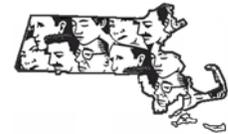




Massachusetts FACE • Injury Report

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



Two 11th Grade Students Shocked in Separate Incidents in the Same Electrical Technology Vocational School Program - Massachusetts

Investigation: # 11-MA-1NF-01

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SUMMARY

Within a nine month timeframe in 2010 and 2011, two 11th grade students enrolled in an Electrical Technology program in the same Chapter 74 approved public regional vocational technical high school education program sustained electrical injuries in two separate incidents. One of the two students was assigned a task of using an existing de-energized wire located in a ceiling as a snake to feed a new higher voltage wire. While standing on a ladder, the student mistakenly grabbed a wire that was energized, resulting in an electrical shock. The second incident involved a student who was shocked while feeding wire into a piece of metal conduit, a task that reportedly went beyond the assigned scope of work; the wire was live and caused the metal conduit to become electrified shocking the student. In both cases, the students were being supervised by an instructor, but during the actual time of these incidents the instructor had stepped away to check on other Electrical Technology program students. The school nurse was called for both injuries and performed an evaluation of the students and then called for Emergency Medical Services (EMS). EMS responded to each incident within minutes and transported the students by ambulances to local hospitals. Both students were released from the hospital on the same day they were injured. The Massachusetts Department of Public Health concluded that to prevent similar occurrences in the future, schools with vocational shops should:

- **Develop comprehensive safety and health plans, as required by Massachusetts regulations, to protect both students and school personnel by ensuring that schools are providing conditions that, at a minimum, meet occupational safety and health standards set by the Occupational Safety and Health Administration (OSHA);**
- **Conduct a job safety analysis (JSA) for each assigned task to ensure proper practices and procedures are implemented enabling the task to be performed safely; and**
- **Routinely review and enforce lockout/tagout programs and provide relevant training to students and school staff.**

Schools with vocational shops that also provide in-house skill building opportunities for students should:

- **Develop guidelines for these opportunities to ensure that:**
 - a) **students have a clear understanding of the tasks they are being asked to perform; and**
 - b) **appropriate levels of supervision are provided.**

INTRODUCTION

The Occupational Health Surveillance Program at the Massachusetts Department of Public Health conducted an investigation of these two electrical injuries. As part of this process, the school site was visited with a representative of the Department of Elementary and Secondary Education and the two incidents were discussed with school personnel.

This Chapter 74 approved public regional vocational technical high school consists of grades nine through 12, has 30 career and technical programs and has more than 2,000 students enrolled. The two injured students were enrolled in the Electrical Technology program in which the various skill sets taught include: electrical circuit theory; wiring methods and materials; reading blueprints and mechanical drawing; industry codes; and vocational shop. The Electrical Technology program is designed to provide students with the skills that can eventually lead the student to work in a number of occupations upon graduation, including as an electrician, line and cable installer, and instrument technician.

The school follows a schedule that alternates every nine days between academic and vocational courses. The first half of the freshman year, students participate in the Exploratory Program Selection of Permanent Career Major. During the exploratory program students spend time in nine vocational areas to help assist the student in selecting a permanent program. At the end of the first half of the freshman year, students choose and typically stay with one vocational area for the remainder of their time at the school. The school did have a safety and health plan that, at the time of the visit, was being reviewed and updated.

INVESTIGATION

Incident #1

Two 11th grade Electrical Technology program students were assigned to an in-building placement within the school (sometimes known as a work-based learning activity) to perform electrical work on outdoor building lights in the gym area of the school. The task was explained to the students by the electrical instructor who then stepped away to check on other Electrical Technology program students. The task was to cut a previously de-energized wire located in a junction box in the ceiling, and to use that wire as a pull snake to install a new higher voltage wire. At the time of the incident, the student who was uninjured was positioned outdoors and the student that received the shock injury was indoors standing on an eight foot fiberglass step ladder in order to access the ceiling. It was reported that the injured student had accessed a ceiling junction box approximately six feet away from the box that needed to be accessed to perform the task. The wires located in the junction box accessed by the student were energized with 277 volts. While standing on the ladder, the student came in contact with the live wires and received an electrical shock. The shock caused the student to lose his balance and the ladder to fall against an adjacent glass wall. The student stumbled down the ladder steps to the ground.

The student was discovered by a person employed in the gym building who called the school nurse. The nurse immediately went to the gym to assist and assess the student and observed a burn on the student's right index finger and did not observe an exit wound. The nurse called for Emergency

Medical Services (EMS) and placed a call to the student's parents. EMS arrived within minutes and the student was transported to a local hospital. The student was discharged from the hospital the same day.

Incident #2

Two Electrical Technology program students were assigned to an in-school placement to perform electrical work within the steam engineering shop area of the school. The task was explained to the students by the electrical instructor who then stepped away to check on other Electrical Technology program students. The task was to run new conduit pipe for some existing ceiling lighting. The light fixtures had been removed from the ceiling and the wires that originally powered the lights were energized with 277 volts, but reportedly had been dead ended, coiled up, and tucked up into the ceiling. The students formed the new conduit pipe to match the existing conduit pipe's contours. The electrical instructor came back to the steam engineering shop and inspected the new conduit pipe and did not approve the new section of conduit. The electrical instructor asked the students to start over and left the steam engineering shop. The students formed and installed a new section of conduit pipe. Then the students went beyond the instructions that were provided to them and retrieved one of the dead ended coiled wires from the ceiling. They started to feed the wire, which was energized, into the conduit that the students just finished installing. At some point the energized wire caused the metal conduit to become electrified shocking one of the students.

Personnel from the steam engineering shop went to the student and then called the school nurse. The nurse immediately went to the steam engineering shop to assist and assess the student and observed a burn on the student's right thumb and index finger and did not observe an exit wound. The nurse called for Emergency Medical Services (EMS) and placed a call to the student's parents. EMS arrived within minutes and the student was transported to a local hospital. The student was discharged from the hospital and returned to school that same day.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Schools with vocational shops should develop comprehensive safety and health plans, as required by Massachusetts regulations, to protect both students and school staff by ensuring that schools are providing conditions that, at a minimum, meet occupational safety and health standards set by the Occupational Safety and Health Administration (OSHA).

Discussion: Chapter 74 approved vocational technical education programs provide students with important opportunities to learn technical skills and to introduce them to various work environments. Occupational safety and health is a crucial component of work preparation, both to ensure safety in the school shop and to develop safe work skills for the future. Schools are required by the Massachusetts Board of Education, under the Code of Massachusetts Regulations (603 CMR 4.03), to provide environments that, at a minimum, meet safety and health standards set by the Occupational Safety and Health Administration (OSHA) and to train students about these standards and about hazard recognition.

The Code of Massachusetts Regulation (603 CMR 4.03(3) (d)) – *Vocational Technical Education – Location (Facilities) and Equipment*, specifically states that: “The school shall develop and implement

a comprehensive safety and health plan to safeguard the safety and health of all students and school personnel. The regulations of the Occupational Safety and Health Administration (OSHA) governing work sites shall serve as the minimum standards for safety in the vocational technical education program. The plan should include provisions for safety inspections of all facilities, safety training for all students and staff and the use, storage and disposal of toxic and hazardous materials.”

In this case, the relevant OSHA standards for working with electrical circuitry include:

1) 29 CFR 1926.416 – *General requirements*, this standard states that employers should protect employees against electric shock by deenergizing circuits that employees are working on or could come in contact with during the course of work.

2) 29 CFR 1926.417 – *Lockout and tagging of circuits*, this standard states that circuits that have been deenergized should be rendered inoperative and tags should be attached at all points where the circuit can be energized (more on lockout/tagout in Recommendation #3).

In addition, the National Fire Protection Association (NFPA) 70E *Standard for Electrical Safety in the Workplace*, a national consensus standard, 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.

Recommendation #2: Schools with vocational shops should conduct a job safety analysis (JSA) for each assigned task to ensure proper practices and procedures are implemented enabling the task to be performed safely.

Discussion: A job safety analysis (JSA) is a technique to systematically evaluate job tasks to ensure they are performed safely. It involves identifying all potential hazards and hazardous situations that could occur when performing tasks by focusing on the relationship between the worker, the task, the tools and the work environment. JSAs should be routinely performed to identify uncontrolled hazards by breaking down the tasks to be performed into steps, including the operation of any equipment and use of tools to complete the task. Each step should be evaluated to identify the hazards or potential hazards. Once hazards are identified, employers should take steps to eliminate or control these hazards. In school settings it is important to have the students participate in the JSA.

Performing the JSA, also provides an ideal opportunity to train students on how to recognize and avoid unsafe conditions. Hazard recognition training can be partially based on the evaluation of the tasks students will perform. This training should also include specific instructions that students should not risk physical harm to accomplish tasks. According to 29 CFR 1926.21 - *Safety training and education*, “the employer shall instruct each employee in the recognition and avoidance of unsafe conditions and the regulations applicable to his work environment to control or eliminate any hazards or other exposure to injury or illness.”

In both of these cases, the JSAs should have identified all potential hazards and unsafe conditions within the immediate area of where the tasks were to be performed. This is important because the location of the tasks were outside of the shop area and in settings with which the students were not necessarily familiar. A JSA would have ensured that the students knew there were energized wires within the work area.

Recommendation #3: Schools with vocational shops should routinely review and enforce lockout/tagout programs and provide relevant training to students and school staff.

Discussion: As discussed above in Recommendation #1, the Code of Massachusetts Regulations requires schools with approved vocational technical education programs to have comprehensive safety and health plans. A lockout/tagout program, as required by OSHA (see below), should be one part of this comprehensive safety and health plan and training on lockout/tagout must be provided. A properly developed and implemented lockout/tagout program can help prevent electrical shock injuries and electrocutions by ensuring that when work needs to be performed on or near electrical circuits or electrical devices, they are de-energized first. In this case, the school had a lockout/tagout program, but two separate shock injuries still occurred. After the first shock injury, a complete review of the lockout/tagout program should have been performed to ensure the effectiveness of the program.

OSHA regulations 29 CFR 1926.417, *Lockout and tagging of circuits*, and 29 CFR 1910.333, *Selection and use of work practices*, requires that circuits and equipment cannot be reenergized during the course of the work by locking the circuits out. Lockout/tagout programs should include that before any work on circuits begin that the circuits are turned off at the switch gear and are physically locked in the off position with a lock (lockout/tagout devices) and that this process is performed by a qualified person. Locks must be attached to every location where circuits or equipment could be reenergized. Each individual working on the circuits or equipment should apply their own lock and should be the only one to have the ability to remove the locks that they applied. In these shock injury incidents, both the students whom were assigned the tasks and the instructor should have together gone through appropriate steps of the school's lockout/tagout plan. This should have resulted in both the students and the instructor applying their own lockout/tagout devices.

Lockout/tagout programs must include procedures to test the circuits that were de-energized and locked out to ensure that the circuits are completely de-energized and in an electrically safe work condition. In these cases, while performing the procedures to test the circuits to ensure that they were completely de-energized, the surrounding circuits could have also been tested to ensure that the students knew which of the surrounding circuits remained energized. Lockout/tagout programs must also include the category of personal protective equipment to be worn by the qualified person performing the circuit testing.

A qualified person must be clearly identified in the lockout/tagout programs. In a school setting, the instructors who meet the following definition would be the qualified persons. OSHA defines a qualified person as "one who has received training in and has demonstrated skills and knowledge in the construction and operation of electric equipment and installations and the hazards involved." In addition to the tasks mentioned above, a qualified person's responsibilities would include, but are not limited to, training, tool and equipment inspection, and safely reenergizing circuits.

Recommendation #4: Schools with in-house skill building opportunities should develop guidelines for these opportunities to ensure that:

- a) students have a clear understanding of the tasks they are being asked to perform; and**
- b) appropriate levels of supervision are provided.**

Discussion: Both of these cases reportedly had similar factors. These factors included: a) the electrical instructor explaining the tasks to the students, but when it came time for the students to perform these tasks, the students had not done exactly what they were directed to do; and b) the injured students being provided supervision, but during the actual time of these incidents, the supervising instructor was checking on other students, resulting in both students performing part of the tasks without the instructor in the immediate area.

Explaining a task once may not ensure that individuals, including teenagers and less experienced adults, fully comprehend the tasks at hand and feel comfortable enough to safely perform the task. Teenagers typically have limited work experiences and this combined with a desire to demonstrate independence may lead to hesitation to speaking up about their concerns, including asking for a process to be re-explained to them.

Guidelines should be developed that will ensure student safety during in-house opportunities. The guidelines should include, but not be limited to steps to assess student comfort level, competency and comprehension of the tasks they are being assigned. This should include instructors directly ask students exactly how comfortable they feel with performing the task. Then, based on the results of the assessment and the specific task to be performed, the instructor can make an informed decision on the level of supervision needed. It is imperative that instructors immediately correct and point out to students when any observed unsafe actions are being performed.

During the site visit, it was reported that the school is now attempting to better assess student competency before allowing them to start tasks. The school is having students restate the entire explanation of the assigned task back to the instructor. If the student can not clearly restate the entire task, the instructor will re-explain the task to the student who will then attempt to restate again to the instructor. This will continue to occur until the student can clearly restate the task instructions. This new process can be used as the beginning of the school's in-house opportunity guidelines. As recommended above, the guidelines should also address selecting a level of supervision that will ensure that students with limited experience are performing tasks properly and safely.

REFERENCES

American Journal of Industrial Medicine. *Protecting Youth at Work*, 36:579-582 (1999), Wegman, Davis

American Journal of Industrial Medicine. *Improving Safety for Teens Working in the Retail Trade Sector: Opportunities and Obstacles*, 34:342-350 (1998), Zakocs, et al

Code of Massachusetts Regulations. 603 CMR 4.03. Program Approval Criteria, *Vocational Technical Education*.

Code of Massachusetts Regulations. 603 CMR 4.10. Professional Standards, *Vocational Technical Education*.

NIOSH Alert: *Preventing Deaths, Injuries, and Illnesses of Young Workers*. DHHS NIOSH Publication No. 03-128.

NIOSH. *Safety and Health for Electrical Trades Students*. DHHS NIOSH Publication No. 09-113. www.cdc.gov/niosh/docs/2009-113/. Date accessed: May 31, 2011.

NIOSH. Workplace Safety and Health Topics: Electrical Safety. [cited on 2011 November 1]. Available from: URL: www.cdc.gov/niosh/topics/electrical/.

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

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

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

OSHA. Code of Federal Regulations. 29 CFR 1910.333. *Selection and use of work practices*. Washington, DC: U.S. Printing Office, Office of the Federal Register.

OSHA. *Job Hazard Analysis*. Publication Number: 3071. www.osha.gov/Publications/osha3071.pdf. Date accessed: May 31, 2011.

OSHA. Safety and Health Topics: Electrical. [cited on 2011 November 1]. Available from: URL: www.osha.gov/SLTC/electrical/index.html.

OSHA. Standard Interpretation February 29, 2008. *Whether employees who are verifying that an electrical system is de-energized or are turning off circuit breakers are required to use personal protective equipment.*[1926.95(a);1926.416(a);1926.416(a)(1);1926 Subpart K] www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=INTERPRETATIONS&p_id=25973

OSHA. Standard Interpretation June 22, 1998. *Training and PPE for employees performing tests on equipment.*[1910.333(a)(1); 1910.335(a)(2)(i); 1910.331(a); 1910.334(c)(1)] www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=INTERPRETATIONS&p_id=22605

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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.

Additional information regarding this report is available from:

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