MIFACE INVESTIGATION: #03MI079

SUBJECT: Department of Public Works Employee Electrocuted Attempting to Read a Water Meter Located Behind an Apartment Boiler

Summary

On June 30, 2003, a 37-year-old male Department of Public Works (DPW) employee was electrocuted while attempting to read a water meter that was located behind an apartment boiler. The boiler room was lit by one overhead 40-watt light bulb. The meter was located near ground level. There was approximately a two-foot gap between the boiler and the back wall. He placed his water meter logbook on top of the boiler. Bracketed on a water pipe near the boiler was the boiler's low water cutoff switch. It is unknown if the switch cover was on the switch when the victim tried to maneuver between the water pipes and the boiler to read the water meter. During his attempt to read the water meter, he contacted exposed, 120-volt energized low water cut-off switch terminals with his right chest. Following contact with the terminals, he collapsed and became wedged between vertical pipes coming from the boiler. The low water cutoff switch cover was found hanging under the victim's chest. A cigarette lighter was found on the floor under the body. A screwdriver, not the type used by DPW employees, and a small metal screw was found near the victim's body. He was found by an apartment complex resident who alerted an apartment complex employee. The apartment complex employee contacted 911. The power company was notified and turned the power off to the boiler room. The victim was declared dead at the scene.

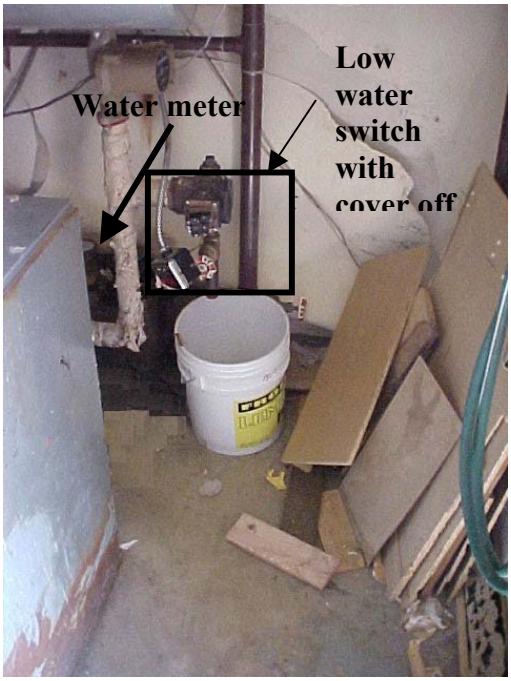

Figure 1. View of area near boiler

RECOMMENDATIONS

- DPW should establish electrical safety work practices and identify and train those employees who, under normal working conditions, are exposed to electrical hazards and have little or no electrical training in these safe work practices.
- DPW should form a working group with area businesses to develop a method of communication to alert the DPW employees of maintenance/repair/construction efforts at the business as well as DPW employees alerting customers of unsafe conditions.
- **Additionally, city officials should consider a phase-in conversion of direct reading water meters to remote reading meters.**

For Administrative Use Only
Keywords: Electrocution, DPW

INTRODUCTION

On June 30, 2003 a 37-year old male Department of Public Works (DPW) employee was killed when he came into contact with electric current while attempting to read a water meter that was located behind a boiler. On July 1, 2003, MIFACE was informed by the Michigan Occupational Safety and Health Act (MIOSHA) personnel, who had received a report on their 24 hour-a-day hotline, that a work-related fatal injury had occurred on June 30, 2003. On August 12, 2003, the MIFACE researcher visited the site, talked with the DPW supervisor and fellow employees and police chief about this incident. During the course of writing the report, the death certificate, autopsy results, and police report were obtained. All Figures used in this report are police photographs taken at the time of the incident.

The Department of Public Works received one alleged "Serious" citation and one "Other" citation as a result of the MIOSHA inspection. The Serious citation was for violation of Electrical Safety-Related Work Practices, Part 40, Rule 4005(4) – employees were not trained to recognize electrical hazards and there was no procedure to address hazard while reading water meters at customer locations. The Other citation was a MIOSHA recordkeeping violation.

The Department of Public Works has five employees. This was their first fatality. The victim was a full-time, hourly utility worker. He typically did various jobs such as running heavy equipment, reading meters, ran streetsweepers, etc. He had four years of total work experience in the DPW, two years of part-time work and two years of full time work with the department. He had two years experience reading water meters. The DPW did not have a comprehensive written safety and health plan and did not have specific standard operating procedures for hazard assessment while reading water meters. There is no safety and health committee, but safety meetings are held with employees on an "as necessary" basis. All DPW employees have attended various education and training courses sponsored by the employer and an insurance provided consultant. DPW workers were not expected nor trained to conduct any electrical work. The victim's usual workshift was 7:00am-4:00pm, five days a week.

INVESTIGATION

The city is divided into quadrants, each quadrant has it own water meter logbook identifying the water meters in the quadrant. According to fellow workers the victim had the "hardest" logbook. This quadrant had the highest number of customers. It took the victim one to one and one-half days to read all the meters in this quadrant. On the day of the incident, he started at approximately 9:00am to read his meters. This was a little later start than usual because he was training new DPW employees.

The boiler involved was a Hydrotherm model from 1975. It had received a boiler inspection, and passed, in 2002. This model heats an incoming water supply and supplies heated water to the apartment complex heating units. Eight apartments received their hot water from this boiler unit. The boiler has a 120-volt low-water level cut-off switch located behind and to the side of the boiler on a water pipe. The low water switch will turn off the boiler when water is lost through the system. The 120-volt low water cut-off switch had two terminals and was not properly

grounded. On the day of the incident, the boiler was running and distributing heat to the apartments.

The water meter involved had been installed at the apartment complex in 1972. The water meter is located behind the boiler near the wall at floor level. (See Figure 2) Current building codes would not permit the water meter location to be behind the boiler, however installation in that location was permitted in 1972. The meter was read one time per month.

Figure 2. Water meter at floor level

The police report stated that the apartment complex maintenance person had worked on this boiler unit approximately one month prior to the fatal incident, because no heat was being provided to the apartments serviced by the boiler. While performing the required maintenance, the police report states that the maintenance worker removed the cover to the low water shut-off switch to assure it was operating. While working on the switch, the maintenance worker was distracted by a resident and left the boiler area. The maintenance worker could not remember if the cover was properly secured.

It was 80 degrees on the day of the incident. Co-workers thought that the boiler room was probably much warmer than 80 degrees. The victim had read 12 meters before arriving at the apartment complex to read its meter. The victim had read this water meter uneventfully many times in the past. He spoke with the apartment complex manager a few minutes, then went to the meter location. The boiler room was lit by one 40-watt light bulb. The floor was dry. He placed his logbook and the boiler room keys on top of the boiler. When the logbook was found, an entry for this boiler had not been made.

There was approximately 13 inches of clearance between the piping behind the boiler and the water meter. It is unknown if the switch cover was on the switch at the time of the incident or whether the cover was inadequately secured on the switch housing, and the victim knocked the cover off of the boiler's 120-volt low water cutoff switch as he was positioning himself to read the water meter. The victim was a large man, over 250 pounds and over 6 feet tall, which could have made it difficult for him to enter the space behind the boiler to read the meter.

Fellow workers thought it unlikely that the victim would have entered the space behind the boiler to read the meter if the cover was off of the exposed terminals. Whether the cover was on the switch when the victim arrived or whether he placed the cover on the switch is unknown. A screwdriver, not the type used by DPW employees, and a small metal screw were found near the victim's body. Due to the lighting in the room, fellow workers thought it was unlikely that the victim saw the screw and screwdriver lying on the floor. It is unknown if this screw fell out at the time of the incident or whether the maintenance person left it on the floor when he left to assist the resident and never returned.

Although exactly what occurred is not known, MIFACE proposes the following scenario based upon the interviews of fellow employees, law enforcement and review of other documents. The low water cut-off switch cover was on the switch but was not properly secured. The victim used the small cigarette lighter that was found under his body to see the water meter face, holding the lighter in his left hand. His back was to the boiler and his chest area was facing the back wall. He may have been using his right hand on the water pipes as support. He attempted to crawl in between the pipes and boiler to read the meter. As he was attempting to enter the space behind the boiler, he knocked the cover off of the low water switch, due to the location of the cover under the victim's left chest when he was found. (If he had knocked the cover off as he was exiting the space, it is thought that the cover would be more towards the right shoulder). (See Figure 3) When he attempted to exit the space, his right chest contacted the exposed terminals, "bending" one terminal into the energized terminal. (See Figure 4) He was apparently touching either the water pipes or the boiler with his body as he provided a path to ground. After collapsing, he became wedged between the vertical pipes behind the boiler.

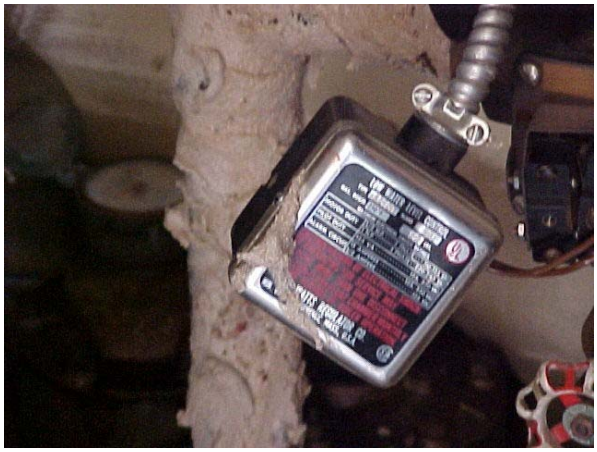

Figure 3. Low water switch box cover hanging from bracket

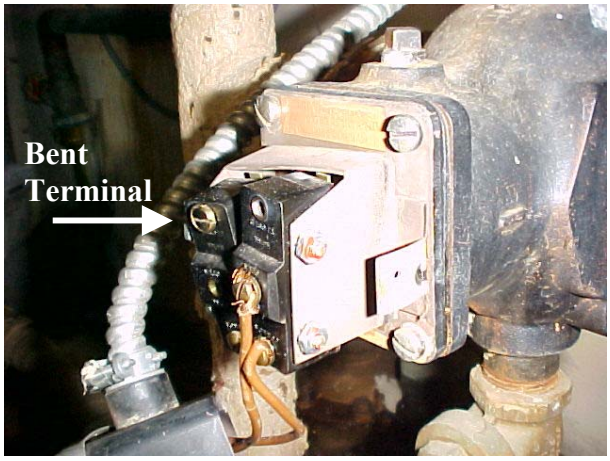

Figure 4. Low water switch terminals after victim contact

A resident of the apartment complex saw the open boiler room door, and upon walking through, noticed boots near the boiler. The resident went to get the apartment complex manager and the manager went to investigate. Upon seeing the victim, the manager called 911. Emergency response arrived. Police found the victim in a kneeling position, with one leg extended. His head was resting on a hot water pipe from the boiler. His left hand was under his body, his right hand by his hip. His back was against the boiler. The low-water level cut-off switch cover was hanging under his body. There was a burn mark on his shirt and a corresponding burn mark on his chest below the right nipple, nearly the size of the terminals from the cut-off switch. No exit area for the electricity was noted.

The power company was notified and turned power off to the boiler room. The victim was declared dead at the scene.

CAUSE OF DEATH

The cause of death as listed by the medical examiner on the death certificate was electrocution. Toxicological studies showed no illegal drugs, alcohol, or other medications that could be a factor in this incident.

RECOMMENDATIONS/DISCUSSION

- Employers should establish electrical safety work practices and identify and train those employees who, under normal working conditions, are exposed to electrical hazards and have little or no electrical training in these safe work practices.

DPW workers read water meters in a variety of settings, commercial and residential, both indoors and outside. DPW employees may reasonably be expected, by the nature of their work, to read meters that may be near exposed parts of electric circuits that operate at 50 volts or more to ground. The MIOSHA General Industry Safety Standard, Electrical Safety-Related Work Practices, Part 40 addresses the need for safety-related work practices for both qualified persons and unqulaified persons. A qualified person is one who has training in avoiding the electrical hazards of working on or near exposed entergized parts and is permitted to work on or near the exposed energized parts. Many DPW employees would be considered unqualified persons, that is, those *who have little or no such training*, *who work on*, *near*, or *with* a variety of electrical installations.

To prevent electric shock or other injuries resulting from either direct or indirect electrical contact, an employer must develop safety-related work practices. Specific work practices must be consistent with the nature and extent of the associated electrical hazard. No one knows the location of the low water switch cover or any victim action relating to this cover. Because he had read this meter without incident in the past, and with the dimly lit work area, if the cover was placed on the switch housing, it is easy to presume that he thought that the cover would be secure and that he would not be exposed to an electrical hazard. If the switch cover was left hanging and/or he reattached the cover, an electrical hazard would have been present and he was not properly trained to assess this hazard and take appropriate precautionary measures.

To develop the safety-related electrical work practices, a hazard assessment of the varied work areas the DPW employees enter should be conducted. The hazard assessment would gather information about potential electical shock sources so specific safety-related work practices, consistent with the nature and extent of the associated elctrical hazrds can be developed as required under the MIOSHA standard. The work practice of using a cigarette lighter as a light source to read a meter should be discouraged. DPW employees stated that they are issued flashlights. A flashlight, with high-intensity adjustable spot-to-flood beam better illuminates a “hard-to-read” meter than does a cigarette lighter.

Employee participation in the hazard assessment is critical, as they are routinely in these environments and may be aware of existing and potential hazards. Once the electrical hazards are identified and safe work procedures developed, employees should be trained in these procedures to prevent electric shock or other injuries resulting from either direct or indirect contact with electrical current.

- DPW should form a working group with area businesses to develop a method of communication to alert the DPW employees of maintenance/repair/construction efforts at the business.

The hazard assessment conducted to determine electrical shock hazards could also include looking at other safety and health issues that DPW workers are exposed to while entering businesses to read their water meters. According to the victim's colleagues, identified hazards associated with reading the water meters included poor lighting, nonmaintained stairways, and cluttered areas that present trip hazards. In this incident, the room was lit with a 40-watt light bulb, which would have increased his difficulty in determining any changes of work environment, i.e., if the switch cover was on and inadequately secured. Working with area businesses to improve the working conditions for the DPW employees not only increases the safety for the DPW workers, but also the businesses' workers who may enter that environment as part of their job responsibilities.

When the MIFACE researcher spoke with the victim's coworkers, they indicated that the incident circumstances were not unusual; the DPW is often unaware of maintenance efforts that may impact DPW worker safety that is/was performed within the month between the water meter readings. The coworkers indicated that it is difficult to tell when the environment is changed. In this instance, if the low water switch cover was on the switch housing, but not secured, the environment would not appear to be different to the individual performing the water meter reading. But in fact, the environment would be very different. The coworkers suggested, and MIFACE concurs, that a method of communication could be developed to alert the DPW workers of changes in the environment between the visits due to maintenance or other activities that the business engages in. The customer should also be notified by DPW employees of unsafe conditions noted at the meter reading so the customer has an opportunity to correct those condtions by the next meter read date. A joint effort to identify and institute a communication system also benefits the businesses by allowing them to also alert their own employees to changed work conditions.

- **Additionally, city officials should consider a phase-in conversion of direct reading water meters to remote reading meters.**

Many businesses and homes have water meters that are in hard-to-reach areas and may be difficult to read. Traditionally, the water meter in the building is usually located on the lower level where the water service pipe enters the building. To read the meter requires access be provided to the meter reader.

Remote water meters provide digital readings of water usage that can be gathered (a) visually and manually recorded, (b) with a handheld scanning device at the meter itself, or (c) by reading radio signals from the meter. The remote reader is installed on the outside of the building to facilitate reading. The meter reading is transmitted by wire to the remote readout.

Many cities have had multi-year programs to convert direct reading water meters to remote reading meters. MIFACE encourages this trend to minimize DPW worker exposure to potentially unsafe working conditions.

REFERENCES

1. MIOSHA General Industry Safety Standard, Part 40, Electrical Safety-Related Work Practices

MIOSHA Standards cited in this report can be directly accessed from the Michigan Department of Labor and Economic Growth, MIOSHA website www.michigan.gov/mioshastandards.

The Standards can also be obtained for a fee by writing to the following address: Michigan Department of Labor and Economic Growth, MIOSHA, Management and Technical Services Division, P.O. Box 30649, Lansing, Michigan, 48909-8149. Management and Technical Services phone number is (517) 322-1817.

MIFACE
Investigation Report # 03 MI 079
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To improve the quality of the MIFACE program and our investigation reports, we would like to ask you a few questions regarding this report.

Please rate the following on a scale of:

Excellent	Good	Fair	Poor
1	2	3	4

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Thank You!

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