MIFACE INVESTIGATION: #02MI208

SUBJECT: Laborer Electrocuted When Antenna on Top of Steel Pole Building Contacts 14400-Volt Energized Line

Summary

On December 5, 2002, a 48-year-old male laborer was electrocuted when a county road commission steel pole-building antenna contacted an energized 14,400-volt overhead power line while the building was being relocated via a state highway. An electric company lineman, a cable company employee, road commission employees and a police escort were on site. The building was positioned on three dollies, two steer dollies at the "rear" of the building and one dolly at the "front" of the building that hooked to the tow vehicle. The lineman dropped the neutral wire from the pole and left the 14,400-volt electrical lines energized. The lineman was present in an aerial bucket positioned on the road shoulder to observe building clearance while the building was being moved. Approximately 75 feet of the building had proceeded under the lines when two employees assigned to the "rear" steer dollies went under the building and began to ratchet each dolly chain to steer the rear of the building onto the road. (See Figure 1). Near the front of the building a "bolt of lightening" was observed as the building antenna contacted the line. The two employees at the "rear" steer dollies received electrical shocks and fell to the ground. Bystander CPR was initiated and emergency response was called. One of the workers was taken to the hospital and survived, the other worker was pronounced dead at the scene.

Figure 1. Incident Scene

RECOMMENDATIONS

- Employers should verify that a minimum of 10 feet is maintained by employees when working near an energized electrical line, gear or equipment exposed to contact with an energized overhead power line.
- Develop a building assessment standard operating procedure that includes roof protrusions regardless of building height as part of a company specific Accident Prevention Plan that is in compliance with MIOSHA requirements.
- Stress and routinely review the hazards regarding overhead power lines so that all employees are cognizant of these energized sources.
- Select personal protective equipment and other equipment insulating materials to provide operator protection from inadvertent contact with electricity.
- Companies should not use skip boards to raise electrical or other overhead lines.
- **Additionally, MIFACE recommends that electric utility companies review their policy for communicating with individuals prior to work that will be performed within the vicinity of an energized overhead power line and the documentation procedures of this communication.**

INTRODUCTION

On December 5, 2003, a 48-year-old male laborer was electrocuted when the antenna on a county road commission steel pole building contacted an energized overhead power line while it was being moved from one location to another location. On December 16, 2002, MIFACE investigators were notified of the fatality by a newspaper article. On June 6, 2003, the MIFACE researcher interviewed the manager of the company. At the time of the interview, the manager escorted the MIFACE researcher to the site of the electrocution, to the new location of the pole building, and an additional site where the vehicle used to haul the pole building was located During the course of writing the report, the autopsy results, death certificate, police report, the MDOT permit, the contract for services between the moving company and road commission, and the MIOSHA citations were obtained. Pictures used for Figures 1, 4, 5 and 6 are police department photographs taken at the time of the incident. Pictures for Figures 2, 3 and 7 were taken at the time of the MIFACE site visit.

The MIOSHA investigation resulted in three alleged serious citations being issued to the company; the company's Accident Prevention Program did not provide for elimination of hazards, employees did not maintain 10-foot clearance from an overhead 14,400-volt power line and that the employer did not notify the Department of Consumer and Industry Services within 8 hours of the fatality.

The company has been in business for 24 years, specializing in moving buildings, both private and commercial. The company was family owned and has 4 employees, the owner and two employees who work in the field and the spouse of the owner who acts as "office manager". The victim had previously worked for the company for 10-12 years, but had left and started his own business. The victim had been involved in the building moving business for at least 40 years, beginning by assisting his father who was also in the house moving business. The employee working directly with the victim had 4-5 years experience moving buildings. The company had a written health and safety program, but it was a generic program, not specific to the business. The company provides safety training as "on-the-job".

INVESTIGATION

The company was contracted by the county road commission to move a steel pole building (40-feet-wide by 100-feet-long) that acted as its maintenance garage, from one location to another location along a 2-lane state paved highway. The original location of the building was approximately 50-100 feet away from the state road. The building was located on a concrete slab. A compacted dirt driveway led to the pole building location. There was an estimated elevation change of approximately 4-6 feet from the building location to the state road. (See Figure 2)

Figure 2. Original building location

The building had 4 ventilation stacks on the roof that

did not extend beyond the roof peak. An antenna with a rubber tip used for 2-way radio communication was also present on the building roof. The estimated height of the antenna was 30-36 inches. (See Figures 3 and 4).

Figure 3. Pole building

The contract between the moving company and the road commission stated that the moving company was responsible for raising the structure, obtaining all building move permits and police escorts required by any State or local governmental authority, moving the structure to the new location and setting the structure on the new foundation provided by the building owner. The road commission was responsible for having all public and private utilities disconnected from the structure, all wire raising costs, all zoning and building permits required at the new site, excavation and installation of a foundation for the structure, reconnecting all public and private utilities to the structure after it has been set on the foundation and removal of the existing foundation and site cleanup after the structure has been moved.

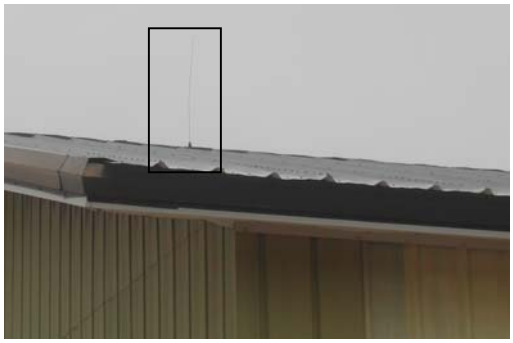

Figure 4. Antenna on building roof

The moving company prepared for the move by taking a survey of the building, measuring the building, identifying the route to be traveled and the location of utility lines and applied for a State of Michigan Department of Transportation (MDOT) Transport Permit, Special Provisions Governing the Movement of Oversize and Overweight Vehicles or Loads. According to the office manager, the MDOT engineer had been to the building several times to inspect it once it was loaded and did not mention seeing the antenna at the top of the building to any moving company personnel. A permit checklist was completed as required by MDOT in order to approve application for the moving permit. MDOT approved the Oversize and Overweight Vehicles or Loads moving permit.

Approximately one month prior to the move, moving company employees began to prepare the building for transfer. The building was raised and steel support beams were fabricated and installed. The dollies used to carry the building were positioned. Two tandem axle dollies were at one end of the building (referred to in this report as the "rear steering dollies"). (See Figure 5). The rear steering dollies had a metal ratchet with steel chain wrapped around one of the steel beams. A tandem axle dolly with a trailer-type tongue was placed at the opposite end of the building ("front") to hook to a front-end loader (tow vehicle). When the building was raised

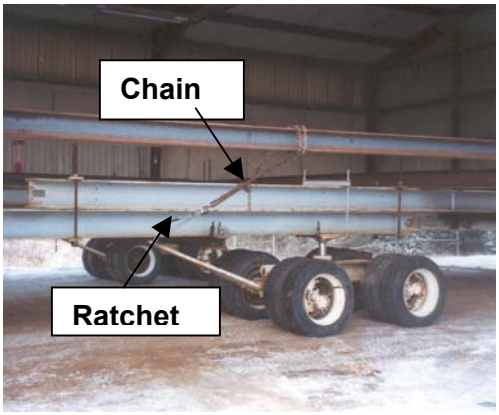

Figure 5. Rear Steer Dollies under building

and placed on the dollies, its height was approximately 25 feet (without the antenna).

After measuring the building, the moving company determined that the top of the building would be higher than 18½ feet. The office manager said that whenever a building is higher than 18 ½ feet, they assume the building cannot safely pass under the power lines. For this reason, the moving company did not go on top of the building roof to identify any protrusions from the roof that would substantially raise the effective height of the building. Generally, company personnel will go on top of a building to identify items that will add to the building height and remove them, if possible, to keep the building's effective height less than 18½ feet. If not possible to remove the protruding items, sometimes the moving company will build a "skip board", a wooden board that is 1"x 4"x 12' long. Any overhead lines will ride on the board up and over any roof protrusions (like a chimney or water vents).

The moving company contacted the electrical utility company, telephone, cable, and other entities that may have owned overhead lines within the travel route. The company told all contacted line owners where the original building location was and the building's destination location as well as the travel route that was going to be taken. The moving company determined that the phone line was buried. Entities with active overhead lines were the cable company and the electric utility company. The electrical utility company had also measured the building height and had driven the route to determine the line clearance and whether lines needed to be raised or lowered. According to the company manager, the power company did not identify the presence of the antenna to the building movers.

At the time of the incident, there was snow on the ground and a light mist in the air. Snow covered the building roof. The building moving crew consisted of 4 people, the owner and his two employees and the victim. A front-end loader (CAT IT18) was the tow vehicle. It was selected to haul the building because the turning radius of the loader met the angle requirements to turn the building from the driveway onto the state road. One employee was driving the front-end loader, another other employee and victim were assigned to the rear steer dollies. The owner was the director of operations. Also on-site were road commission employees, sheriff department employees for traffic control, an employee from the electrical utility and an employee from the cable company.

Directly prior to the building move, road commission employees sanded the driveway leading out of the property to ensure traction for the front-end loader. The company had moved the building up the driveway leading into the property, stopping right before the utility support poles located near the shoulder of the state road where the cable and electric lines crossed the driveway.

The cable company took their fiber optic cable off of the poles and laid it on the ground. The moving company built a plywood crib to protect the fiber optic cable as the dollies went over it. The utility company dropped the neutral wire from the pole. The high voltage line was left energized on the pole, uninsulated and not grounded. The utility company employee positioned the bucket truck on the shoulder of the state road at the intersection of driveway and the state road.

The victim and coworker had worked together in the past and for this move, had practiced using the two rear steering dollies in tandem. They had to simultaneously ratchet the chains on the rear steering dollies to turn the dolly wheels to successfully turn the rear of the building. (See Figure 6). The company owner stood near the end of the building that was attached to the front-end loader and was responsible for telling the victim and coworker at what point they needed to begin turning the rear of the building.

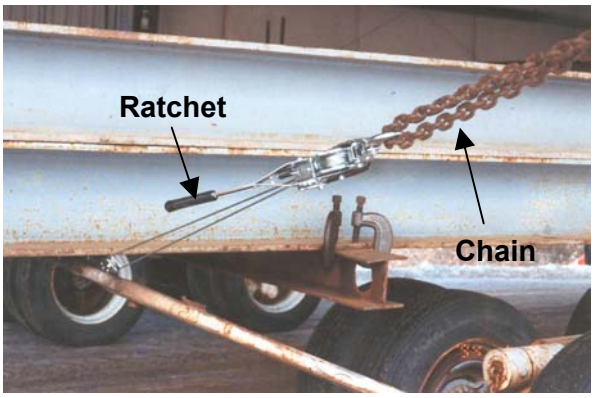

Figure 6. Rear steering dollies ratchet and chain

The MIOSHA compliance officer investigating this incident informed the office manager at the closing conference of the following findings: the lineman in charge for the power company met with the owner of the moving company and told him that no one was to be near the steel building until the building cleared the overhead power lines, the same lineman who was up in the bucket of the utility truck observing the building clearance and the power line yelled to an employee to get out from under the building, and that the employee acknowledged his command and exited from under the building as the move continued under the overhead wires.

When the MIFACE researcher conducted the on-site visit, the office manager stated that the moving company had worked many times over many years with the same lineman at other similar moving situations and that the lineman had never made similar warnings to the company personnel. The office manager stated that the lineman was very familiar with how the company operated and how buildings were to be maneuvered. The office manager was not aware of any warnings issued by the utility lineman in this incident or of a pre-move meeting.

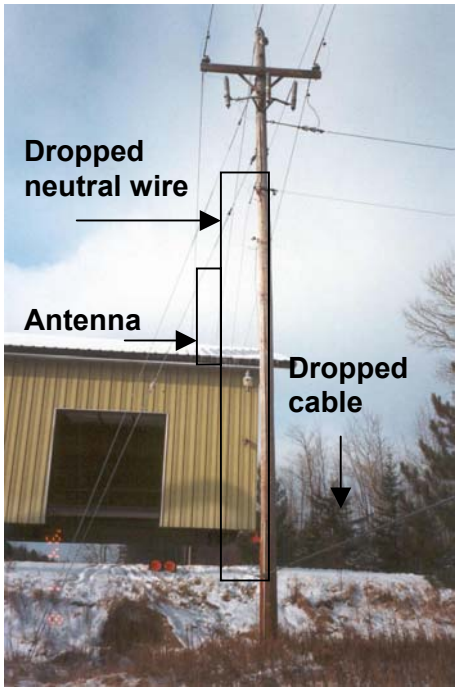

Figure 7. Building position and dropped utility lines

After dropping the neutral and cable lines, the building move continued. Approximately 75 feet of the building had passed under the energized overhead line. (See Figure 7) The owner, by 2-way radio, instructed his employees to go under the building to adjust the steering mechanism on the rear steering dollies with approximately ¼ of the building still under the power lines. As they adjusted the steering, the building continued to move and the rear steer dollies went over cable's plywood crib. The 30-36 inch antenna protruding up from the peak made contact with the energized 14,400-volt line. The owner saw a flash of light near the front tandem axle dolly. Both the victim and his coworker under the building adjusting the rear steering

dollies provided a path to ground for the voltage. It is unknown if the workers were holding onto the ratchets or in contact with the building when they became a path to ground. Both workers broke contact by falling to the ground.

The owner observed his employee under the building as he staggered and fell to the ground. The owner moved this individual from under the building and began CPR. The victim was under the other side of the building. Both the coworker and victim received bystander CPR until emergency response personnel arrived at the scene. The coworker required hospitalization for injuries sustained as a result of the incident. The victim was declared dead at the scene.

The electric utility employee went to the substation that controlled the contacted line and de-energized it. The electricity blew out the front tires of the front dolly. The company owner contacted another company to finish the building move.

Both victims were wearing gloves. The office manager indicated that the victim was wearing steel-toed boots at the time of the incident; the coworker was not wearing steel-toed boots.

The probable current entrance was on the victim's right hand as evidenced by a characteristic burn pattern indicating electrical current entrance. Both feet had burns on them and are the probable exit path.

CAUSE OF DEATH

The cause of death as stated on the death certificate was high voltage electrocution. The victim was noted to have caffeine in his blood; results of all other toxicological tests were negative.

RECOMMENDATIONS/DISCUSSION

- Employers should verify that a minimum of 10 feet is maintained by employees when working near an energized electrical line, gear or equipment exposed to contact with an energized overhead power line.

The movement of the building near energized overhead power lines was not a task specifically covered by MIOSHA Construction Safety Standards, Part 16. Power Transmission and Distribution, Part 17. Electrical Installations, or Part 30. Telecommunications. The employer was covered by MIOSHA Construction Safety Standard, Part 1, General Rules. Rule 115 of Part 1 requires that an employer may not work or be closer than 10 feet to an energized electrical lines, gears or equipment if the voltage is less than or equal to 50 kv.

According to the office manager, because of their past working relationship with the electrical utility and lineman, the company relied upon the electrical utility company to act as an observer to ensure a safe distance between the building and power line was maintained as well as to assess any electrical hazards. The company had contacted the electric utility; the electric utility did not de-energize, insulate or ground the overhead power line crossing the driveway. The moving company recognized the potential hazard of being too close to overhead power lines because they recognized that the building height would be nearly 25 feet when it was raised on the

dollies. A safe distance could not be maintained due to the height of the building. The company must train their personnel and enforce a policy that no one must be within 10 feet of a structure when under an energized overhead power line.

- Develop a building assessment standard operating procedure that includes roof protrusions regardless of building height as part of a company specific Accident Prevention Plan that is in compliance with MIOSHA requirements.

The development of standard operating procedures should be a part of the health and safety plan. This family-owned company had a generic health and safety program, but did not tailor it to their business and specific job task work exposures. Even small companies benefit from the exercise of developing a safety and health program to evaluate worker tasks, identify potential hazards, and to develop measures to address the identified hazards. A benefit of the process is the assistance it provides employers in developing consistent, thorough health and safety training for their employees.

MIFACE recommends that a standard operating procedure be developed to guide the assessment of hazards that may be presented by a building before a building move. This procedure should be implemented regardless of the height of the building. At the time of the MIFACE researcher visit, the company only accessed the roof of the building was less than 18 ½ feet when raised. If the owners had accessed the roof of the building involved in the incident, they may have seen the building antenna and taken steps to remove it or build a skip board to protect personnel and the building from potential electrical contact. A standard operating procedure that incorporates a full perimeter building assessment regardless of the height could detect additional building projection hazards that may alter the height or width of the building and identify additional measures that may be required to safely move the building.

- Stress and routinely review the hazards regarding overhead power lines so that all employees are cognizant of these energized sources.

The danger of overhead power lines appears to be obvious, however, contact with power lines and the subsequent occupational-related fatalities continue. Employers must stress and routinely review the hazards associated with overhead power lines with their employees. The employer was aware of the power line and the "on-the-ground" work crew was probably well aware of the hazards of overhead power lines based on the level of experience of each person. This incident underscores the need for increased management and worker understanding, awareness, and ability to identify the hazards associated with working on or in proximity to electrical energy.

- Select personal protective equipment and other equipment insulating materials to provide operator protection from inadvertent contact with electricity.

The primary hazard control for preventing worker injury is maintaining at least a 10-foot distance from overhead electrical hazards. Additional protection can be utilized, such as proper selection of personal protective equipment and insulating conductive equipment. Personal protective equipment may include rubber gloves and boots selected using the maximum voltage anticipated for the potential exposure. The gloves should be tested before the first issue and

every 6 months thereafter. The storage of rubber protective equipment in the field is critical to maintaining its integrity. Improper storage such as sharp bends and folds and exposure to ozone will quickly cause damage to the personal protective equipment that is not kept in its natural shape. MIOSHA Construction Safety Standard, Part 6, Personal Protective Equipment, Rule 641, Rubber protective equipment; certification; use and storage, details the requirements for insulating equipment, such as gloves, matting, blankets, covers, line hose and sleeves. Safety shoes without steel toes are recommended.

The tow dollies used may be operated in areas both with and without an overhead electrical hazard. The ratchet handles should have an insulating material such as fiberglass or rubber placed on them to provide additional operator protection.

- Companies should not use skip boards to raise electrical or other overhead lines.

The office manager indicated that they would build a skip board when a building roof protrusion which could/would not be removed raised the height of the building and interfered with the moving the building under an energized line. The purpose of the skip board is to allow the energized line to move above the protrusion without getting entangled or caught by the protrusion. This practice is not recommended. Often, a skip board is constructed of wood. Wood can still conduct electricity if contacted by an energized line. It is a standard operating practice in structure moving industry to construct a skip boards to allow a structure to move under an energized overhead line. If an exposure to electricity may occur, the wood may not provide the employee protection intended. The use of the skip board will not comply with MIOSHA standards to maintain the 10-foot clearance requirement. If an energized line must be raised to allow for structure clearance, the line owner should be held responsible to raise the overhead line.

- **Additionally, MIFACE recommends that electric utility companies review their policy for communicating with individuals prior to work that will be performed within the vicinity of an energized overhead power line and the documentation procedures of this communication.**

It is unclear if the lineman gave instruction to the workers steering the dollies to stay away from the building as it went under the line as well as if there was a pre-move meeting between the utility company personnel and the moving company. The owner of the moving company was in communication with his employees, but not in communication with the utility's person in the bucket.

This highlights and emphasizes the role of effectively communicating hazards to all individuals involved in operations around energized electrical power lines. It is unknown if the utility lineman observed the antenna on the building roof until it contacted the overhead wire. A communication protocol between the utility company and moving company owner directing his employees was not established and may have played a role in this incident. MIFACE recommends that utility companies review company policy for communicating with individuals prior to work that will be performed within the vicinity of an energized overhead power line and the documentation procedures of this communication**.** Documentation of the communication

meeting and the meeting results will assist all involved while working in the vicinity of energized lines to develop communication procedures so companies can effectively coordinate employee activity, maintain appropriate employee safety distances, and provide an avenue for communication between utility personnel and the company performing work.

REFERENCES

MIOSHA Standards cited in this report can be directly accessed from the Consumer and Industry Services, MIOSHA website www.michigan.gov/mioshastandards. The Standards can also be obtained for a fee by writing to the following address: Department of Consumer and Industry Services, MIOSHA Standards Division, P.O. Box 30643, Lansing, MI 48909-8143. MIOSHA phone number is (517) 322-1845.

1. MDCIS Construction Safety Standards, MDCIS, MIOSHA Construction Safety Standards, Part 1. General Rules
2. MDCIS, MIOSHA Construction Safety Standard, Part 6, Personal Protective Equipment
3. Occupational Safety and Health Administration (OSHA). Overhead Power Lines: Don't Get Zapped! Employer Kit, February 3, 2003 www.osha.gov/Region7/overheadpowerlines/index.html
4. Occupational Safety and Health, Overhead power lines: High-wire safety, August 2001 Issue. www.stevenspublishing.com Click on link "Online Services". Select "Occupational Safety and Health". Click on link "Archives", then August 2001 issue.
5. National Institute for Occupational Safety and Health, Worker Deaths by Electrocution, A Summary of NIOSH Surveillance and Investigative Findings, May 1998. Internet site: www.cdc.gov/niosh/elecmono.html

MIFACE
Investigation Report # 02 MI 208
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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

What was your general impression of this MIFACE investigation report?

Excellent	**Good**	**Fair**	**Poor**
1	2	3	4

Was the report…	**Excellent**	**Good**	**Fair**	**Poor**
Objective?	1	2	3	4
Clearly written?	1	2	3	4
Useful?	1	2	3	4

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Clearly written?	1	2	3	4
Practical?	1	2	3	4
Useful?	1	2	3	4

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