrect connections at this transformer established a path for current energy from another circuit to travel back (backfeed) through the transformer, energizing the line that the victim had contacted. Tests determined that 2400 volts were present on the line.

## CAUSE OF DEATH

The medical examiner listed electrocution as the cause of death.

## RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers must ensure that established safety procedures are followed at all times.

Discussion: Company policy requires linemen to verify that powerlines are de-energized, grounded, and tested before starting work on the lines. The victim accepted the word of his supervisor that someone else had de-energized the lines. The supervisor allowed the victim to proceed without following established procedures. Had the victim or the supervisor verified that the lines were de-energized, grounded, and tested, this incident might have been prevented.

Recommendation #2: Special precautions should be taken to guard against feedback electrical energy.

Discussion: The potential for electrocution due to feedback energy should not be underestimated. This is especially true in this case, where massive damage was inflicted on the area's electrical system by the hurricane. To protect against the hazard of electrical feedback energy, linemen must verify that powerlines have been de-energized. De-energized lines must also be properly grounded to the system neutral. Grounds must be attached to the system neutral first and removed from the system neutral last. If work is being performed on a multi-phase system, grounds must be placed on all lines, and should be grounded in sight of the work area, with work being performed between the grounds whenever possible. If work is to be performed out of sight of the point where the line has been de-energized, an additional ground should be placed on the source side of the work area. Unless a power line is effectively grounded on both sides of a work area, it must be considered energized even though the line has been de-energized. Linemen should also be instructed to always wear the appropriate personal protective equipment (NIOSH 88-104).

## REFERENCES

1. Morbidity and Mortality Weekly Report October 29, 1989/Vol. 38/No. 42 Update: Work-Related Electrocutions Associated with Hurricane Hugo - Puerto Rico.
2. DHHS (NIOSH) Publication No. 88-104, Request for Assistance in Preventing Electrocutions by Undetected Feedback Electrical Energy in Powerlines.

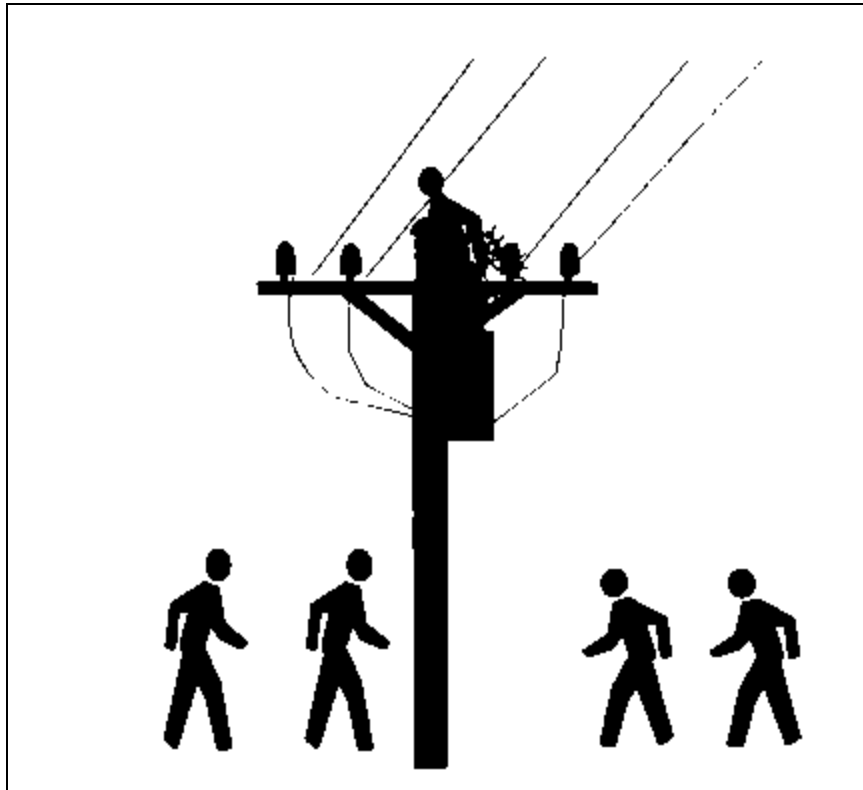


Figure. Lineman Electrocution