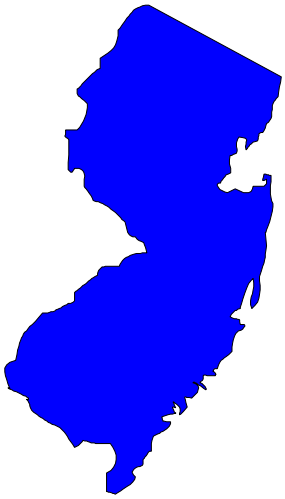
F.A.C.E.
INVESTIGATION REPORT

Fatality Assessment and Control Evaluation Project

FACE #97-NJ-051-01
School HVAC Mechanic Electrocuted
After Contacting an Energized 480 Volt Heating Coil



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FROM: Fatality Assessment and Control Evaluation (FACE) Project
New Jersey Department of Health and Senior Services (NJDHSS)

SUBJECT: Face Investigation #97-NJ-051-01
School HVAC Mechanic Electrocuted After Contacting an
Energized 480 Volt Heating Coil

DATE: March 20, 1998

SUMMARY

On July 17, 1997, a 33-year-old male heating, ventilation, and air conditioning (HVAC) mechanic was electrocuted while cleaning an HVAC system in a public elementary school. The incident occurred in the school's all-purpose room as the victim and a co-worker were servicing two large HVAC units, one of which had been leaking water. Before starting work, the two workers first tried to deenergize the units by shutting down the circuit breakers, a change from their usual procedure of turning off the power switches mounted on each unit. They inspected the first unit, found that it was wet and needed cleaning, and reenergized the ventilator fan to allow it to dry. The second unit was also dirty, so they decided to vacuum it out with a small vacuum cleaner. Entering the unit from a ladder raised to an access panel, the victim started to vacuum the loose dirt when he contacted the exposed 480 volt heating coils in the rear of the duct. He was electrocuted by the energized coils, which were on a separate fused circuit and not connected to the circuit breaker panels. NJDHSS FACE investigators concluded that, to prevent similar incidents in the future, these safety guidelines should be followed:

- Employers and employees should ensure that all electrical circuits are deenergized and tested before working on them.

- Employers should develop, implement, and enforce an electrical lock-out, tag-out procedure.

- Employers should be aware of educational and training resources for health and safety information.

INTRODUCTION

On July 17, 1997, NJDHSS FACE personnel were informed by the county medical examiner of a work-related electrocution that occurred earlier that day. After contacting the employer, a FACE investigator conducted a site visit on July 18, 1995 to interview the employers' representative and view the incident site. The scene was examined and photographed, and the FACE investigator briefly spoke with an electrical contractor hired by the employer to examine the HVAC unit following the incident. Additional information on the incident was obtained from the NJ Department of Labor , Office of Public Employees Safety, the police report, and the county medical examiner's reports.

The employer was a municipal township board of education (BOE) that operated six schools and an administrative building. Founded in 1923, the BOE employed about 70 union and non-unionized workers. The BOE did not have a comprehensive safety program, but did have a written lock-out/tag-out program. Training for the HVAC mechanics included sending them to outside training school and seminars.

The victim was a 33-year-old master HVAC mechanic who had been working for the BOE for about three years. He was described by the employer as an experienced HVAC mechanic who had worked with HVAC systems in his previous job. The BOE also provided supplementary training by sending him to training school and seminars. The victim had been promoted to his position of master mechanic about one year before the incident.

INVESTIGATION

The incident occurred inside a public elementary school in a suburban area. With school out for the summer, the school was only occupied with administrative staff. Two days before the incident the victim and his co-worker (a master HVAC mechanic with eight years of experience) were notified by a part-time school employee that an HVAC unit in the all purpose room was leaking water. The all purpose room was a large, open area with a raised stage in the front. Directly behind the stage were two identical, 480 volt electric duct heaters that supplied heat and air conditioning to the room. Each unit measured roughly fifteen feet long by three feet high and four feet wide and operated by drawing air from the room and passing it though a series of filter panels, heating coils, and air-conditioning coils. A two foot wide by three foot high access panel was located on the side of the heaters near the air intake and filter panels. On the opposite side was an electrical cabinet with an external quarter-turn power switch marked on-off. Both units were suspended from the ceiling at a height of about 12 feet from the floor.

On the day of the incident, the victim arrived at 7:00 a.m. and went to work on a small classroom ventilator with his co-worker, who was the senior HVAC mechanic. The two proceeded to the all purpose room where one duct heater was reportedly leaking water. They had worked on these units often, changing the air filters every two months and occasionally cleaning the units. When they worked on the duct heaters they usually deenergized them by turning off the power switch on each unit's electrical cabinet, but decided this day to find and shut down the circuit breakers that powered the units. The co-worker went to the breaker box in a small maintenance room near the all-purpose room. Using a radio to talk with the victim, the co-worker shut down the breakers until the victim said that the power was off. In this manner the workers identified, marked, and shut down two breakers for each unit. They then raised a ladder to examine the leaking heater and found that some water had collected in the bottom of the duct. The workers reenergized the first unit's fan to dry it out and moved on to examine the second duct heater.

Setting up a ladder to the second heater, the victim climbed up to the access panel to remove the dirty air filters. The co-worker looked for a vacuum cleaner to clean the duct but could not find one, so the victim went to get the vacuum while the co-worker threw out the dirty air filters. The co-worker returned to find the victim inside the duct with the vacuum cleaner. He climbed the ladder to the victim, who asked if was OK to start. The co-worker replied that it should be. The victim started the vacuum and laughed, saying that he was not going to get zapped. As he began to vacuum inside the duct, the victim cried out when he contacted the exposed 480 volt heating coils. The co-worker immediately tried to pull him away but could not, so he went back to the breaker panel and threw the main disconnect switch. He returned to find that the heater was still energized, so he shut down the breakers to the entire building. He again went back to find the power still on, so he moved the ladder to the heater's electrical cabinet and turned off the power switch. The co-worker was moving the ladder back to the access panel when he was told that the police arrived and not to put the metal ladder against the heater. The co-worker complied and went to another room to shut down another breaker box. When the police and EMS arrived they found the victim trapped and unresponsive in the duct heater. The local utility company was called to shut the power off, and the victim was removed from the heater. He was pronounced dead at the scene at 11:49 a.m.

Investigations by the police and an electrical contractor found that the duct heater was on a separate, three phase 480 volt power source. The two breakers that the victim and co-worker deenergized were connected to the unit's air conditioning compressor on the roof and the fan inside the unit. The heating coils were not connected to any breakers but were protected by fuses inside the unit's electrical cabinet. The electrical contractor explained that the three phase power

source was controlled through relays connected to the thermostat. This design left at least one phase always on, leaving the heating coils energized although they were not generating heat. The main power switch on the unit was also reported to be jammed in the "on" position.

CAUSE OF DEATH

The county medical examiner attributed the cause of death to electrocution.

RECOMMENDATIONS AND DISCUSSION

Recommendation #1: Employers and employees should ensure that all electrical circuits are deenergized and tested before working on them.

Discussion: This was a tragic incident where the workers were trying to properly deenergize the duct heater by disconnecting the circuit breakers but were unaware that the unit had a separate fused power supply. To prevent future incidents, it is imperative that employers and employees identify all circuits that they may potentially contact. This should include consulting wiring diagrams for all the units to confirm their power sources. After shutting down the power, the circuits must be tested to verify that they are deenergized. One method is to check the circuit with a voltage detector, such as a tic-tracer that can detect a circuit's electric field without making direct contact with the wires. It must be noted that energy control procedures are required under the PEOSH standard 29 CFR 1910.147(c) and verification of deenergization is required under 29 CFR 1910.147(d).

Recommendation #2: Employees should receive periodic training on electrical lock-out, tag-out procedures.

Discussion: In this situation, the employees did not properly follow the written lock-out, tag-out program that required verifying that the circuits were deenergized. It is recommended that the employer implement an effective electrical lock-out, tag-out training program that includes instruction in locking out all circuits at the power source. The locking out and tagging of electrical controls is required by the NJ PEOSH standard 29 CFR 1910.147(d)(4).

Recommendation #3: Employers should be aware of educational and training resources for health and safety information.

Discussion: Besides the electrical hazards, It was noted by the NJDOL PEOSH inspector that the

victim was inside a confined space, which requires a permit entry program under the PEOSH standard 29 CFR 1910.146(c) and (d). It is vital that employers obtain correct information about OSHA regulations and methods of ensuring safe working conditions. Because obtaining this type of information is often difficult for employers, the following sources may be helpful:

U.S. Department of Labor, OSHA

On request, OSHA will provide information on safety and health standards. OSHA has several offices in New Jersey that cover the following areas:

Hunterdon, Middlesex, Somerset, Union, and Warren counties.....(732) 750-4737
Essex, Hudson, Morris, and Sussex counties.....(973) 263-1003
Bergen and Passaic counties.....(201) 288-1700
Atlantic, Burlington, Cape May, Camden, Cumberland, Gloucester,
Mercer, Monmouth, Ocean, and Salem counties.....(609) 757-5181

NJ Public Employees Occupational Safety and Health (PEOSH) Program

The PEOSH act covers all NJ state, county, and municipal employees. The act is administered by two departments; the NJ Department of Labor (NJDOL) which investigates safety hazards, and the NJ Department of Health and Senior Services (NJDHSS) which investigates health hazards. Their telephone numbers are:

NJDOL, Office of Public Employees Safety .....(609) 633-3896
NJDHSS, PEOSH Program..... (609) 984-1863

NJDOL Occupational Safety and Health On-Site Consultative Program

Located in the NJ Department of Labor, this program provides free advice to private businesses on improving safety and health in the workplace and complying with OSHA standards. For information regarding a safety consultation, call (609) 292-0404, for a health consultation call (609) 984-0785. Requests may also be faxed to (609) 292-4409.

New Jersey State Safety Council

The NJ Safety Council provides a variety of courses on work-related safety. There is a charge for the seminars. Their address and telephone number is: NJ State Safety Council, 6 Commerce Drive, Cranford, NJ 07016. Telephone (908) 272-7712

Internet Resources

Information and publications on safety and health standards can be easily obtained over the internet. Some useful sites include:

www.osha.gov -The US Department of Labor OSHA website.
www.state.nj.us/health/eoh/peoshweb/peoshome.htm -The NJDHSS PEOSH website.
www.dol.gov/elaws -USDOL Employment Laws Assistance for Workers and Small Businesses.

REFERENCES

Code of Federal Regulations 29 CFR 1910. U.S. Government Printing Office, Office of the Federal Register, Washington DC.

Control of Hazardous Energy (Lockout/Tagout) US Department of Labor, OSHA Publication #3120, OSHA Publications Office, 200 Constitution Ave. N.W., Washington, D.C. 20210.

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