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FROM: Minnesota Fatality Assessment and Control Evaluation (MN FACE)
Minnesota Department of Health

Program

SUBJECT: MN FACE Investigation 93MN01101
Electrician Electrocuted After Contacting Energized Equipment

SUMMARY

A 27-year-old male journeyman electrician (victim) was electrocuted when he contacted an energized unit of a potato transport system. The five individual units of the system—an accumulator, two conveyor tables, a telescoping conveyor table, and a piler—were mechanically joined to form a 198-foot long transport system used to move potatoes from delivery trucks into a warehouse. The victim and a coworker were making repairs to the control circuit of the system and reconnecting a remote stop switch. At some time in the past, a green colored wire in the control circuit had been used as a current carrying conductor. It was inadequately marked as such along the circuit and, unknown to the electricians, had been connected to another green wire in the system ground circuit. Due to existing circumstances during the repair work, the accumulator and a conveyor table frame were energized with a 277 volt potential as a result of the improper wiring connection. When the victim grabbed a hand hold on the accumulator to board it during troubleshooting, he provided a path to ground and was electrocuted. He called out for help and the coworker, seeing the victim was in trouble, disconnected power to the transport system and summoned medical help. Despite CPR attempts the victim died of his injuries. MN FACE investigators concluded that to prevent similar occurrences, employers should:

- > ensure that all ungrounded conductors are labelled according to applicable standards as recommended by the National Electrical Code.
- > ensure that electrical equipment is grounded according to applicable standards as recommended by the National Electrical Code; and

INTRODUCTION

MN FACE was notified of an August 26, 1993 occupational electrocution on August 27, 1993.

MN OSHA and the county coroner's office were contacted and releasable information was obtained. A county sheriff's report of the incident was requested and received. An employer interview was conducted via telephone a week after the incident. An investigation of the incident site and the equipment that was being repaired by the victim was conducted on September 21, 1993.

The victim worked for a private electrical company which had been in business for 12 years and employed ten electricians. He was a journeyman electrician and had worked for the company for three years. The company had been contracted to repair an electrical control circuit of a potato transport system.

INVESTIGATION

The incident took place outside of a 5,500,000 pound capacity warehouse located at a potato processing plant. The victim and a coworker, both electricians, were troubleshooting and repairing the electrical control circuit of a transport system used to move potatoes from trucks into the warehouse.

The transport system consisted of five individual units: an accumulator, two horizontal conveyor tables (#1 and #2), a telescoping conveyor table, and a piler. An overview of the system is depicted in figure 1. Each unit was mounted on rubber tired wheels for portability and were mechanically coupled together by metal pin and eye connections to form a 198-foot long conveyor line. During normal operation, 480 volt AC power from a distribution panel inside the warehouse was routed to the units by three separate power circuits—one each to the accumulator, the piler, and the telescoping conveyor table—and operated the 2 hp motor of each unit. Power to the two horizontal conveyor tables was provided through flex cord connections with the telescoping conveyor table.

The drive motors of the two conveyor tables and the telescoping conveyor were connected to a control circuit carried by flex cords between these units. The control circuit allowed the conveyors to be started or stopped by the accumulator operator or stopped using a remote stop switch located at the telescoping conveyor. Near the end of the 1992 harvest season, the control circuit had malfunctioned, repeatedly blowing fuses, and the remote switch had been electrically bypassed. It was necessary for workers at the piler then to verbally notify the accumulator operator to shut down the system to control the flow of potatoes. The system was operated in this manner for the rest of the season. After the 1992 harvest, the system was disconnected and its individual units were placed in storage.

In anticipation of the 1993 harvest, electricians from the same electrical company bypassing the remote switch were now repairing the transport system's control circuit and reconnecting the remote stop switch. Several factors led to the occurrence of the fatal incident. First, a green colored wire at the junction box on the telescoping conveyor had, at an unknown time in the past, been used as an energized conductor. It was identified at the box by marking as such but was unmarked elsewhere along the line of conveyor tables. Despite two electrical companies having serviced the equipment, the marking problem was never corrected. Second, during system assembly by maintenance employees earlier in the summer of 1993, the energized green wire originating at the telescoping conveyor control circuit was connected to another green wire in the system ground circuit at a newly replaced box on conveyor #2. Third, during control circuit repair on the day of the incident, only the telescoping conveyor was plugged into the power distribution panel. And finally, the accumulator, the ground around it, and the metal connection between the #1 conveyor table and accumulator were wet because of heavy rains. The above conditions, in combination, resulted in energizing the frames of the #1 conveyor table and accumulator with a 277 volt potential as the electricians performed their repair work. When the victim attempted to board the accumulator, he grabbed a hand hold on the machine's frame, completed a path to ground, and was electrocuted.

The victim called out for help. His coworker, after running out of the warehouse to investigate and seeing the victim was in trouble, ran back to the distribution board and disconnected power to the transport system. The victim fell away from the accumulator at that time. A call for emergency medical assistance was placed and CPR was administered as quickly as possible by the coworker and another site employee. EMS personnel responded within five minutes and continued CPR during transport to a local emergency room, but the victim was pronounced dead on arrival.

CAUSE OF DEATH

The cause of death listed on the death certificate was electrocution.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should ensure that power conductors are properly identified and that wires having green colored insulation jackets are never used for power conductors.\

Discussion: Article 310-12 of the National Electrical Code recommends that individually covered or insulated grounding conductors shall have a continuous outer finish that is either green, or green with one or more yellow stripes. The color green is widely recognized as identifying ground conductors and the improper connection which occurred at the junction box on the #2 conveyor is not surprising. The tape identification on the green wire at the connection at the junction box on the telescoping conveyor was not effective since the marking was not carried to the other end of the wire.

Recommendation #2: Employers should ensure that electrical equipment is adequately grounded.

Discussion: When the unidentified energized conductor was connected to the system ground at the junction box on the #2 conveyor, it effectively removed the #1 conveyor and accumulator from the system ground while at the same time energizing the frame of the #1 conveyor and the accumulator. Although the individual conveyor units were mechanically connected by pin and eye connections at each end, these connections would not necessarily be electrically continuous, and it appears that the connection between the #2 and #1 conveyors was a poor electrical connection. The connection between the #1 conveyor and the accumulator, however, was outside the warehouse and exposed to rain just prior to the incident making it a good electrical connection. These conditions isolated the energized frames of the #1 conveyor and the accumulator from the system ground so that they were no longer provided with short circuit protection.

REFERENCES

1. **The National Electrical Code-1990 Handbook**, National Fire Protection Association, Quincy, Massachusetts, 1989.

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