Northwestern | DEPARTMENT OF SAFETY & SECURITY ENVIRONMENTAL HEALTH & SAFETY

Electrical Safety

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I. Purpose

This program establishes the framework to protect individuals and property from the hazards associated with electrical energy through design, safe work practices, and protective equipment, and to ensure that electrical work is only performed by qualified individuals in alignment with regulatory requirements and best practices.

II. Scope

This program applies to Northwestern employees, students, and contractors who use, maintain, repair, build, or install electrical equipment.

III. Responsibilities

A. **Environmental Health and Safety (EHS)**
   i. Adhere to the requirements of this program.
   ii. Review and revise this program, as necessary.
   iii. Provide consultation and guidance, as necessary and upon request, to identify, evaluate, and control potential hazards associated with electrical energy.
   iv. Coordinate and provide online training (see **Section XIV – Training**).

B. **Schools and Units**
   i. Adhere to the requirements of this program.
   ii. Ensure employees are trained (see **Section XIV – Training**).
   iii. Ensure that only qualified electricians maintain, repair, or install electrical equipment, systems, and installations who are familiar with the procedures, personal protective equipment (PPE), and tests required.
   iv. Where applicable, provide qualified electricians with all required electrical protective equipment (see **Section VI – Protective Equipment**), which includes personal protective equipment (PPE), insulating tools and handling equipment, ground-fault circuit interrupter (GFCI) protective devices, and access-limiting equipment (e.g., safety signs and barricades).
   v. Ensure all electrical maintenance, repair, testing, and new construction and renovation installations adhere to applicable standards and codes (see **Section XVI – Regulatory Authority and Related Information**).
   vi. Maintain applicable databases of electrical studies, diagrams, and schematics, along with any known hazards and associated control measures.
   vii. Communicate this program and its requirements to applicable parties (e.g., contractors, researchers), as necessary.

C. **Electrical Contractors**
   i. Adhere to the requirements of this program.
   ii. Ensure subcontractors adhere to the requirements of this program.
   iii. Must have an electrical safety program, specific to the operation(s), which meets or exceeds the applicable sections of this program, which must be available upon request.
   iv. Ensure employees are trained (see **Section XIV – Training**).
   v. Ensure that only qualified electricians maintain, repair, or install electrical equipment, systems, and installations, and are familiar with the procedures, PPE, and tests required.

vi. Provide qualified electricians with all required electrical protective equipment (see **Section VI – Protective Equipment**), which includes personal protective equipment (PPE), insulating tools and handling equipment, ground-fault circuit interrupter (GFCI) protective devices, and access-limiting equipment (e.g., safety signs and barricades).
vii. Notify Northwestern prior to electrical work and coordinate all electrical work on University property, including equipment, systems, or installations not owned by Northwestern (e.g., ComEd electrical vaults).

D. **Qualified Electricians (Northwestern, Contractors, and Subcontractors)**
i. Adhere to the requirements of this program.
ii. Adhere to the training requirements (see **Section XIV – Training**).
iii. Must be appropriately qualified to perform assigned tasks.
iv. Adhere to all safe work practices, safety labels and signage (e.g., arc flash, limited approach, and restricted approach boundaries), procedures, and permits, and perform all electrical work in compliance with applicable standards, codes, and best practices.
v. Maintain and wear all required PPE and report any deficiencies or concerns to supervisors.
vi. Ensure electrical equipment at worksites is appropriately guarded and locked when energized.
vii. Ensure worksites are maintained free of hazards and appropriate barriers are utilized to prevent unauthorized access.
viii. Report hazards, unsafe conditions, and equipment failures immediately to Northwestern supervisors or project managers.

E. **Non-Electrician Maintenance Employees (Northwestern, Contractors, and Subcontractors)**
i. Adhere to the requirements of this program.
ii. Adhere to the training requirements (see **Section XIV – Training**).
iii. Adhere to all safe work practices, safety labels and signage, and procedures, including arc flash, limited approach, and restricted approach boundaries.
iv. Not permitted to perform electrical work on equipment at or above 50 volts, including damaged or modified electrical equipment.
v. If trained and qualified, may perform maintenance and troubleshooting activities on equipment operating on less than 50 volts to ground (e.g., telecommunication lines) if a risk assessment performed by a qualified person determines there is no increased exposure to electrical burns or explosions from electrical arcs.
vi. If authorized by the Northwestern school or unit (e.g., Facilities) responsible for the equipment, may only reset a tripped breaker or replace a fuse once, after an evaluation is performed by a qualified person to determine whether the equipment and circuits can be safely reenergized, and if doing so would not expose employees to electrical parts that are energized at or above 50 volts. If the same breaker trips again, the circuit and/or equipment must be examined and repaired by a qualified electrician before it can be re-energized. Repetitive manual reclosing of circuit breakers or reenergizing circuits through replacement fuses is prohibited.
vii. Ensure worksites are maintained free of hazards and appropriate barriers are utilized to prevent unauthorized access.

viii. Report hazards, unsafe conditions, and equipment failures immediately to Northwestern supervisors or project managers.

F. **General University Population (e.g., Non-Maintenance Employees, Students, Contractors, Research Laboratories)**
   i. Adhere to the requirements of this program.
   ii. Adhere to the training requirements (see **Section XIV – Training**).
   iii. Not permitted to perform any electrical work, including but not limited to modifying electrical equipment or systems, accessing electrical panels, resetting tripped breakers, or replacing fuses.
   iv. Permitted to perform the following tasks on Nationally Recognized Testing Laboratory (NRTL)-approved, undamaged, and unmodified equipment:
      a. Plug, unplug, and use office equipment, appliances, tools, and similar equipment to/from standard receptacles (i.e., outlets).
      b. Replace batteries in common electrical equipment (e.g., remote controls, computer mice, flashlights, clocks, smoke/carbon monoxide detectors).
   v. Ensure worksites are maintained free of hazards and appropriate barriers are utilized to prevent unauthorized access.
   vi. Report hazards, unsafe conditions, and equipment failures immediately to Northwestern supervisors or project managers.

IV. General Safe Work Practices and Requirements

A. Power Strips
   i. Must only be used if necessary.
   ii. Must meet the requirements of **Section XIII - Nationally Recognized Testing Laboratories (NRTLs).**
   iii. Must only be used as intended and not modified (e.g., removal of the grounding pin) or used if damaged.
   iv. Must be inspected for damage prior to use.
   v. Must be replaced if components are frayed, cracked, or damaged. Taping frayed or damaged electrical cords is not an acceptable repair method.
   vi. Must be of equal or greater rating to the energy source they are plugged into (i.e., receptacle); the receptacle load cannot exceed the power strip rating.
   vii. Hands must not be wet when plugging and unplugging equipment.
   viii. Never use in wet environments unless specifically designed for such purposes, and always use a Ground Fault Circuit Interrupter (GFCI) in such instances.
   ix. Must be plugged into a wall outlet and may not be plugged into another extension cord or power strip (i.e., daisy chain).
   x. Must be unplugged from the power source when not in use.
   xi. If a ground pin is present, it must only be plugged into grounded outlets that accept the ground pin.

B. Extension (Flexible) Cords
   xii. Must meet the requirements of **Section XIII - Nationally Recognized Testing Laboratories (NRTLs).**
   i. Job-made extension cords are permitted only when NRTL-listed components are used and are assembled by a qualified electrician.
   ii. May only be used as intended and may not be modified (e.g., removal of the

grounding pin) or used if damaged.

iii. Must be inspected for damage prior to use.

iv. Must be replaced if components such as the outer jacket are frayed or damaged. Taping frayed or damaged electrical cords is not an acceptable repair method.

v. Must be of equal or greater rating to the energy source they are plugged into (i.e., receptacle); the receptacle load cannot exceed the cord rating.

vi. Hands must not be wet when plugging and unplugging equipment.

vii. Never use in wet environments unless specifically designed for such purposes, and always use a GFCI in such instances.

viii. Multi-outlet extension cords without GFCI circuit protection are prohibited in locations where the cord may come into contact with moisture or water.

ix. Must be plugged into a wall outlet and may not be plugged into another extension cord or power strip (i.e., daisy chain).

x. Must be unplugged from the power source when not in use.

xi. If a ground pin is present, it must only be plugged into grounded outlets that accept the ground pin.

xii. Must not be used in place of permanent wiring and must only be used for a temporary period of up to 90 days.

xiii. Must be heavy-duty and rated for the power tool or equipment with which it is being used. Household-use extension cords are prohibited.

xiv. Only extension cords rated for outdoor use may be used outdoors.

xv. Must not be run over sharp corners and projections, above ceilings, or inside or through walls, ceilings, or floors.

xvi. Must not pass through windows or doors unless they are protected from damage and only used temporarily.

xvii. Must not be fastened or attached to building surfaces and secured with staples or otherwise hung in such a fashion as to damage the outer jacket or insulation or create another hazard.

xviii. Avoid running extension cords in walkways or other working areas when feasible; cover extension cords with a cable bridge or tape when they extend into a walkway or other path of travel to avoid tripping hazards.

xix. Must not be used to suspend portable lighting, unless specifically designed to do so.

xx. Must not be used to lift or lower equipment.

C. Industrial Equipment, Power Tools, and Other Similar Equipment

i. Must meet the requirements of **Section XIII - Nationally Recognized Testing Laboratories (NRTLs).**

ii. If not hard-wired, cord must be double-insulated or grounded (three-pronged plug).

iii. Must only be used by a qualified person with adequate training, as applicable.

iv. Must be inspected before each use and maintained in accordance with the manufacturer's guidelines.

v. Must only be used as intended and must not be modified (e.g., removal of the grounding pin) or used if damaged.

vi. Must not be used if unguarded energized conductors and circuit parts or missing, loose, altered, or damaged blades, pins, covers, cords, or contacts are present.

vii. Must not be handled or stored in a manner that will cause damage such as carrying the device by the cord or pulling on the cord to disconnect it.
viii. Must be removed from service and tagged “Do Not Use” if damaged or malfunctioning (e.g., equipment smoking, odors).
ix. Never use electrical equipment that has been submerged in water unless specifically designed for such purposes. Equipment must be thoroughly dried out and properly evaluated by a qualified person before use.
x. Devices that have a ground pin may only be plugged into receptacles, extension cords, and power strips that accept ground pins, and that are rated for such use.
xi. Must be of equal or lower rating to the energy source they are plugged into (i.e., receptacle).
xii. Never use in wet environments, including wet hands, unless specifically designed for such purposes, and always use a GFCI in such instances.
xiii. Disconnect tools when not in use, before servicing, and when changing accessories such as blades, bits, and cutters.
xiv. Ensure that cords adhere to the applicable requirements of **Section IV.B.**

D. GCFI Requirements

i. Must meet the requirements of **Section XIII - Nationally Recognized Testing Laboratories (NRTLs).**
ii. Required locations:
    a. Receptacles near sinks or any other areas where water may be present.
    b. Where individuals are likely to make contact with water or conductive liquids such as outdoor environments, bathrooms, kitchens, or mechanical rooms.
    c. Construction or renovation sites (e.g., ‘spider boxes’).
    d. Temporary wiring circuits.
    e. Portable generators.
iii. The GFCI can be located on the extension cord, receptacle, or circuit breaker.

E. Portable Generators

i. Prohibited in indoor locations such as garages, crawl spaces, and basements; if extenuating circumstances require their use indoors, contact EHS to develop a safety plan, including air monitoring (e.g., carbon monoxide).
ii. Must only be operated by a qualified person.
iii. Always plug electrical appliances directly into the generator using the manufacturer’s supplied cords or extension cords that are grounded (3-pronged), and that are appropriately rated for the intended use; do not overload generators.
iv. Must be properly grounded with tight connections and in accordance with the manufacturer's requirements.
v. Unless designed and intended for wet conditions, portable generators must be kept dry (i.e., do not use them in rain or wet conditions). If necessary, equipment can be protected with a canopy.
vi. Never manipulate the electrical components if you are wet or standing in water.
vii. Maintain at least 3 to 4 feet of clear space on all sides and above to ensure adequate ventilation, unless the manufacturer requires more, in which case the more stringent requirement must be followed.
viii. Must be placed at least 20 feet from campus buildings and other structures (e.g., tents) when in use.

ix. Do not use near doors, windows, and vents that could allow exhaust gases (e.g., carbon monoxide) to enter and build up in occupied spaces.
x. Before refueling, shut down the generator and allow it to cool.
xi. Gasoline and other generator fuels must be stored and transported in approved containers that are properly designed and marked for their contents and vented.
xii. Fuel containers must be kept away from flame-producing and heat-generating devices such as generators, water heaters, cigarettes, lighters, and matches. Smoking is prohibited around fuel containers and generators.
xiii. Spill kits must be in close proximity to capture fuel in the event of a spill.
xiv. Only qualified electricians may connect portable generators to the University's electrical infrastructure, in coordination with the appropriate Northwestern school or unit (e.g., Facilities) and in accordance with the Portable Generator Guidelines.

F. Faulty Equipment

i. De-energize equipment immediately if there is evidence that equipment could fail or cause damage or injury, if qualified, feasible, and safe to do so.
ii. Tag defective, malfunctioning, or hazardous equipment "Do Not Use" until it is repaired or replaced by a qualified person.
iii. Immediately report any electrical equipment failures or known or suspected electrical safety concerns or hazards to supervisors, Facilities, EHS, or Research Safety (in laboratory settings).

V. General Electrical Safe Work Practices (Qualified Electricians)

A. The installation, testing, repair, and maintenance of electrical equipment and systems must comply with applicable standards and codes, including, but not limited to, those listed in **Section XVI – Regulatory Authority and Related Information**. Where codes, regulations, or requirements conflict, the more stringent guidelines will govern.
B. Adhere to all danger and warning signage, including posted arc flash, limited approach, and restricted approach boundaries.
C. Prior to the commencement of electrical work, including testing and troubleshooting:
   i. Identify all sources of electricity utilizing applicable drawings, diagrams, equipment, and identification tags.
   ii. Conduct a hazard analysis (refer to NFPA 70E Informative Annex I Job Briefing and Job Safety Planning Checklist) to identify electrical hazards and implement the appropriate control measures utilizing the hierarchy of controls (i.e., elimination, substitution, engineering controls, awareness, administrative controls, and PPE), which must be reviewed with the individuals performing the work and others affected, and when conditions change.
   iii. Ensure all potentially impacted parties are informed of any known electrical hazards or operational disruptions, and that the appropriate safety control measures are in place.
D. Electrical equipment must not be opened, serviced, repaired, or otherwise handled until it has been de-energized, locked or tagged out, and verified de-energized in accordance with the Northwestern Control of Hazardous Energy (Lockout/Tagout) Program unless live electrical work is authorized (see **Section X – Live Electrical Work**).

E. Wear all required PPE of the appropriate rating and use approved insulating mats and tools when necessary (see NFPA 70E Informative Annex H Guidance on Selection of Protective Clothing and Other Personal Protective Equipment and **Section VI – Protective Equipment**).
F. Never reach blindly into equipment or other non-visible areas that might contain unguarded energized electrical parts.
G. Never enter spaces containing energized electrical parts unless illumination is provided that allows the work to be performed safely.
H. Conductive jewelry (e.g., rings, watches, bracelets, necklaces), keyrings, tools, and clothing are prohibited from being worn when working on or near energized electrical parts.
I. Always handle conductive materials, tools, and equipment that are in contact with any part of the body in a manner that prevents accidental contact with energized electrical parts.
J. If the work area is in a utility tunnel, vault, rooftop, or other similar type of work area, ensure the appropriate measures are implemented (e.g., confined space permit, safe operating procedure, arc flash-rated fall protection).
K. Any connection to, or interruption of service, of an existing building electrical distribution system requires prior authorization by Northwestern (e.g., Facilities), and the affected school or unit must be notified.
L. Adhere to the Minimum Approach Distance found in 29 CFR 1926.950 for all work near live power transmission and distribution lines (see **Section IX – Overhead Power Lines**).
M. Portable ladders must never be used near overhead power lines or electrical hazards and must be used in accordance with the Northwestern Portable Ladder Safety Program.
N. Electrical work zones
    i. Unauthorized and unqualified individuals are prohibited in the work area.
    ii. Barricades, fencing, signage, and any additional measures necessary must be implemented at a safe distance from the work area and no closer than the Limited Approach Boundary, to prevent unauthorized access.
    iii. Signage must be visible, securely attached, and maintained in legible condition.
    iv. Barricades and fencing must be of sturdy construction and must not be used if conductive, where they might cause an electrical hazard.
    v. If barricades, fencing, and signage do not provide sufficient protection, an attendant must be assigned to warn individuals in the area. The primary duty of the attendant is to keep unauthorized and unqualified individuals out of the work area where an electrical hazard exists. The attendant must remain in the area as long as there is a potential exposure to electrical hazards. Unattended barricades, fencing, and signage are not acceptable safeguards when circuits are exposed.
    vi. Electrical equipment, systems, and work sites must be restored to safe conditions (e.g., panelboard covers replaced) when left unattended and at the completion of the project, and all safeguards must be replaced when work is complete, including guarding circuits and access controls (e.g., locks).

VI. Protective Equipment

A. Personal Protective Equipment (PPE)

i. Must meet the requirements of the Northwestern Personal Protective Equipment Program.
ii. Must be designed and constructed for the specific body part to be protected and for the work to be performed.
iii. Must be approved, rated, periodically tested, and maintained in a safe and reliable condition in accordance with the manufacturer's instructions and applicable standards.
iv. Must be stored in a way that prevents physical damage from moisture, dust, and other deteriorating agents; if arc-rated, also stored in a way that prevents contamination from flammable or combustible materials.
v. Must be visually inspected before each use and immediately following any incident that can be reasonably suspected of having caused damage.
vi. Must be removed from service if damaged until replaced or repaired by a qualified person.
vii. Must only be used by qualified and trained individuals when required and only as intended.

B. Insulated Tools and Handling Equipment

i. Must be designed and constructed to meet the demands of use and the environment to which they are exposed when required.
ii. Only insulated tools and equipment may be used within the Limited Approach Boundary of exposed energized parts.
iii. Must be rated for the voltages on which they are used.
iv. Fuse holder handling equipment, insulated for the circuit voltage, must be used to remove or install a fuse if the fuse terminals are energized.
v. Must be stored in a way that prevents physical damage from moisture, dust, and other deteriorating agents; if arc-rated, also stored in a way that prevents contamination from flammable or combustible materials.
vi. Must be visually inspected before each use and immediately following any incident that can be reasonably suspected of having caused damage.
vii. Must be removed from service if damaged until replaced or repaired by a qualified person.
viii. May only be used by qualified and trained individuals when required and used only as intended.

VII. Electrical Equipment Requirements

A. General

i. Energized electrical equipment must be appropriately guarded, marked, and labeled; equipment must also be locked when feasible.
ii. Adhere to the maintenance frequency, methods, and testing required by the applicable standards and codes in **Section XVI – Regulatory Authority and Related Information.**
iii. Maintain locks, interlocks, panels, covers, and other safety equipment in proper working condition.

iv. Ensure that required identification of components and warning signs, operating or maintenance safety-related instructions, and posted circuit or voltage identification are visible, securely attached, and legible.
v. Maintain overcurrent protective devices in accordance with manufacturer instructions or industry consensus standards, and document maintenance, tests, and inspections (See **Section XV - Recordkeeping**).
vi. Maintain equipment, raceways, cable trays, and enclosure bonding and grounding to ensure electrical continuity.
vii. Maintain fences, physical protection, enclosures, or other protective means that are required to guard against unauthorized access or accidental contact with exposed energized conductors and circuit parts.
viii. Ensure covers for wiring system components are in place with all associated hardware and that there are no unprotected openings.
ix. Ensure guards, barriers, and access plates prevent individuals from contacting moving or energized parts.

B. Electrical Panels and Equipment

i. Must be kept locked or otherwise secured to prevent unauthorized access, and only accessed by qualified electricians or other authorized individuals.
ii. Danger signs must be posted on the panel door warning of the potential electrical hazard, including the circuit voltage ratings from the feed side.
iii. Circuit breakers must be labeled to show the receptacle, system, equipment, or tool they supply.
iv. Maintain a minimum of 3 feet of clear working space in front of panels and keep escape passages clear and unobstructed.
v. Maintain enclosures to guard against accidental contact with energized conductors and circuit parts and other electrical hazards. Ensure covers and doors are in place with all associated fasteners and latches secured.
vi. Ensure required identification of components and warning signs, operating or maintenance safety-related instructions, and posted circuit or voltage identification are visible, securely attached, and legible.
vii. Receptacles must be labeled or marked showing the panel number/location and the breaker from which the receptacle is powered.

C. Fuses and Circuit Breakers

i. Fuses
    a. Must be free of breaks or cracks in fuse cases, ferrules, and insulators.
    b. Clips must provide adequate contact with fuses.
    c. Fuse holders for current-limiting fuses must not be modified to allow the insertion of non-current-limiting fuses.
    d. Non-current-limiting fuses must not be modified to allow their insertion into current-limiting fuse holders.
ii. Circuit breakers
    a. Molded-case circuit breakers must be free of cracks in cases and cracked or broken operating handles.
    b. Circuit breakers that interrupt faults approaching their interrupting ratings must be inspected and tested in accordance with manufacturer instructions.

D. Electrical Vaults and Switchgear/Transformer Rooms, Cages, and Shacks

i. Must be locked to prevent unauthorized access, and only accessed by qualified electricians or other authorized individuals.
ii. Danger signs must be visible, securely attached, and legibly posted to warn individuals of the potential electrical hazard, including voltages present.
iii. Must not be used for general storage, and maintained free of materials that could create hazards (e.g., flammable materials).
iv. Access to working spaces, access points (e.g., doors), and escape passages must be kept clear and unobstructed.

VIII. Electrical Installations

A. Must only be performed by qualified electricians.
B. Equipment must meet the requirements of **Section XIII - Nationally Recognized Testing Laboratories (NRTLs).**
C. Must be free of conditions that may cause injuries, electrical fires, or other hazards.
D. Must be suitable for installation and use and installed and used in accordance with any manufacturer's instructions or labeling.
E. New electrical wiring and equipment, and modifications, extensions, or replacements of existing wiring and equipment, must conform to the applicable standards, codes, and testing in **Section XVI – Regulatory Authority and Related Information**. Where codes, regulations, or requirements conflict, the more stringent guidelines will govern.
F. Electrical wiring:
   i. Conductors entering boxes, cabinets, or fittings must be protected from damage (e.g., abrasion), and openings through which conductors enter must be effectively closed.
   ii. Unused openings in cabinets, boxes, and fixtures must be effectively closed.
   iii. GFCI outlets must be installed in accordance with **Section IV.D – GFCI Requirements**.
   iv. All new receptacles must be grounded (e.g., 3-pronged).
   v. Electrical wiring, components, and fixtures must be of the proper rating for the location of their installation.

IX. Overhead Power Lines

A. General

When work is performed near overhead lines:

i. The lines must be de-energized and grounded or other protective measures put in place before work begins.
ii. If the lines are to be de-energized, arrangements must be made with the person or organization that operates or controls the electric circuits involved (i.e., ComEd) to de-energize, lockout or tagout, and ground them.
iii. If protective measures (e.g. guarding, isolating, insulating) are provided they must prevent individuals from contacting power lines directly with any part of their body or indirectly through conductive materials, tools, or equipment.

B. Elevated Vehicular and Mechanical Equipment

Where any vehicle or mechanical equipment structure will be elevated near energized overhead lines, they must be operated such that the Limited Approach Boundary

distance of NFPA 70E Table 130.4(C), Column 2, is maintained. However, under the following conditions, the clearances can be reduced:

i. If the vehicle is in transit with its structure lowered, the Limited Approach Boundary distance to the overhead lines in NFPA 70E Table 130.4(C), Column 2, can be reduced by 6 feet. If insulated barriers, rated for the voltages involved, are installed and are not part of an attachment to the vehicle, the clearance can be reduced to the design working dimensions of the insulating barrier.

ii. If a mobile elevated work platform (MEWP) or 'bucket truck' is insulated for the voltage involved, and the work is performed by a qualified electrician, the clearance (between the uninsulated portion of the MEWP or bucket truck and the power line) can be reduced to the Restricted Approach Boundary in NFPA 70E Table 130.4(C), Column 4. Refer to the Northwestern Mobile Elevated Work Platform Program for additional requirements.

C. Equipment Contact

Individuals standing on the ground must not contact the vehicle, MEWP, bucket truck, or any other mechanical equipment, including any of their attachments, unless one of the following conditions applies:

i. The individual is using protective equipment rated for the voltage, or

ii. The equipment is located so that no uninsulated part of the structure (i.e., that portion of the structure that provides a conductive path to individuals on the ground) can come closer to the line than permitted in NFPA 70E 130.8(F)(1).

D. Equipment Grounding

i. If any vehicle, MEWP, bucket truck, or mechanical equipment capable of having parts of its structure elevated near energized overhead lines is intentionally grounded, individuals working on the ground near the point of grounding cannot stand at the grounding location whenever there is a possibility of overhead line contact.

ii. Additional precautions (e.g., barricades or insulation) must be implemented to protect individuals from hazardous ground potentials (e.g., step and touch potential), which can develop within a few feet or more outward from the ground point.

X. Live Electrical Work

A. It is assumed feasible and practical to isolate, de-energize, and lock or tag out all electrical hazardous energy sources in accordance with the Northwestern Control of Hazardous Energy (Lockout/Tagout) Program, except in those instances where continuity of service is essential to life and health, or where testing of circuits must be performed in the energized state.

B. Live electrical work must be avoided unless it is absolutely necessary.

C. Working on energized equipment is only allowed when:

i. De-energizing introduces additional or increased hazards (e.g., interruption of life support equipment, deactivation of emergency alarm systems, or shutdown of hazardous location ventilation systems),

ii. It is not possible due to equipment design or operational limitations (e.g., circuits that form an integral part of a continuous process that would otherwise need to be completely shut down to permit work on one circuit or piece of equipment), or

iii. Live parts are operating at less than 50 volts to ground (e.g., telecommunication lines), and there is no increased exposure to electrical burns or explosions from electrical arcs.

D. All live electrical work must be in accordance with NFPA 70E, including but not limited to NFPA 70E Article 130 Work Involving Electrical Hazards, and requires a thorough risk assessment and a permit.

XI. Hazardous (Classified) Locations

In areas where airborne flammable dust, vapor, or gas may be present and would present a hazard if a source of ignition were present, equipment and installations must meet the following criteria:

A. No exposed energized circuits, except intrinsically safe and nonincendive circuits.
B. No breaks in conduit systems, fittings, or enclosures from damage, corrosion, or other causes (i.e., no unguarded energized circuits).
C. All bonding jumpers are securely fastened and intact.
D. All fittings, boxes, and enclosures with bolted covers have all bolts installed and bolted tight.
E. All threaded conduits are wrench-tightened and enclosure covers are tightened in accordance with the manufacturer's instructions.
F. There are no open entries into fittings, boxes, or enclosures that would compromise the protection characteristics.
G. All close-up plugs, breathers, seals, and drains are securely in place.
H. Marking of lighting fixtures for maximum lamp wattage and temperature rating is legible and not exceeded.
I. Required markings are secure and legible.

XII. Research Laboratories

A. Not authorized to modify hard-wired equipment, premise wiring, electrical panels, or similar systems without explicit approval from the responsible Northwestern school or unit (e.g., Facilities).
B. A competent and qualified person (e.g., Principal Investigator “PI”) must ensure adherence to this program and the use of appropriate electrical safety-related work practices and controls.
C. Laboratory equipment is subject to the requirements of **Section XIII – Nationally Recognized Testing Laboratories (NRTLs)** and NFPA 70E Article 350 – Safety-Related Work Requirements: Research and Development Laboratories.

XIII. Nationally Recognized Testing Laboratories (NRTLs)

A. Many electrical devices, such as computers, power cords, tools, and equipment, require approval from a Nationally-Recognized Testing Laboratory (NRTL), such as Underwriters Laboratories (UL), which certifies that electrical equipment meets the required standards for the U.S. market. This certification shows that the equipment was investigated by an independent third party and complies with safety requirements.
B. NRTL approval must be appropriately marked or labeled on the equipment or device.
C. Modifying NRTL-listed electrical equipment can cause it to lose its listed status, which means it cannot be used until a qualified electrician inspects and approves it.

D. Unlisted or modified equipment must be field inspected and approved by a qualified person before installation or use. Contact EHS or Research Safety for more information.

XIV. Training

A. General

Employees and contractors must complete electrical safety training when they have the potential to be exposed to an electrical hazard, and the risk associated with that hazard is not reduced to a safe level by the applicable electrical installation requirements. Such individuals must be trained:

i. To understand the specific hazards associated with electrical energy.
ii. In safety-related work practices and procedural requirements, as necessary, to provide protection from the electrical hazards associated with their respective job or task assignments.
iii. To identify and understand the relationship between electrical hazards and possible injury.

B. Qualified Electricians (Note: A person can be considered qualified with respect to certain equipment and methods but unqualified for others).

i. All work on electrical circuits at or above 50 volts must be performed by trained and qualified electricians in accordance with industry standards, including but not limited to the standards and codes in **Section XVI – Regulatory Authority and Related Information**.
ii. Training, which can be obtained through a combination of methods including education, past work experience, apprenticeships, and on-the-job training, must demonstrate knowledge in the following areas:
    a. Construction and operation of equipment on which work is assigned.
    b. Familiarity with the proper use of special precautionary techniques, applicable electrical policies and procedures, PPE, insulating and shielding materials, and insulated tools and test equipment.
    c. The process necessary to determine the degree and extent of electrical hazards, along with the PPE and job planning necessary to perform the task safely.
    d. Additional training is required when working within the Limited Approach Boundary:
        1. Skills and techniques necessary to distinguish exposed energized electrical conductors and circuit parts from other parts of electrical equipment.
        2. Skills and techniques necessary to determine the nominal voltage of exposed energized electrical conductors and circuit parts.
        3. Approach distances specified in NFPA 70E Table 130.4(E)(a) and Table 130.4(E)(b) and the corresponding voltages to which the qualified person will be exposed.
        4. Decision-making process necessary to be able to do the following:
            I. Perform the job safety planning
            II. Identify electrical hazards
            III. Assess the associated risk

IV. Select the appropriate risk control methods from the hierarchy of controls

iii. Subject to the training requirements contained in the Northwestern Control of Hazardous Energy (Lockout/Tagout) Program.

iv. Additional training and retraining in safety-related work practices and applicable changes to standards are required every 3 years and whenever there is evidence that:

a. The supervision or annual inspections indicate the employee is not complying with the safety-related work practices,
b. New technology, new types of equipment, or changes in procedures necessitate the use of safety-related work practices different from those that the employee would normally use,
c. The employee needs to review tasks that are performed less often than once per year, or
d. The employee's job duties change.

C. Online Electrical Safety training must be completed biennially by Northwestern electricians, non-electrician maintenance employees, and other similar roles (e.g., theaters, workshops).

XV. Recordkeeping

A. Training records
   i. Northwestern EHS will maintain online electrical safety training records for the duration of employment plus 1 year.
   ii. Schools and units are responsible for maintaining qualified electrician training and certifications for the duration of employment plus 1 year.
B. Northwestern and contractor permits and forms (e.g., Utility Method Operating Procedure, permits) must be retained for at least 5 years.
C. A database of electrical studies, diagrams, and schematics, and documented maintenance, tests, and inspections for equipment and systems must be maintained as required by NFPA 70B, Standards for Electrical Equipment Maintenance, and the ANSI/NETA Standards for Maintenance Testing Specifications for Electrical Power Equipment and Systems.

XVI. Regulatory Authority and Related Information

Northwestern and contractors will comply with the Occupational Safety and Health Administration (OSHA) standards, the National Fire Protection Association (NFPA) standards, and any other applicable codes and standards, including:

ANSI/NETA Standards for Maintenance Testing Specifications for Electrical Power Equipment and Systems
City of Evanston Building and Electrical Codes
City of Chicago Building and Electrical Codes
IEEE 3007.2 Recommended Practice for the Maintenance of Industrial and Commercial Power Systems
NFPA 70, National Electrical Code (NEC)
NFPA 70B, Standards for Electrical Equipment Maintenance
NFPA 70E, Standard for Electrical Safety in the Workplace

Northwestern Control of Hazardous Energy (Lockout/Tagout) Program
Northwestern Contractor Safety Program
Northwestern Facilities Master Specifications
Northwestern Facilities Design Guidelines
Northwestern Mobile Elevated Work Platform Program
Northwestern Personal Protective Equipment Program
OSHA 29 CFR 1910 Subpart S – Electrical
OSHA 29 CFR 1926 Subpart K – Electrical

XVII. Contact

For questions, contact Environmental Health and Safety at ehs@northwestern.edu.