Massachusetts FACE • Occupational Fatality Report

Massachusetts Department of Public Health
Occupational Health Surveillance Program
Fatality Assessment and Control Evaluation Project

Apprentice Electrician Electrocuted while Wiring an Elevator Disconnect Switch - Massachusetts

Investigation: # 06-MA-043-01
Release Date: December 23, 2008

SUMMARY

On October 23, 2006, a 24-year-old male apprentice electrician was electrocuted by an energized 480-volt, three-phase circuit while permanently wiring a heavy duty disconnect switch for a new elevator. The supply side of the disconnect switch had three energized wires fed into it through the switch's top mechanical lugs. At the time of the incident, the victim had just finished disconnecting the three energized wires from the switch's top mechanical lugs and came in contact with an energized source, either a wire or the switch housing, and was electrocuted. A co-worker noticed a bright flash and, upon investigating the source of the flash, found the victim slumped on the ground of the elevator mechanical room. The co-worker yelled for help and started to attend to the victim. A second co-worker entered the elevator mechanical room and then placed a call for emergency medical services (EMS). Both co-workers administered cardiopulmonary resuscitation (CPR) until the arrival of EMS a few minutes later. The local police and fire departments were also notified and responded to the incident site. EMS transported the victim to a local hospital were the victim was pronounced dead. The Massachusetts FACE Program concluded that to prevent similar occurrences in the future, employers should:

- **Ensure that electrical circuits and equipment are de-energized and that lockout/tagout procedures are implemented and enforced prior to beginning work;**

In addition, general contractors, when feasible, should:

- **Ensure that elevators are permanently wired during installation.**

INTRODUCTION

On October 24, 2006, the Massachusetts FACE Program was alerted by local media that on October 23, 2006, an apprentice electrician had been electrocuted. An investigation was initiated. On November 17, 2006, the Massachusetts FACE Program Director and an assistant traveled to the employer's corporate offices where two representatives of the company were interviewed. The death certificate, police report, corporate information, and the Occupational

Safety and Health Administration (OSHA) fatality and catastrophe report were reviewed during the course of the investigation.

The company, an electrical contractor, was established in 1976. Since that time, the company has expanded from just an electrical division to also include telecommunications and maintenance/service divisions and has established offices in three New England states. The company has approximately 300 employees, 230 of which work in the electrical division. Of the 230 employees in the electrical division, approximately 185 employees are routinely out in the field at job sites. Half of these employees are licensed electricians and half are apprentices. The victim had been employed by the company for seven years at the time of the incident and was a high-level apprentice electrician. The requirements to become a high-level apprentice electrician include at least four years and 8,000 hours of electrical work experience. Prior to being hired as a full time employee, the victim had completed a cooperative placement at the company while he was attending an electrical training program at a vocational technical high school.

The company has a comprehensive health and safety program that addresses among other things lockout/tagout procedures. The company's new employees are required to go through a mandatory three hour safety orientation. The company also provides additional employee training that is comprised of Web-based, on-the-job, and classroom components, including watching videos and reviewing written materials. The Web-based safety training system was developed by the company and employees can access this system from any computer connected to the Internet. The Web-based trainings include the OSHA 10-hour course, CPR, and the National Fire Protection Association (NFPA) 70E standard for electrical safety in the workplace. The company also reported that they have approximately 60 safety officers. The victim was a safety officer for the company. A majority of the safety officers are electricians who have completed a three month, 60-hour safety officer training. The company reported that the safety officers have the authority to shut down a job if they feel that it is unsafe. Employees do not have union representation.

INVESTIGATION

The project involved in the incident was a renovation of a shopping mall. The company was hired by the project's general contractor as an electrical subcontractor (company). The company's task as part of the renovation included, but was not limited to, wiring a newly installed elevator and wiring and installing new lighting. The job was estimated to take approximately four months, and at the time of the incident the company had been onsite almost three months.

The company had temporarily wired the new elevator providing it with the required three-phase, 480-volts needed for operation. It was reported that this temporary wiring enabled the elevator subcontractor to test the newly installed elevator ensuring that it was operating properly. These three temporary wires originated in the main electrical room and terminated in the elevator's mechanical room, a six foot by eight foot room near the new elevator. There was no heavy duty

safety switch (disconnect switch) installed between the main electrical room and the elevator's mechanical room.

The three temporary feed wires that ran from the main electrical room to the elevator's mechanical room were installed into the top of a disconnect switch (Figure 1) located inside the elevator's mechanical room and attached to the disconnect switch's top mechanical lugs, the switch's supply side (Figure 2). Temporary wiring had also been installed from the bottom mechanical lugs of the elevator mechanical room disconnect switch to the control unit for the elevator that were also located in the elevator mechanical room. These were the wires being replaced at the time of the incident.

On the day of the incident the victim and nine other employees were onsite and were working third shift from 10:00 p.m. – 6:00 a.m. The victim's task on that day was to remove the temporary wiring between the new elevator's control unit and the disconnect switch located in the elevator's mechanical room and replace it with permanent wiring. It was estimated that this task would take the entire work shift.

The task of permanently wiring the elevator included installing rigid conduit from the elevator mechanical room disconnect switch to the elevator controls, feeding the new permanent wiring through the rigid conduit, inserting the wire into the top of the disconnect switch, feeding the wire down through the disconnect switch, and attaching the wire to the disconnect switch's bottom mechanical lugs. The other end of the permanent wire would then be connected to the elevator's control unit. The main function of this disconnect switch is to cut off power to the elevator controls. The disconnect switch involved in this incident was equipped with three 100-amp fuses that provided overload and short circuit protection and an arc shield that covered the top lugs. The shield was reportedly in place during the incident.

The employer reported that the three energized feed wires from the main electrical room had been disconnected from the disconnect switch's top lugs by inserting a screwdriver into the holes in the arc shield and loosening the lugs to which the wires were attached. These wires were also bent outward towards the front of the switch's housing. It was also reported by the employer that the disconnect switch's three 100-amp fuses had been removed and that the disconnect switch's throw, located on the right side of the switch's housing, was in the off position and locked out by both the victim's foreman and one of the elevator contractor's employees, but there was only one lock location and the lock used was that of the elevator contractor.

The disconnect switch being in the off position and locked out would only de-energize the bottom section of the disconnect switch including the wiring between the disconnect switch's bottom lugs and the elevator controls. The feed wires from the main electrical room that were attached to the disconnect switch's top mechanical lugs would remain energized. It was reported that a second disconnect switch should have been installed between the main electrical room and the elevator mechanical room. If this was installed the feed wires could have been de-energized

at the second disconnect switch and the entire elevator's mechanical room and disconnect switch could have been completely de-energized.

At the time of the incident, approximately 1:45 a.m., the victim was wearing a hard hat and safety glasses while working on the disconnect switch inside the elevator's mechanical room. The victim had completed the installation of the rigid conduit between the elevator's mechanical room and the elevator's control unit, had fed the new permanent wire through the conduit and was getting ready to insert the new wire into the top of the disconnect switch box. During this time, the three main feed wires remained energized and inside the disconnect switch's housing. While working with the disconnect switch, the victim came in contact with an energized source, either one of the lugs or the switch housing. It is unclear if an arc flash occurred and caused the victim to come in contact with the energized source or if the arc flash occurred after contact was made with the energized source.

The actual incident was un-witnessed, but a co-worker who was close by did observe a bright flash. Looking for the cause of the flash, the co-worker found the victim slumped on the ground inside the elevator's mechanical room and started yelling for help. A second co-worker who was in the same area reportedly heard a loud bang, followed by the yell for help and came across the victim in the elevator control room as well. This co-worker placed a call for emergency medical services (EMS) and the local police and fire departments. Both co-workers started administering CPR. EMS and the local police and fire departments all arrived within minutes. EMS transported the victim to a local hospital where he was pronounced dead.

CAUSE OF DEATH

The medical examiner listed the cause of death as electrocution.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should ensure that electrical circuits and equipment are de-energized and that lockout/tagout procedures are implemented and enforced prior to beginning work.

Discussion: The OSHA regulation 29 CFR 1926.416, *General requirements*, states that employers shall not permit an employee to work in such proximity to any part of an electric power circuit that the employee could contact the electric power circuit in the course of work. If employees will work in proximity of an energized electrical power circuit, then lockout/tagout must be implemented (OSHA regulation 29 CFR 1926.417, *Lockout and tagging of circuits*). Lockout/tagout ensures that circuits and equipment are not reenergized during the course of the work. Locks and/or tags must be attached to every location where equipment or circuits could be reenergized. Each individual working on the equipment and circuits should apply their own lock and/or tag and should be the only one to have the ability to remove the lockout/tagout device that they applied. In addition, the National Fire Protection Association (NFPA) 70E

Standard for Electrical Safety in the Workplace also states that live parts to which an employee might be exposed shall be put into an electrically safe work condition before an employee works on or near them.

In this case, the victim was working on an elevator disconnect switch where the supply side of the switch was energized. The disconnect switch had been locked out, but the lock used was not the victim's lock, the person performing the work, it belonged to an employee of the elevator contractor. Prior to the incident, the switch should have been totally de-energized and tested to verify that it was totally de-energized and in an electrically safe work condition and locked out by the employees performing the work. The company had an electrical safety program that included procedures for locking out and tagging of circuits. The company also provided employees training on these procedures. However, as this case demonstrates, training alone will not ensure that hazardous energy control programs and the required procedures, such as requiring electrical systems to be de-energized, tested, and locked out prior to beginning work, are being properly implemented and followed. To ensure the effectiveness of these procedures, management must provide oversight ensuring that procedures are being followed.

Recommendation #2: General contractors, when feasible, should ensure that elevators are permanently wired during installation.

Discussion: The shopping mall where the incident took place was being partially renovated. The elevator and elevator control room were part of this renovation project and a new permanent fixture in the mall. It was reported by the employer that during the elevator installation, temporary wiring was provided so the elevator could be tested once installation was complete. In this case, if the elevator could have been permanently wired when it was originally installed, the task that the victim was performing at the time of the incident would have been eliminated. When feasible, general contractors should ensure that as much permanent wiring is incorporated during the initial installation of elevators to eliminate temporary wiring and the need to then remove the temporary wiring and replace it with permanent wiring.

REFERENCES

National Fire Protection Association (NFPA). *70E: Standard for Electrical Safety in the Workplace.* Quincy, MA.

Code of Federal Regulations. 29 CFR 1926.416. *General requirements.* Washington DC. U.S. Government Printing Office, Office of the Federal Register.

Code of Federal Regulations. 29 CFR 1926.417 *Lockout and tagging of circuits.* Washington DC. U.S. Government Printing Office, Office of the Federal Register.

Code of Federal Regulations. 29 CFR 1926.21 *Safety training and education.* Washington DC. U.S. Government Printing Office, Office of the Federal Register.

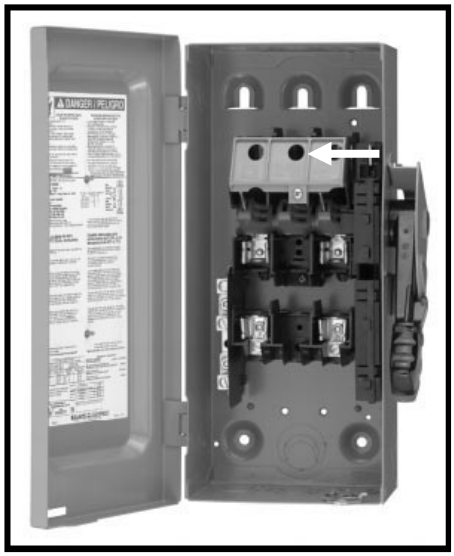
DOL. OSHA. Standard interpretations: *Lockout and tagging of circuits*; *§ 1926.417.* [www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=INTERPRETATIONS&p_id=25516]. Date accessed: November 30, 2007.

Schneider Electric. *Enclosed Safety Switches.* [www2.nectec.or.th/courseware/electrical/pdf-document/3100CT9801.pdf]. Date accessed: November 30, 2007.

Figure 1* – Similar heavy duty disconnect switch with front cover closed

* Figures obtained from:
http://ecatalog.squared.com/pubs/Electrical%20Distribution/Safety%20Switches/3100CT9801.pdf

**Figure 2* – Similar heavy duty disconnect switch with front cover open
Arrow pointing to arc suppressor shield**



- Figures obtained from:
  http://ecatalog.squared.com/pubs/Electrical%20Distribution/Safety%20Switches/3100CT9801.pdf

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FATALITY ASSESSMENT AND CONTROL EVALUATION PROGRAM

The Massachusetts Department of Public Health, in cooperation with the National Institute for Occupational Safety and Health (NIOSH), conducts investigations on the causes of work-related fatalities. The goal of this program, known as Massachusetts Fatality Assessment and Control Evaluation (Massachusetts FACE) is to prevent future fatal workplace injuries. Massachusetts FACE aims to achieve this goal by identifying and studying the risk factors that contribute to workplace fatalities, by recommending intervention strategies, and by disseminating prevention information to employers and employees.

Massachusetts FACE also collaborates with engineering and work environment faculty at the University of Massachusetts at Lowell to identify technological solutions to the hazards associated with workplace fatalities.

NIOSH funded state-based FACE Programs currently include: California, Iowa, Kentucky, Massachusetts, Michigan, New Jersey, New York, Oregon, and Washington.

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Additional information regarding this report is available from:

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