MICHIGAN HAZARD ALERT

MICHIGAN STATE UNIVERSITY: Prevention of work-related injuries & illnesses through research & investigation

LOOK UP FOR OVERHEAD POWER LINES

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Overhead power lines transmit electrical energy along large distances, along conductors (bare wires) and with insulator supports used to attach the conductor to the utility pole to prevent current from flowing to ground. Overhead power lines can carry voltages ranging from 240 volts (V) for residential areas to 765 kilovolts (kV) for long-distance transmission.

Electric Shock vs Electrocution

Electric Shock: An electric shock refers to any contact with electricity that causes a physiological reaction or injury in the human body. Electricity will always find the path of lowest resistance. An individual will receive an electrical shock if any part of their body contacts electric current or current flows through their body and completes an electrical circuit to ground. There are two primary contact mechanisms of contact: Direct and Indirect. Electric shocks can occur by **direct contact** when the individual *directly* touches the energized conductor. **Indirect contact** involves touching a machine or tool that becomes electrified due to contact with an energized conductor or contacting different voltages (voltage gradient) emanating from electrified equipment or an electrical ground (step potential). Figure 1 shows individuals standing within two different voltage gradients which could cause them to be shocked/electrocuted. Depending on the electrical current intensity, the path it takes, and the duration of exposure, it can cause a range of injuries, including death.

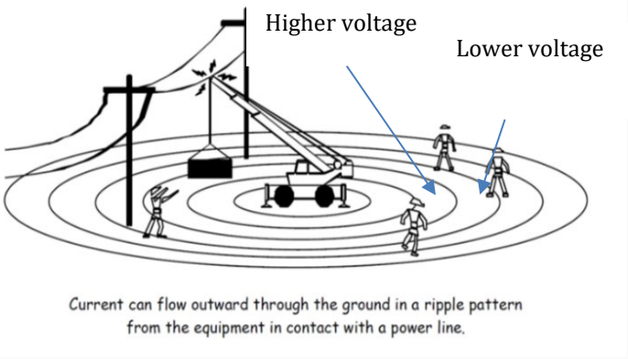

Figure 1 Step Potential illustration. courtesy of CPWR-Center for Construction Research and Training Electronic Library

Electrocution refers to instances where the electric shock is fatal or nearly fatal. Every electrocution involves an electric shock, but not all electric shocks result in electrocution.

From 2001-2023, there have been 116 work-related electrocutions in Michigan; Sixty-eight (58.6%) of the 116 deaths involved energized overhead power lines. Figure 2 identifies the number of electrocution deaths caused by the source of contact with the overhead power line. Forty-two (42, 61.8%) overhead line electrocution deaths were caused by indirect contact. *Truck-mounted equipment* includes a Christmas tree painting boom, digger derrick, guardrail post pounder, and a pumper truck with extendable conveyor system. *Cranes* included one free-standing and two truck-mounted; the free-standing crane incident had 2 deaths. *Earthmoving equipment* includes a backhoe, excavator and crawler/excavator. *Other machines* include a telehandler, extendible boom rough terrain forklift and an extendible articulating boom lift.

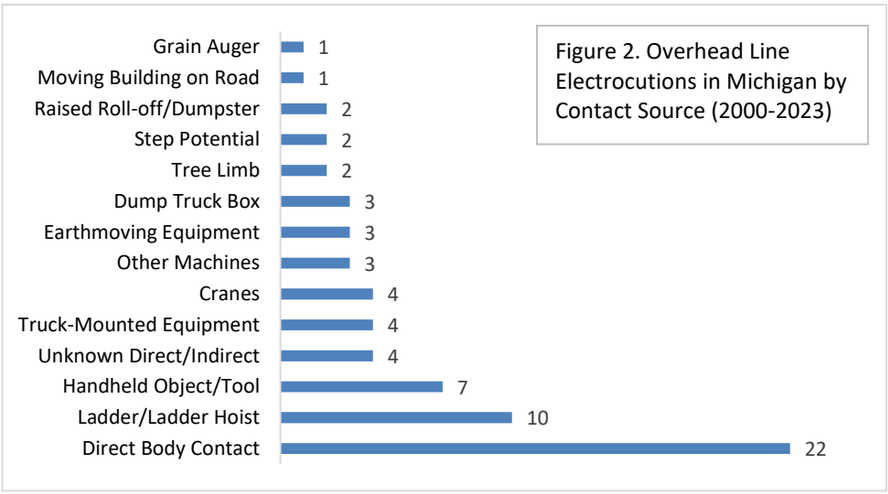

Figure 2. Overhead Line Electrocutions in Michigan by Contact Source (2000-2023)

EXAMPLES OF WORK-RELATED FATALITIES FROM CONTACT WITH AN OVERHEAD LINE IN MICHIGAN

- A church volunteer in his mid-teens and his youth pastor both were electrocuted when they moved an aluminum extension ladder. The ladder was extended more than 29 feet and contacted an overhead power line of unknown voltage. The youth died and the youth pastor survived.

- A laborer in his 20s was electrocuted when the boom of a stake truck modified to paint Christmas trees contacted an energized overhead 7,200-volt power line while he held an aluminum paint gun connected to the boom by a metal-reinforced hose. (MIFACE Investigation Report #07MI121)
- A lineman in his 50s was electrocuted when he contacted a 4,800-volt overhead electrical line during the replacement of an antiquated cross arm with associated dowel pins and insulators.
- A tree trimming service foreman in his 30s was electrocuted when he picked up an energized 4,800-volt power line that had fallen to the ground in a windstorm. The decedent and his coworker were sent to clear a downed tree. After assessing the area but before starting the job, a job briefing was conducted. The decedent used a chain saw to cut up the tree. After he wrapped up the neutral line and placing it by a tree, the decedent thought the primary line was dead and grabbed the line with his bare hands.

PREVENTING FATALITIES FROM WORK-RELATED ELECTROCUTIONS FROM OVERHEAD LINE CONTACT

- **LOOK UP! Survey the area. Locate all power lines and other electrical hazards on the job site** before starting work.
- **Develop a written plan** to eliminate inadvertent power line contacts**.** The plan should address the following:
  - The power line hazards on the jobsite.
  - Which activities and equipment will be at risk of power line contact.
  - Methods to eliminate or control power line hazards. For example:
    - ✓ Utility company coordination: a) de-energize and visibly ground the line, b) move the power line a safe distance from the work, c) install an insulative sleeve on the power line (physical barrier), d) install warning spheres on the line.
    - ✓ Dedicated spotters.
    - ✓ Flagged warning lines to mark horizontal and vertical power line clearance distances.
    - ✓ Barricades, barriers, fencing in the area which may be a hazard.
    - ✓ Personal protective equipment (PPE), such as rubber insulating gloves, hoods, sleeves, matting, blankets, line hose, and helmets.
  - Worker training (content and verification).
  - Assignment of responsibility for certain activities (e.g. observer for a crane near power line).
  - Communication between contractors about power line hazards and control methods.
  - Emergency response plan.
- **Don't assume that:**
  - Overhead wires are telephone or cable lines!
  - Overhead lines are insulated. Any cover on the line may be weatherproof covering.
- **Establish and ensure no employee approaches or takes any conductive object closer to exposed energized parts than the Minimum Clearance Distance.** Required minimum clearance distances vary by equipment and activity: See MIOSHA Construction Fact Sheet: Electrical Safety – Power Line Clearances (References section) For exceptions, consult MIOSHA Part 86.

Table 1. Minimum Clearance Distance For Workers, Tools, and Equipment

Equipment	Minimum Clearance Distance
Cranes	***20 feet*** from ≤ 350kV energized power lines and ***50 feet*** if > 350kV. Distances may be reduced if the power line voltage is verified by the utility owner *as stipulated in* Table A and Table T of Construction Safety Standard, Part 10, Cranes and Derricks
Excavators	***10 feet*** or as stipulated in Table A of MIOSHA Construction Safety Standard Part 15. Excavators, Hoists, Elevators, Helicopters, and Conveyors. *Traveling with no load* - see Table B of the standard
Aerial Work Platform	***10 feet***. MIOSHA Construction Safety Standard: Part 32, Aerial Work Platforms. For more information, see Table1, Table 2 and Table 3 of the standard.
Metal Ladders	***20 feet*** for any part of the person's body or the metal ladder. MIOSHA Construction Safety Standard: Part 11, Portable and Fixed Ladders. See Table 1 of the standard.
Scaffolds	***10 feet*** from uninsulated electrical lines. ***3 feet*** from insulated electrical lines ≤ 300 volts. MIOSHA Construction Safety Standard: Part 12, Scaffolds and Scaffold Platforms. If de-energizing is impractical and the equipment is exposed to contact by an employee, maintain the minimum clearances in Table 1 of the standard between the scaffold, employee, or material, whichever is closer.
Other Tools, Materials, & Mobile Equipment	***10 feet***. Table 1, MIOSHA Construction Safety Standard: Part 1, General Rules. See Table 1 of the standard. Equipment examples include paint rollers, long-handled cement finishing floats, metal framing, metal roofing materials, gutters forklifts, dumb trucks, concrete pump truck booms and loaders. **Look up before raising long-handled tools and equipment. Always carry them horizontally**.

- **Work only in good weather (exception-restoring power).** Thunderstorms, rain, winds, and damp or icy ground can cause you to lose control and contact the power lines.
- **Determine which employees will be deemed "qualified" or "unqualified"** to perform work including line clearance work) in areas containing unguarded, uninsulated energized lines or parts of equipment

operating at 50 volts or more.

- **Provide safety-related work practices, safety procedures, and other safety required training (and re-training as necessary) for each designation** in accordance with MIOSHA Part 86. **Establish employee competency and proficiency** in the work practices.
  - **Only qualified employees may work in areas** containing unguarded, uninsulated energized lines or parts of equipment operating at 50 volts or more.
    - ✓ If working around parts, equipment or lines or if using mechanical equipment (other than insulated aerial lifts) that are **energized at more than 600 volts, two employees must be present** (exception: use of live-line tools when the employee's position is not within reach of nor otherwise exposed to contact with energized parts and emergency repairs to safeguard the general public).
- **Determine employee compliance** with the safety-related work practices through supervision and inspections conducted on at least an annual basis.
- **Use only non-conductive tag lines** when securing load movement.
- **Properly stow boom-mounted truck cranes and lower dump boxes** prior to truck movement.
- **Use American National Standards Institute (ANSI) approved ladders** for work near energized power lines. **DO NOT use metal (including aluminum) ladders near power lines.** Fiberglass ladders are preferred over wooden ladders. Ensure all ladders, especially wood ladders, are clean and dry. Wood ladders should not be preserved with an oil finish as the finish can conduct electricity.
- **Lower ladder and carry horizontally** when moving it.
- **Develop and train workers on emergency procedures in case of equipment contact with power lines**
  - Stay calm. Call 911.
  - Warn all personnel to stay away (at least 35 feet) from the energized equipment. **Don't touch a piece of equipment or a person in contact with a piece of equipment** when equipment is in contact with the powerline.
  - When in or on a piece of equipment, if possible, try to remove it from contact by moving it in the reverse direction from that which caused the contact.
  - Stay in the cab if equipment cannot be moved away from contact. Wait for lines to be de-energized.
  - If you must leave the equipment because of a more immediate hazard (e.g., fire), minimize voltage between the feet! Keep feet together and move away from the equipment with short, shuffling steps.

DID YOU KNOW?

- Less than one ampere of electricity can burn, severely injure, or cause death.
- Non-metallic materials, such as trees and ropes can conduct electricity depending upon moisture content and surface contamination.
- An electrical current passing through the body, will "tingle" at 0.5 to 1.0 milliamps (mA). At levels between 11 and 16 mA, an individual can't let go.
- Currents greater than 75 mA can cause ventricular fibrillation (rapid ineffective heartbeat) and death in a few minutes unless a defibrillator is used.
- Most house circuit breakers are 15 amp, which is 15,000 milliamps. Only Ground Fault Circuit Interrupters (GFCI's) will protect in the 0.5 to 75 mA range.
- A spark of static electricity can measure up to 3,000 volts.

RESOURCES AND REFERENCES

- MSU Occupational & Environmental Medicine:
  - MIFACE Investigation Report #08MI005: Roll-Off Container Truck Driver Electrocuted When Raised Tilt Frame Contacted Overhead Line
  - MIFACE Investigation Report #06MI185: Truck Driver Electrocuted When Raised Long-Bed Dump Trailer Contacted 4,800-Volt Overhead Power Line
  - Construction Electrocution Fatalities Investigation Reports
- MIOSHA
  - GI Safety & Health Standard, Part 40 Safety Related Work Practices
  - GI Safety & Health Standard, Part 86 Electric Power Generation Transmission & Distribution
  - Construction Fact Sheet: Electrical Safety – Power Line Clearances
  - Contractor's Directory to Overhead Power Line Safety
- OSHA
  - Electric Power Generation, Transmission and Distribution e-Tool
  - Hazard Alert: Working Safely Near Overhead Power Lines
- CPWR-Center for Construction Research and Training: Electronic Library of Construction Occupational Safety and Health (eLCOSH): Managing Power Line Hazards
- Electrical Transmission and Distribution Partnership: Powering Safety to New Heights
- NIOSH FACE IT: Worker Safety Matters When Working Near Power Lines
- CDC/NIOSH Public Health Publications on Electrocution
- Electrical Safety Foundation international (ESFi): Overhead power line safety poster
- MISS DIG 811: Working Safely Near Overhead Lines
- American National Standards Institute (ANSI) ANSI/ASC A14.5-2017: Ladders – Portable Reinforced Plastic – Safety Requirements Blog ANSI Store