Electrical Safety Program

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Applies to: Employees, Faculty, Students, Others
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I. Purpose

This program was developed to assure that University employees understand and comply with the regulatory requirements related to electrical work; assure the safety of employees who may work in the vicinity of, or on, electrical systems; and assure that all departments that perform electrical work on campus follow uniform work practices and regulatory requirements. This program does not serve as a method to qualify persons. This program incorporates the requirements of the Occupational Safety and Health Administration's (OSHA) Electrical Standard (29 CFR 1910), and serves as the electrical safety program in accordance with the standard. Failure to comply with this program and the OSHA standard is cause for disciplinary action up to, and including, dismissal.

II. Definitions – Words in *italics* throughout this program are defined in this section.

2.1 ***Battery Enclosure*** – enclosure containing batteries that is suitable for use in an area other than a *battery room* or an area restricted to authorized personnel.

2.2 ***Battery Room*** **–** room specifically intended for the installation of batteries that have no other protective enclosure.

2.3 ***Dead Front*** **-** without live parts exposed to a person on the operating side of the equipment.

2.4 ***Disconnecting Means*** - the switch or device used to disconnect the circuit from the power source.

2.5 ***Fault-clearing time*** **-** the timing required for the nearest circuit protective device (i.e., circuit breaker

or fuse) to operate to clear a fault, typically in milli-seconds.

2.6 Flash hazard analysis **-** a study investigating a worker's potential exposure to arc-flash energy, conducted for the purpose of injury prevention and the determination of safe work practices and appropriate levels of personal protective equipment.

2.7 ***Flash protection boundary*** **-** The flash protection boundary is the distance from the arc source at which the potential incident heat energy from an arcing fault impacts the surface of the skin at 1.2 calories/cm^2, which is considered the onset of second degree burns.

2.8 ***FPN*** **–Fine Print Note.** Used in the excerpts from NFPA 70E found in the appendices.

2.9 ***GFCI*** **-** Ground Fault Circuit Interrupter. A device intended for the protection of personnel that monitors the amount of current flowing from hot conductor to neutral conductor and interrupts the circuit if there is an imbalance of more than 4-5 milliamps.

2.10 ***Hot stick*** **-** an insulated live-line tool that that allows a *qualified person* to manipulate switches, fuses or other electrical devices while still allowing safe minimum approach distances.

2.11 ***Incident energy*** **-** the amount of energy impressed on a surface, a certain distance from the source, generated during an electrical arc event.

2.12 ***Limited Approach Boundary*** **-** a boundary around exposed live parts that may not be crossed by an *unqualified person* unless accompanied by a *qualified person*.

2.13 ***Lockout/tagout (LOTO)*** - refers to specific practices and procedures to safeguard employees from the unexpected energization or startup of machinery and equipment, or the release of hazardous energy during service or maintenance.

2.14 ***Prohibited Approach Boundary*** **-** is the area near exposed live parts that may be crossed only by *qualified* persons using the same protection as if direct contact with live parts were planned. This is defined by the nominal voltage.

2.15 ***Restricted Approach Boundary*** **-** is the area near the exposed live parts that may be crossed only by "*qualified*" persons using appropriate shock prevention techniques and equipment.

2.16 ***Short circuit current*** **-** is the maximum electrical current which can flow in a particular electrical system under short circuit conditions

2.17 ***Sleeves*** **-** Rubber insulating *sleeve*s extend coverage for a person's arm from the cuff of the rubber insulating glove to the shoulder, fully protecting these areas from accidental contact with energized conductors and equipment.

2.18 ***Qualified person*** – One who has skills and knowledge related to the construction and operation of the electrical equipment and installations and received safety training on the hazards involved. (Synonyms for this term include: qualified worker, qualified employee and qualified designee)

2.19 ***Unqualified persons*** are those with little or no such training.

2.19.1 An employee undergoing on-the-job training who has demonstrated the ability to perform duties safely at his/her level of training, and who is under the direct supervision of a *qualified person*, is considered to be a *qualified person* for the purpose of those duties.

III. Scope

This program applies to University employees working on or near premises wiring; installations of electric conductors and equipment and feeder circuit conductors in or on buildings, structures, and in other areas such as yards, parking and other lots, confined spaces and industrial substations. Additionally, it applies to installation of optical fiber cable near or with electric wiring. This program does not apply to communication installations below 50 volts. This program applies to the main campus in Storrs as well as regional campuses. In addition, contractors shall comply with section 4.3 of this program.

IV. Electrical Safety Program Responsibilities

4.1 Environmental Health and Safety (EHS) and Facility Operations and Building Services are responsible for developing, implementing, and administering the Electrical Safety Program. This includes:

4.1.1 ensuring the training of supervisors and their employees;
4.1.2 maintaining centralized records of training, energy control procedures, and program review;
4.1.3 providing technical assistance to university personnel;
4.1.4 developing and maintaining the written program, training programs and other training resources that can be used by university personnel;
4.1.5 evaluating the overall effectiveness of the Electrical Safety Program on a periodic basis.

4.2 Planning Architectural and Engineering Services is responsible for informing contractors they procure, of UConn electrical safety design and installation requirements appertaining to this program.

4.3 Contractors must comply with all local, state, federal and University safety requirements (e.g., OSHA, National Electric Code), and assure that all of their employees performing work on UConn campuses have been suitably trained and licensed.

4.3.1 Additionally, contractors are required to comply with all aspects of the UConn Contractor EHS Manual.

4.3.2 After a contractor performs repairs, maintenance or installations, verification to ensure that the electrical equipment components are operationally intact and that no electrical hazard exists upon re-energization shall be performed before UConn *qualified persons* shall attempt to re-energize the electrical equipment. This verification can be performed by *qualified persons* from the Facilities Electric Shop or a qualified third party, at the discretion of the Facilities Electric Shop supervisor.

V. Training

5.1 Supervisors must ensure that employees who face a risk of electrical shock in their work are trained in accordance with this program.

5.1.1 Employees whose job duties do not bring them close enough to the exposed parts of electrical circuits for a hazard to exist (operating at 50 volts or more to ground), are not required to receive training under this program.

5.1.2 Employees whose job duties do not bring them close enough to the exposed parts of electrical circuits for a hazard to exist (operating at 50 volts or more to ground), shall receive Electrical Safety Awareness Training for *Unqualified Persons* and *Lockout/tagout* Training from EHS if:

- they use power tools;
- perform service on machines or equipment; or
- perform maintenance or repair functions as part of their job.

5.1.3 *Qualified Persons* working on or near exposed energized parts must receive training in the following:

- The skills and techniques necessary to distinguish exposed live parts from other parts of electric equipment;
- The skills and techniques necessary to determine the nominal voltage of exposed live parts; and,
- The clearance distances specified for working on or near exposed energized parts and the corresponding voltages to which the *qualified person* will be exposed.
- Specific approach boundaries (i.e., *flash protection boundary, limited approach boundary, restricted approach boundary and prohibited approach boundary*).
- Electrical Hazards and Safety Awareness for *Qualified Persons* training, from EHS.

5.1.4 *Qualified persons* whose work on energized equipment involves either direct contact, or contact by means of tools or materials, must be trained on how to work safely on energized circuits. These employees must be familiar with proper precautionary work practices, personal protective equipment, insulating and shielding materials, and the use of insulated tools.

5.1.5 The determination of an employee's qualifications, as well as the level of training for each employee lies with the employee's supervisor or manager.

5.1.6 An individual's supervisor will review (or coordinate the review in consultation with a *qualified person*), the work performed by each employee to assure that they demonstrate the skills and techniques needed to perform their electrical work safely.

5.1.7 Training must be performed before the employee is assigned duties involving work around or on electrical systems.

5.1.8 Retraining will be performed whenever inspections performed by the employee's supervisor or EHS indicate that an employee does not have the necessary knowledge or skills to safely work on or around electrical systems. Retraining will also be performed when policies or procedures change and/or new equipment or systems are introduced into the work area.

VI. Electrical Installation Requirements

6.1 Free from Recognized Hazards - Electrical equipment must be free from recognized hazards that are likely to cause death or serious physical harm. Equipment must be suitable for the installation and use, and must be installed and used in accordance with any instructions included in the listing or labeling and maintained in accordance with the National Electrical Code (NEC) and/or Occupational Safety and Health Administration (OSHA). ("Suitable" means that the equipment is listed or labeled for the intended use by a nationally recognized testing laboratory, e.g., Factory Mutual (FM), Underwriters Laboratory (UL), etc.)

6.2 Labeling of Disconnects -Each *disconnecting means*, must be clearly labeled to indicate the circuit's function unless it is located and arranged so the purpose is evident. Identification should be specific rather than general; a branch circuit serving receptacles in a main office should be labeled as such, not simply labeled "receptacles". All labels and marking must be durable enough to withstand the environment to which they may be exposed and must include nominal voltage being utilized by the device.

6.2.1 Energy from more than one source – motors and motor operated equipment with more than one source of power may have multiple disconnects. Where multiple *disconnecting means* are provided, a permanent warning sign shall be provided on or adjacent to each *disconnecting means*.

6.3 Guarding of Live Parts - Live parts of electric equipment operating at 50 volts or more must be guarded against accidental contact. Proper guarding can be achieved by use of an approved cabinet or other approved enclosure or by location in a room or vault that is accessible to *qualified person*s only. If electric equipment is located in an area where it is potentially exposed to physical damage, the enclosure or guard must be of sufficient strength to prevent such damage.

6.4 Warning Signage – Entrances to rooms and other guarded locations that contain exposed live parts operating at 50 volts or more shall be marked with conspicuous warning signs forbidding *unqualified persons* to enter.

6.5 General Wiring Design and Protection - New electrical wiring, and the modification, extension or replacement of existing wiring must conform to the requirements of NEC, the National Fire Protection Association (NFPA), OSHA and the following:

6.5.1 No grounded conductor may be attached to any terminal or lead so as to reverse designated polarity.

6.5.2 The grounding terminal or grounding-type device on receptacles, cord connector, or attachment plug may not be used for any purpose other than grounding.

6.5.3 Conductors and equipment must be protected from overcurrent above their listed current carrying capacity.

6.5.4 All alternating current systems of 50 to 1,000 volts must normally be grounded as required by the NEC and OSHA. The path to ground from circuits, equipment and enclosures must be permanent and continuous. For information on exceptions to these requirements, please contact Facilities - Electric Shop Supervisor.

6.5.5 Conductors entering boxes, cabinets or fittings must be protected from abrasion, and openings through which conductors enter must be effectively closed. Unused openings in cabinets, boxes and fixtures must also be effectively closed.

6.5.6 All pull boxes, junction boxes and fittings must be provided with covers approved for the purpose. If metal covers are used they must be grounded. In completed installations, each outlet box must have a cover, faceplate or fixture canopy. Pull boxes and junction boxes for systems over 600 volts, nominal, must provide complete enclosure, the boxes must be closed by suitable covers securely fastened in place, and the cover must be permanently marked "High Voltage."

6.5.7 Switchboards and panelboards that have exposed live parts must be located in permanently dry locations and accessible to *qualified persons* only. Panelboards must be mounted in cabinets, cutout boxes or other approved enclosures, and must be *dead front* unless accessible to *qualified persons* only. Receptacles installed in damp or wet locations must be suitable for the location. Exposed blades of knife switches must be dead when open unless the switch is connected to circuits or equipment inherently capable of providing a backfeed source of power. (For such installations a warning sign stating "**WARNING - LOAD SIDE OF TERMINALS MAY BE ENERGIZED BY BACKFEED**" or equivalent, shall be posted in close proximity to the switch).

6.5.8 Cabinets, cutout boxes, fittings, boxes and panelboard enclosures in damp or wet locations must be installed to prevent moisture or water from entering and accumulating within the enclosure. In wet locations the enclosures must be weatherproof.

6.5.9 Fixtures, lamp holders, lamps, rosettes, and receptacles may have no live parts normally exposed to employee contact.

6.5.10 Screw-base light socket adapters do not maintain ground continuity and may not be used.

6.5.11 Multiplug receptacle adapters may not maintain ground continuity or may overload circuits and must not be used. If additional receptacles are needed in a work location, additional circuits and/or receptacles must be installed.

- Multi-plug power strips with overcurrent protection are acceptable for use with electronic equipment, however, they may not be "daisy-chained" (i.e., two or more power strips plugged into each other in a chain).

6.5.12 Electrical equipment, wiring methods and installations of equipment in hazardous classified locations must be intrinsically safe, approved for the location, or safe for the location. Hazardous

classified locations are areas where flammable liquids, gases, vapors, or combustible dusts or fibers exist or could exist in sufficient quantities to produce an explosion or fire.

6.5.13 Installation of all lasers must first be approved by the Laser Safety Officer in the Department of Environmental Health and Safety. (The UConn Laser Safety Manual can be obtained at http://www.ehs.uconn.edu/Radiation/LaserSafetyManual.pdf)

6.6 Requirements for Temporary Wiring - Temporary electrical power and lighting installations 600 volts or less, including flexible cords, cables, extension cords and distribution panels, may only be used during and for renovation, maintenance, repair, or experimental work. Temporary wiring may also be used for decorative lighting for special events and similar purposes for a period not to exceed 90 days. The following additional requirements apply:

6.6.1 Ground-fault protection (e.g., ground-fault circuit interrupters or *GFCI*) must be provided on all temporary-wiring circuits, including extension cords, used on construction sites. A *GFCI* must also be used when extension cords and/or equipment are used in wet, damp or conductive locations.

6.6.2 In general, all equipment and tools connected by cord and plug must be grounded. Listed or labeled double insulated tools and appliances need not be grounded.

6.6.3 Feeders must originate in an approved distribution center, such as a panelboard, that is rated for the voltages and currents the system is expected to carry.

6.6.4 Branch circuits must originate in an approved power outlet or panelboard.

6.6.5 Bare conductors or earth returns shall not be used for the wiring of any temporary circuit.

6.6.6 Receptacles must be of the grounding type. Unless installed in a complete metallic raceway, each branch circuit must contain a separate equipment-grounding conductor, and all receptacles must be electrically connected to the grounding conductor.

6.6.7 Flexible cords and cables must be of an approved type and suitable for the location and intended use. They may only be used for pendants, wiring of light fixtures, connection of portable lamps or appliances, elevator cables, hoists, connection of stationary equipment where frequently interchanged, prevention of transmission of noise or vibration, data processing cables, temporary wiring, or where needed to permit maintenance or repair. Flexible cords and cables must be protected from accidental damage. Strain relief devices must be used whenever necessary. Sharp corners and projections are to be avoided. Flexible cords may not be:

- Used as a substitute for the fixed wiring.
- Run through holes in walls, ceilings or floors.
- Run through doorways, windows or similar pinch points unless protected from damage, and then only temporarily.
- Attached to building surfaces.
- Concealed behind building walls, ceilings or floors.

6.6.8 Suitable disconnecting switches or plug connects must be installed to permit the disconnection of all ungrounded conductors of each temporary circuit.

6.6.9 Lamps for general illumination must be protected from accidental contact or damage, either by elevating the fixture or by providing a suitable guard. Handlamps supplied by flexible cord must be equipped with a handle of molded composition or other approved material and must be equipped with a substantial bulb guard.

6.6.10 Flexible cords and cables must be protected from accidental damage. Sharp corners and projections are to be avoided.

6.7 Open Conductors, Clearance from Ground - Open conductors must be located at least 10 feet above any

finished grade, sidewalk or projection; 12 feet above areas subject to non-truck traffic; 15 feet above areas subject to truck traffic; and 18 feet above public streets, roads or driveways.

6.8 Entrances and Access to Workspace - In any workspace where there is electric equipment operating at over 600 volts, there must be at least one entrance at least 24" wide and 6'-6" high to permit escape in the event of an emergency. Any exposed energized conductors operating at any voltage and located near the entrance must be guarded to prevent accidental contact. Any insulated energized conductors operating at over 600 volts and located next to the entrance must also be guarded.

6.9 Working Space about Electric Equipment - Sufficient access and working space must be provided and maintained around all electric equipment to permit ready and safe operation and maintenance of the equipment. Working clearances may not be less than 36 inches in front of electric equipment. Except as permitted by OSHA or the NEC, the working space in front of live parts operating at 600 volts or less that requires servicing, inspection or maintenance while energized may not be less than indicated in Table 1 below. **This working space shall not be used for storage.**

TABLE 1
Working Clearances

Nominal Voltage to Ground	Minimum Clear Distance for Condition (3)		
	A	B	C
0-150	3' (1)	3' (1)	3'
151-600	3' (1)	3-1/2'	4'
601-2,500	3'	4'	5'
2,501-9,000	4'	5'	6'
9,001-25,000	5'	6'	9'
25,001-75 kV (2)	6'	8'	10'
Above 75 kV (2)	8'	10'	12'

(1) Minimum clear distance may be 2-1/2' for installations built prior to April 16, 1981.

(2) Minimum clear distance in front of electrical equipment with nominal voltage to ground above 25 kV may be the same as for 25 kV under conditions A, B and C for installations built prior to April 16, 1981.

(3) Conditions A, B and C are as follows: (A) Exposed live parts on one side and no live or grounded parts on the other side of the working space, or exposed live parts on both sides are effectively guarded by an insulating material. Insulated wire or insulated busbars operating at not over 300 volts are not considered live parts. Concrete, brick or tile walls are considered to be grounded. (B) Exposed live parts on one side and grounded parts on the other. (C) Exposed live parts on both sides of the workspace not guarded as per condition (A), with the operator between.

VII. Selection and Use of Work Practices

The work practices used by an employee must be sufficient to prevent electric shock or other injuries that could result from either direct or indirect electrical contact. These work practices must be used when work is performed near or on equipment or circuits that are or may be energized. The work practices used must be consistent with the nature and extent of the electrical hazard.

7.1 Working on Electrical Systems - Energized Parts: Live parts to which an employee may be exposed will be de-energized, using approved *lockout/tagout* procedures, before the employee works on or near them, unless:

7.1.1 work is performed on or near live parts by *qualified persons* related to tasks such as testing, trouble-shooting, voltage measuring, etc., provided **appropriate safe work practices** and **personal protective equipment** are used or,

7.1.2 the live parts operate at less than 50 volts to ground and there is no increased exposure to electrical burns or to explosion due to electric arcs.

7.1.3 work is performed on or near live parts by *qualified employees* following and authorized by an approved (UConn or CL&P) Energized Electrical Work Permit (see Appendix A for the UConn Energized Permit Decision Tree and Permit Form). **Justification for issuing a permit to allow employees to work on or near live parts is limited to the following conditions**:

- de-energizing introduces "additional or increased hazards." (Examples include interruption of life support equipment, deactivation of emergency alarm systems, shutdown of critical fume hood ventilation systems); or
- de-energizing is not possible due to equipment design or operational limitations. (Examples include tasks that can only be performed with the electrical circuit energized, and work on circuits that form an integral part of a continuous process that would need to be completely shut down in order to permit work on one circuit or piece of equipment).
- If any there is any question if an Energized Work Permit is necessary for specific work, refer to Appendix A, UCONN Energized Permit Decision Tree and/or call EHS (860-486-3613) for guidance.

NOTE 1: Except for emergency repairs to the extent necessary to safeguard the general public, at least two *qualified persons* shall be present during:

- installation, removal, or repair of lines that are energized at more than 600 volts;
- installation, removal, or repair of de-energized lines if an employee is exposed to contact with other parts energized at more than 600 volts; or
- installation, removal, or repair of transformers, capacitors, regulators, switch gear or other mechanical equipment, if an employee is exposed to contact with parts energized at more than 600 volts.

NOTE 2: If de-energizing exposed live parts could add to or increase the hazard, or is not possible, then other approved work practices must be used to protect employees who may be exposed to the electrical hazards. The work practices used must protect employees from contact with energized circuit parts directly with any part of their body or indirectly through some other conductive object. The work practices used must be suitable for the conditions under which the work is performed and for the voltages of exposed electric conductors or circuit parts.

7.2 Working On Or Near Exposed De-energized Parts - When employees work on exposed de-energized parts or near enough to them to expose the employee to an electrical hazard, then the following safety

related work practices will be followed.

7.2.1 Any conductors or parts of electric equipment that have not been properly locked and/or tagged out must be treated as energized even if these systems have been de-energized.

7.2.2 If the potential exists for an employee to contact parts of fixed electric equipment or circuits that have been de-energized, the circuits energizing the parts must be locked and tagged out. Locking and tagging procedures must comply with UConn*'s* *Lockout/Tagout Program*.

7.3 De-energizing Equipment: Safe procedures for de-energizing circuits and equipment will be determined by a *qualified person* before the circuit or equipment is de-energized.

7.3.1 Circuits and equipment to be worked on will be disconnected by the worker from all electric energy sources. Control circuit devices, such as push buttons, selector switches, and interlocks will not be used as the sole means for de-energizing circuits or equipment. Interlocks for electric equipment may not be used as a substitute for lockout and tagging procedures.

7.3.2 Stored electrical energy that might endanger personnel must be safely released prior to the work. (e.g., discharging capacitors, and short-circuiting and grounding high capacitance elements. If the capacitors or associated equipment are handled during this work, they must be treated as energized.

7.3.3 Stored non-electrical energy (e.g., hydraulic or pneumatic) in devices that could reenergize electric circuit parts must be blocked or relieved so that circuit parts cannot be accidentally reenergized by the device.

7.3.4 A lock and tag must be placed on each *disconnecting means* used to de-energize circuits and equipment on which work is to be done. The lock must be attached so as to prevent persons from reenergizing the circuit and must be substantial enough that only excessive force could defeat it.

7.3.5 Verification of De-energized Condition: The following requirements must be met before any circuit or equipment is considered de-energized or may be worked on as de-energized.

- A *qualified person* must activate the equipment operating controls or use other methods to verify that the equipment cannot be restarted.
- A *qualified person* must use test equipment to ensure that electrical parts and circuit elements are de-energized. The test must confirm there is no energized condition from induced voltage or voltage backfeed.
- Test equipment and instruments must be visually inspected for external defects or damage before being used to verify that the equipment or circuit is de-energized.
- When voltage over 600 volts nominal is tested, the test equipment must be checked for proper operation immediately before and after the test on a known live source.

7.4 Re-energizing Equipment: In addition to the requirements of the *Lockout/Tagout Program*, the following requirements must be met, in the order given, before circuits or equipment are re-energized, even temporarily:

7.4.1 If electrical jumpers, shorts, grounds or other such devices have been used as part of a lockout/tagout, a *qualified person* must conduct tests and visual inspections as necessary to verify that all electrical jumpers, shorts, grounds and other such devices have been removed so that circuits and equipment can be safely energized;

7.4.2 Employees potentially exposed to the hazards of re-energizing the circuit must be warned to stay clear; and

7.4.3 Each employee removes his or her own lock(s) and tag(s).

7.5 Overhead Power Lines - When work is to be performed near overhead lines, the lines must be de-energized and grounded whenever possible (if not possible, the provisions of 7.5.1 must be followed).

Arrangements must be made with the organization that operates or controls the electric circuits when lines are to be de-energized and grounded.

7.5.1 If it is not possible to de-energize and ground overhead lines, then other protective measures, such as guarding, isolating or insulating, must be taken before the work is started. These protective measures must prevent direct contact by the *qualified person* or indirect contact through conductive materials, tools, or equipment. Only *qualified persons* are allowed to install insulating devices on overhead power transmission and distribution lines. All other persons, and any conductive object used by these employees, may not approach closer than the minimum distance specified in Table 2 when working in an elevated location near unguarded, energized overhead lines. *Unqualified persons* working on the ground are not allowed to bring any conductive object or any insulated object that does not have the proper insulating rating closer to unguarded, energized overhead lines than the distance allowed in Table 2 below.

TABLE 2

Voltage to Ground	Minimum Approach Distance
50 kV or less	10 feet
Over 50 kV	10 feet + 4 inches for every 10 kV over 50 kV

7.5.2 *Qualified persons* working in the vicinity of energized overhead lines, whether in an elevated position or on the ground, are not allowed to approach any exposed energized parts closer than allowed in Table 3 unless:

- The person is insulated from the energized part by using voltage rated gloves, (with *sleeves* and or *hot stick* if necessary); or
- The energized part is insulated from all other conductive objects at a different potential and from the person; or
- The person is insulated from all conductive objects that are at a potential different from the energized part.

TABLE 3

APPROACH DISTANCES FOR *QUALIFIED PERSONS* EXPOSED TO ALTERNATING CURRENT	
Voltage Range (phase-to-phase)	**Minimum Approach Distance**
300 V and less	Avoid contact
Over 300 V, not over 750 V	1 ft. 0 in.
Over 750 V, not over 2 kV	1 ft. 6 in.
Over 2 kV, not over 15 kV	2 ft. 0 in.
Over 15 kV, not over 37 kV	3 ft. 0 in.
Over 37 kV, no over 87.5 kV	3 ft. 6 in.
Over 87.5 kV, not over 121 kV	4 ft. 0 in.
Over 121 kV, not over 140 kV	4 ft. 6 in.

7.6 Vehicles and Mechanical Equipment - A minimum clearance of 10 feet must be maintained between

energized overhead lines and all vehicles or mechanical equipment capable of having parts or its structure elevated (e.g., cranes, mobile scaffolds, elevating platforms, dump trucks, lift trucks, and flatbed trailer cranes). If the voltage of the overhead line is greater than 50 kV, the clearance must be increased by 4 inches for every 10 kV over 50 kV. 7.6.1 The clearance requirement may be reduced if the vehicle is in transit with its structure lowered. The clearance may be reduced to 4 feet when near energized lines operating at less than 50 kV, or 4 ft. plus 4 inches for every 10 kV over 50 kV.

7.6.2 The clearance requirement may be reduced if insulating barriers, rated for the voltage of the line being guarded, are installed to prevent contact with the lines. The barrier may not be attached to the vehicle or its raised structure. The clearance may be reduced to the distance allowed by the design of the insulating barrier.

7.6.3 The clearance requirement may be reduced if the equipment is an aerial lift insulated for the voltage involved and the work is performed by a *qualified person*. The clearance between the uninsulated portion of the lift and the power line may be reduced to the distance given in Table 3.

7.6.4 Persons working on the ground are not allowed to contact the vehicle or mechanical equipment or any of its attachments, unless:

- The person uses protective equipment rated for the voltage; or
- The equipment is located so that no uninsulated part of its structure can provide a conductive path to persons on the ground. Equipment shall not approach closer to the line than 10 feet for voltages less than 50 kV, or 10 feet plus 4 inches for every 10 kV over 50 kV.

7.6.5 When any vehicle or mechanical equipment is intentionally grounded, persons may not stand near the point of grounding when there is any possibility of contact with overhead energized lines. Additional precautions (e.g., such as the use of barricades or insulation) must be taken as necessary to protect persons from hazardous ground potentials that can develop within a few feet or more outward from the grounding point.

7.6.6 *Unqualified persons* shall stay beyond the next utility pole in either direction as a minimum.

7.6.7 *Qualified persons* on the ground shall establish boundaries (i.e., plastic red barrier tape stating "DANGER – Do Not Enter") as a first priority to prevent *unqualified persons* from entering the restricted work area.

- Vehicles not directly associated with the operation shall be spotted beyond the next utility pole in either direction as a minimum.

7.7 Excavation Work – Whenever burial of electrical lines takes place, detectable underground warning tape shall be buried above the electric line to provide easy detection and proximity warning for future excavations.

7.7.1 Whenever energized lines are exposed in excavations, *qualified persons* shall establish boundaries (i.e., plastic red barrier tape stating "DANGER – Do Not Enter") as a first priority to prevent *unqualified persons* from entering the restricted work area.

7.7.2 If during excavation, an electrical line is cut or damaged, **excavation work shall stop** and a *qualified person* shall be called to the site to secure the line and determine if the excavation can safely continue.

7.8 Illumination - Employees may not enter spaces containing exposed energized parts unless there is sufficient illumination for them to perform the work safely. Employees may not perform tasks near exposed energized parts where there is lack of illumination or an obstruction that blocks his/her view of the work to be performed. Do not reach blindly into areas that may contain energized parts.

7.9 Confined or Enclosed Work Spaces – UConn employees working in manholes, vaults or similar confined or enclosed spaces that contain exposed energized parts must be provided with, and must use, protective shields, protective barriers, or insulating materials as needed to prevent inadvertent contact with these energized parts. Doors and hinged panels that could swing into an employee and cause him or her to contact exposed energized parts must be secured before work begins. Work performed within confined or enclosed spaces must comply with UCONN's *Confined Space Entry Program*.

7.9.1 High voltage cable cutting in confined spaces shall only be performed using remotely operated cutting devices and appropriate electrically insulated personal protective equipment. No persons shall be in the confined space during the cutting process.

7.10 Conductive Materials and Equipment - Conductive materials and equipment that are in contact with any part of an employee's body must be handled in a manner that will prevent him/her from contacting exposed energized conductors or circuit parts. If an employee must handle long conductive objects, such as metal conduits, ducts, pipes, or rods, in areas with exposed live parts, then insulation, guarding and/or approved materials handling techniques that will minimize the hazard must be used.

7.11 Portable Ladders - A portable ladder used where there is potential for contact with exposed energized parts must have nonconductive side rails.

7.11.1 Ladders shall be clean (free of oil, grease or contaminants that have the potential to be conductive), and in good working condition.

7.12 Conductive Apparel - Employees may not wear conductive articles of jewelry or clothing (e.g., watchbands, bracelets, rings, key chains, necklaces, metalized aprons, cloth with conductive thread, or metal headgear) or metal eyeglasses without goggles or face shield if they might contact exposed energized parts. If special conductive work apparel is necessary for energized work to be performed, it shall be used in conjunction with an energized work permit and a written procedure (see Appendix B).

7.13 Housekeeping - Housekeeping duties may not be performed close to live parts unless adequate safeguards, such as insulating equipment or barriers, are provided. Electrically conductive cleaning materials, including steel wool, metalized cloth and silicon carbide, as well as conductive liquid solutions, may not be used near energized parts unless procedures are followed which prevent electrical contact.

7.14 Interlocks - Only *qualified persons* are allowed to bypass electrical safety interlocks, and then only temporarily while he/she is **actively** working on the equipment. This work must comply with the specified procedures for working on or near exposed energized parts. The interlock system must be returned to its operable condition when the work is completed.

7.15 Portable Electrical Equipment And Extension Cord Use - The following requirements apply to the use of cord-and-plug-connected equipment and flexible cord sets (extension cords):

7.15.1 Extension cords may only be used to provide temporary power:

- during construction, remodeling, maintenance, repair or demolition of buildings, structures, or equipment, or similar activities; otherwise,
- extension cords for temporary electrical power, lighting installations, decorative holiday decorations or similar purposes may be used for a period not to exceed 90 days.

7.15.2 Portable cord-and-plug connected equipment and extension cords must be visually inspected before use on any shift for external defects such as loose parts, deformed and missing pins, or damage to outer jacket or insulation, and for possible internal damage such as a pinched or crushed outer jacket. Any defective cord or cord-and-plug-connected equipment must be removed from service and no person may use it until it is repaired and tested to ensure it is safe for use.

7.15.3 Job-made extension cords may only be built by *qualified persons*, and must be tested prior to use. Job-made extension cords may only be constructed using parts approved for this use. Metal electrical boxes with knockouts, for example, may not be used for job-made extension cords.

7.15.4 Personnel performing work on renovation or construction sites using extension cords must be provided, and must use, a ground-fault circuit interrupter (*GFCI*).

7.15.5 Portable equipment must be handled in a manner that will not cause damage. Flexible electric cords connected to equipment may not be used for raising or lowering the equipment.

7.15.6 Extension cords must be protected from damage during use. Sharp corners and projections must be avoided. Flexible cords may not be run through windows or doors unless protected from damage, and then only on a temporary basis. Flexible cords may not be run above ceilings, inside or through walls, ceilings or floors, and may not be fastened with staples or otherwise hung in such a fashion as to damage the outer jacket or insulation.

7.15.7 Cords must be covered by a cable bridge or tape when they extend into a walkway or other path of travel to avoid creating a trip hazard.

7.15.8 Extension cords used with grounding-type equipment must contain an equipment-grounding conductor (i.e., the cord must accept a three-prong or grounded plug).

7.15.9 Extension cords and flexible cords must be designed for hard or extra hard usage (for example, types S, ST, and SO). The rating or approval must be visible.

7.15.10 Attachment plugs and receptacles may not be connected or altered in any way that would interrupt the continuity of the equipment-grounding conductor. Additionally, these devices may not be altered to allow the grounding pole to be inserted into current connector slots. Clipping the grounding prong from an electrical plug is prohibited.

7.15.11 Flexible cords that have a ground pin may only be plugged into grounded receptacles. The continuity of the ground in a two-prong outlet must be verified before use with a flexible cord. Preferably, the receptacle should be replaced with a three-prong outlet. Adapters that interrupt the continuity of the equipment grounding connection may not be used.

7.15.12 All portable electric equipment and flexible cords used in highly conductive work locations, such as those with water or other conductive liquids, or in places where employees are likely to contact water or conductive liquids, must be approved for such locations. In such locations, *GFCIs* must also be used.

7.15.13 Employees' hands must not be wet when plugging and unplugging flexible cords and cord-and-plug connected equipment if energized equipment is involved.

7.15.14 If the connection could provide a conducting path to employees' hands (for example, if a cord connector is wet from being immersed in water), the energized plug and receptacle connections must be handled only with insulating protective equipment.

7.15.15 Locking-type connectors must be properly locked into the connector.

7.15.16 Lamps for general illumination must be protected from breakage, and metal shell sockets must be grounded.

7.15.17 Temporary lights must not be suspended by their cords unless they have been designed for this purpose.

7.15.18 Portable lighting used in wet or conductive locations, such as tanks or boilers, must be operated at no more than 12 volts or must be protected by *GFCI*'s.

7.15.19 Extension cords are considered temporary wiring, and must comply with section **6.6**, "**Requirements for Temporary Wiring**" in this program.

7.16 Electric Power and Lighting Circuits

7.16.1 **Routine Opening and Closing of Circuits**: Load rated switches, circuit breakers, or other devices specifically designed as *disconnecting means* must be used for the opening, reversing, or closing of circuits under load conditions. Cable connectors not of the load-break type, fuses, terminal lugs, and cable splice connections may not be used for opening, reversing, or closing circuits under load conditions.

7.16.2 **Re-closing Circuits after a Protective Device Operates**: After a circuit has been de-energized by a protective device (e.g., circuit breaker, *GFCI*, AFCI, etc.), the circuit may not be manually re-energized until it has been determined that the equipment and circuit can be safely energized. The repetitive manual re-closing of protective devices or re-energizing circuits by replacing fuses without verifying that the circuit can be safely energized is **prohibited**. When it can be determined that the protective device operated because of an overload, rather than a fault condition, the circuit may be reenergized without an examination of the circuit or connected equipment, provided that the condition that resulted in the overload has been corrected. Overcurrent protection of circuits and conductors may not be modified, even on a temporary basis.

7.17 Test Equipment and Instruments - Only *qualified persons* may perform testing work on electric circuits or equipment. Test instruments and equipment (including all associated test leads, cables, power cords, probes and connectors) must be visually inspected for external defects and damage before the equipment is used. If there is a defect or evidence of damage that might expose an employee to injury, the defective or damaged item must be tagged out of service. The device may not be returned to service until it has been repaired and tested safe for use. Test instruments, equipment, and their accessories must be rated for the circuits and equipment to which they will be connected and designed for the environment in which they will be used.

7.18 Flammable or Ignitable Materials - Where flammable or ignitable materials are present, do not use electric equipment capable of igniting them unless measures are taken to prevent hazardous conditions from developing. Flammable and ignitable materials include, but are not limited to, flammable gases, vapors, or liquids, combustible dust, and ignitable fibers or filings. Equipment that is intrinsically safe for the hazardous condition may be used.

7.19 *Battery Rooms* – These safety requirements shall apply to new installation of batteries and *battery rooms* with a stored capacity exceeding 1 kWh or a floating voltage that exceeds 115 volts but does to exceed 650 volts.

7.19.1 *Battery rooms* shall be accessible only to authorized personnel (i.e., only *qualified persons* and/or others escorted by a *qualified person*), and shall be locked when unoccupied.

7.19.2 Doors to *battery rooms* and *battery enclosure* doors shall open outward. Doors shall be equipped with quick-release, quick opening hardware.

7.19.3 Foreign piping shall not pass through a *battery room.*

7.19.4 *Battery room* lighting shall be installed to provide a minimum level of illumination of 30 ft-candles. Lighting fixtures shall not be installed directly over cells or exposed live parts. Emergency illumination shall be provided for safe egress from the *battery room*.

7.19.5 Where mechanical ventilation is installed, the following shall be required:

- airflow sensors shall be installed to initiate an alarm if the ventilation fan becomes inoperative;
- control equipment for the exhaust fan shall be located more than 6 feet from the batteries and a minimum of 4 inches below the lowest point of the highest ventilation opening.

- where mechanical ventilation is used in a dedicated *battery room,* all exhaust air shall be discharged outside the building;
- fans used to remove air from the *battery room* shall not be located in the duct unless the fan is listed for the use.

7.19.6 Protective equipment shall not be located in the battery compartment of the enclosure.

7.19.7 Ground-Fault Protection – for an ungrounded battery of nominal voltage of 120 volts, a ground-fault detector shall be provided to initiate a ground-fault alarm.

7.19.8 Section Isolating Equipment – Where a battery section exceeds 120 volts, the installation shall include an isolating switch, plugs, or links, as required, to isolate sections of the battery, or part of the battery for maintenance.

7.19.9 Warning signs- the following signs shall be posted in appropriate locations:

- electrical hazard warning signs indicating the shock hazard due to battery voltage and the arc hazard due to prospective short-circuit current;
- chemical hazard warning signs indicating the danger of hydrogen explosion from open flame and smoking and the danger of chemical burns from the electrolyte;
- Notice for personnel to wear protective equipment and apparel;
- Notice prohibiting access to unauthorized personnel.

7.19.10 The following protective equipment shall be available to employees performing battery maintenance:

- goggles and face shields
- chemical-resistant gloves
- protective aprons
- protective overshoes
- portable or stationary water facilities for rinsing eyes and skin in case of electrolyte spillage.

7.19.11 Tools and equipment for work on batteries shall be of the non-sparking type and be equipped with handles listed as insulated for the maximum working voltage.

7.20 Safeguards for Personnel Protection

7.20.1 **Protective Equipment -** Employees working in areas where there are potential electrical hazards must be provided with, and must use, electrical protective equipment that is appropriate for the specific parts of the body to be protected and for the work to be performed.

7.20.2 **Workmanship and finish:** Rubber insulating equipment must meet applicable American Society of Testing and Materials (ASTM) standards. Manufactured equipment which does not indicate compliance with these ASTM standards must be tested using the a-c and d-c proof tests and related procedures as described in these ASTM standards.

Blankets, gloves and *sleeve*s must be produced by seamless process. Insulating blankets, matting, covers, lines, hose, gloves, and *sleeve*s made of rubber must be marked to indicate the class of equipment (e.g., Class 0 equipment must be marked Class 0, Class 1 marked Class 1, and so forth). Non-ozone-resistant equipment other than matting must be marked Type I. Ozone-resistant equipment other than matting shall be marked Type II. Markings must be nonconductive and must be applied in a way that will not damage the insulating qualities. Markings on gloves must be confined to the cuff portion of the glove.

Equipment must be free of harmful physical irregularities. Surface irregularities (e.g., indentions, protuberances, or imbedded foreign materials) may be present on rubber goods because of imperfections on forms or molds or because of manufacturing difficulties. These surface irregularities are acceptable under the following conditions:

- The indention or part that sticks out blends into a smooth slope when the material is stretched, or
- The foreign material remains in place when the insulating material is folded and stretches with the insulating material surrounding it.

7.21 In-service care and use: Supervisors must make certain that each employee maintains his/her electrical protective equipment in a safe, reliable condition, and that the following requirements are met:

7.21.1 Maximum use voltages for rubber protective equipment must conform to those listed in Table 4.

TABLE 4
RUBBER INSULATING EQUIPMENT, MAXIMUM USE VOLTAGE

Class of Equipment	Maximum use voltage[1] a-c -- rms
0	1,000
1	7,500
2	17,000
3	26,500
4	36,000

[1] The maximum use voltage is the ac voltage (rms) classification of the protective equipment that designates the maximum nominal voltage of the energized system that may be safety worked. The nominal design voltage is equal to the phase-to-phase voltage on multiphase circuits. However, the phase-to-ground potential is considered to be the nominal design voltage if:

- there is no multiphase exposure in a system area and if the voltage is limited to the phase-to-ground potential, or
- the electrical equipment and devices are insulated or isolated or both so that the multiphase exposure on a grounded wye circuit is removed.

7.21.2 Insulating equipment must be inspected for damage before each day's use and immediately following any incident that could have caused damage.

7.21.3 An air test must be performed on rubber insulating gloves before use.

7.21.4 Insulating equipment with a hole, tear, puncture or cut, ozone cutting or checking, an embedded foreign object, any change in texture including swelling, softening, hardening, or becoming sticky or inelastic, or any other defect that could damage the insulating property must not be used.

7.21.5 All protective equipment must be used and maintained in accordance with the manufacturer's instructions.

7.21.6 Insulating equipment found to have defects that might affect its insulating properties must be removed from service until electrical tests have been performed that indicate it is acceptable for continued use.

7.21.7 Where the insulating capability of protective equipment is subject to damage during use, the insulating material shall be protected by an outer covering of leather or other appropriate material.

7.21.8 Insulating equipment must be tested on a schedule as shown in Table 5.

TABLE 5
INSULATING EQUIPMENT TEST INTERVALS

Type of Equipment	When to Test
Rubber insulating line hose	Upon indication that the insulating value is suspect
Rubber insulating covers	Upon indication that the insulating value is suspect
Rubber insulating blankets	Before first issue and every 12 months thereafter[1]
Rubber insulating gloves	Before first issue and every 6 months thereafter [1]
Rubber insulating *sleeves*	Before first issue and every 12 months thereafter[1]
Hot Sticks (live-line tools)	Before first issue and every 24 months thereafter[1]

[1] If the insulating equipment has been electrically tested but not issued for service, it may not be placed into service unless it has been electrically tested within the previous 12 months.

7.21.9 Certification of testing is required and it shall identify the protective device has passed testing and the date tested. Marking the equipment or maintaining a log of test results and dates are acceptable means of meeting this requirement.

7.21.10 Employees must clean insulating equipment as needed to remove foreign substances, and to store insulating equipment where it is protected from light, temperature extremes, excessive humidity, ozone, and other substances and conditions that may cause damage.

- Each *hot stick* (live-line tool) shall be wiped clean and visually inspected for defects before use each day.
- If any defect or contamination that could adversely affect the insulating qualities or mechanical integrity of the *hot stick* (live-line tool) is present after wiping, the tool shall be removed from service and examined and tested.

CAUTION: Do not use soap detergents, liquid or powdered form (such as 409, Fantastic, Comet, ND-150, Bon Ami, Ajax, etc.) to clean fiberglass tools under field conditions. Such cleaning agents will leave a conductive residue unless rinsed with generous amounts of water (usually not available in the field) and abrasive cleaners will destroy the surface gloss on the stick. Use only cleaners and conditioners recommended by the manufacturer.

7.21.11 Employees must visually examine their gloves prior to each use and to avoid handling sharp objects. Protector gloves must be worn over insulating gloves except as follows:

- Protector gloves need not be used with Class 0 gloves, under limited-use conditions, where small equipment and parts manipulation require unusually high finger dexterity.
- Any other class of glove may be used for similar work without protector gloves if is demonstrated that the possibility of physical damage to the gloves is small and if the class of glove is one class higher than that required for the voltage involved. Insulating gloves that have been used without protector gloves may not be used at a higher voltage until they have been electrically re-tested.

7.21.12 The employee must ensure that he/she does not use insulating equipment that fails to pass visual inspections or electrical tests except as follows:

- Rubber insulating line hose may be used in shorter lengths if the defective portion is cut off.
- Rubber insulated blankets may be salvaged by cutting and removing the defective area from the undamaged portion of the blanket if the undamaged area remaining is greater than 22 inches by 22 inches for Class 1, 2, 3 and 4 blankets.

7.22 General Protective Equipment and Tools - Nonconductive head protection must be worn whenever there is danger of head injury from electric shock or burn due to contact with exposed energized parts.

7.22.1 Protective equipment for the eyes and/or face must be worn whenever there is danger of injury to the eyes or face from electric arcs, flashes or flying objects resulting from electrical explosion.

7.22.2 Insulated tools or handling equipment must be used by employees working near exposed energized parts if the tools or handling equipment might make contact with such energized parts.

7.22.3 If the insulating capability of insulated tools or handling equipment is subject to damage, the insulating material must be protected.

7.22.4 Protective shields, protective barriers, or insulating materials must be used to protect each employee from shock, arc flash burns, or other electrically related injuries while employees are working near exposed energized parts which might be accidentally contacted or where dangerous electric heating or arcing might occur.

7.22.4 When normally enclosed live parts are exposed for maintenance or repair, they are to be guarded to protect *unqualified persons* from contact with the live parts.

7.22.5 Fuse handling equipment, insulated for the circuit voltage, must be used to remove or install fuses when the fuse terminals are energized.

7.22.6 Ropes and hand lines used near exposed energized parts must be nonconductive.

7.23 Fire Retardant Clothing – UConn *Qualified persons* shall be provided fire retardant (FR) clothing as personal protective equipment (PPE) in the event of an *arc flash incident*. Whenever an flash hazard analysis has not been performed on electrical equipment to be worked on, NFPA 70E, Table 130.7(C)(15)(a) shall be used to determine the hazard/risk category for a task (see table in Appendix B of this program). This table lists common electrical tasks and may be used to determine a hazard/risk category, (i.e., level 0, 1, 2, 3 or 4). A hazard/risk (*flash hazard analysis*), has been performed on for each common task listed in this table. The *flash hazard analysis* is based on parameters commonly found in industrial workplaces and these are identified as notes at the bottom of the table.

7.23.1 Once the hazard/risk category has been determined from NFPA Table 130(C)(16)(a), the *qualified person* shall use NFPA Table 130.7(C)(10) to determine the required personal protective equipment (PPE) for the task, (this table is shown in Appendix C in this program). Table 130.7(C)(10) lists the requirements for protective clothing and other protective equipment based on hazard category numbers 0 through 4. This clothing and equipment shall be used when working on or near energized equipment within the *Flash Protection Boundary*.

NOTE: Matching the category to the task is limited to electrical systems that do not exceed specified levels of available *short circuit current* and *fault-clearing times*, as described in the table footnotes. A *flash hazard analysis* must be performed for *fault-clearing times* and short-circuit capacities that exceed the information contained in the table's notes.

Additionally, NFPA 70E states that for tasks not included in the table and for electrical systems that exceed the footnote limitations, the tables cannot be used and the incident energy must be calculated for PPE selection. Notify your supervisor in the event of this situation.

CAUTION: Using these tables when the electrical system exceeds the levels described may expose individuals to hazardous energies beyond the protection of their FR clothing, potentially resulting in serious injury or death.

7.24 Alerting Techniques - The following alerting techniques must be used to warn and protect employees from electrical shock hazards, burns, or failure of electric equipment parts.

7.24.1 **Safety Signs and Tags -** Safety signs, safety symbols, or advisory tags are to be used where necessary to warn employees about electrical hazards that may endanger them.

7.24.2 **Barricades** – Barricades are used in conjunction with safety signs where necessary to prevent or limit employee access to work areas exposing employees to uninsulated energized conductors or circuit parts. Conductive barricades may not be used where they might cause an electrical contact hazard.

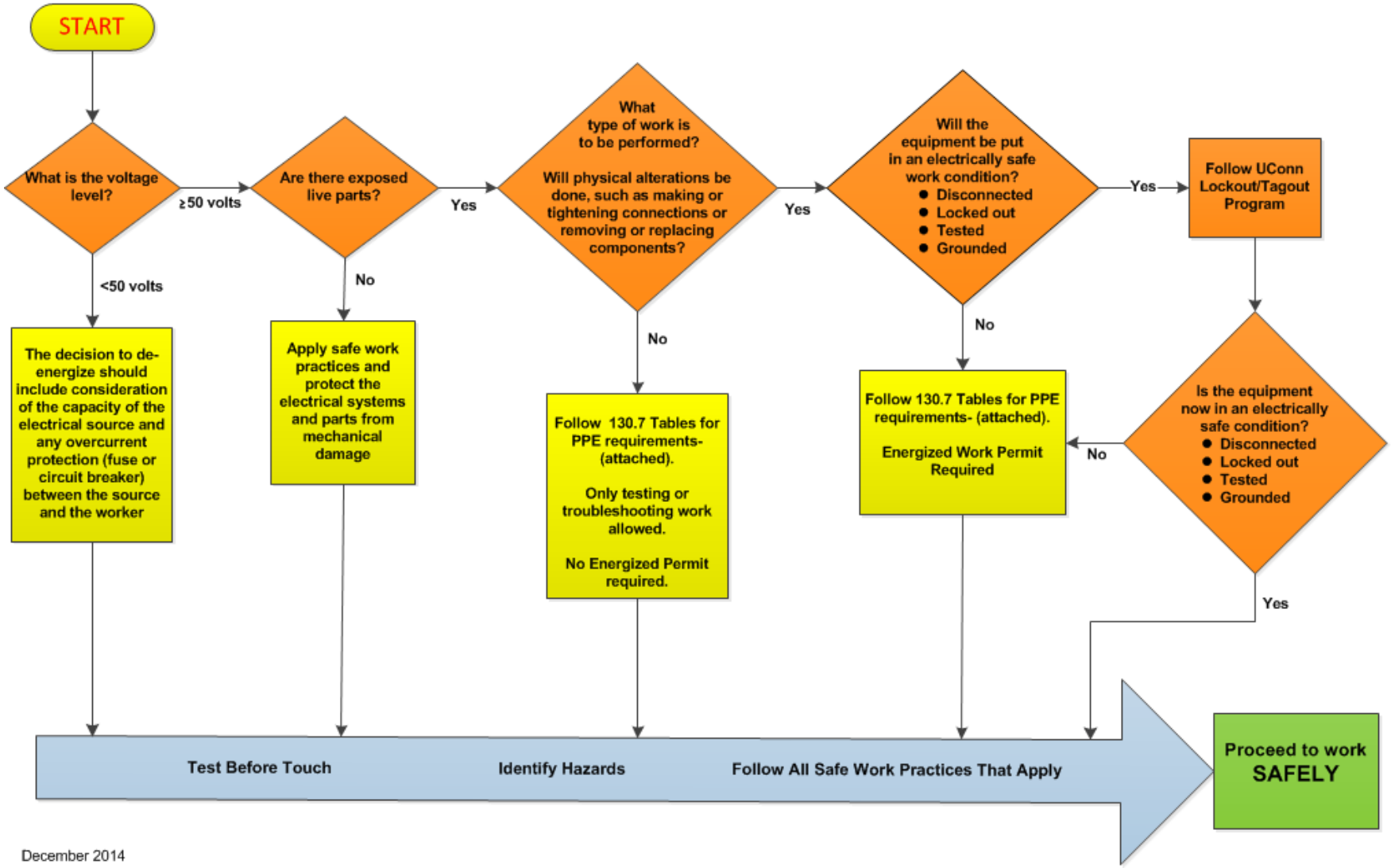
7.24.3 **Attendants -** If signs and barricades do not provide sufficient warning from electrical hazards, an attendant must be stationed to warn and protect employees.

7.25 First Aid and Cardiopulmonary Resuscitation (CPR) Requirements - Employees associated with electric power generation, transmission, and distribution and perform work on, or associated with, exposed lines or energized equipment must be trained in first aid and CPR.

Appendices

UConn Electrical Safety Program – Appendix A

University of Connecticut
Energized Permit Decision Tree



December 2014

ENERGIZED ELECTRICAL PERMIT

SECTION 1.

DESCRIPTION OF WORK AND JUSTIFICATION FOR PERFORMING THAT WORK ENERGIZED.

Description of work: _____

_____

Justification: (Check all that apply)

De-energization introduces additional or increased hazards:

- _____ Violation of an Environmental Permit
- _____ Deactivation of emergency alarm systems
- _____ Shutdown of hazardous ventilation equipment
- _____ Other - Describe _____

De-energization is not feasible due to equipment design or operational limitations:

- _____ Tasks that can only be performed with circuit energized
- _____ Would require continuous operating process to be shutdown
- _____ Other - Describe _____

Requested by: _____ **Title:** _____ **Date:** _____

SECTION 2.

Hazard Risk Category _____ (See Table 130.7(C)9(a) in Appendix B)

Minimum approach safe distance _____

Less than 600 V -- 4 feet
601 V to 5,000 V -- 10 feet
5,001 V to 87,500 V -- 30 feet

TECHNICAL REQUIREMENTS	Yes	Done		Yes	Done
Written Procedure			Approved Insulated Hand Tools		
Review Electrical Live Work			Live-line Tools (e.g., hot sticks)		
Job Briefing Discussion			CAT III or IV rated Voltmeter		
Barricades			Approved Phasing Tester		
Personal Protective Equipment			Illumination		
Class E Hard hat			Limited work space considerations[1]		
Safety glasses			Conductive material considerations[1]		
Polycarbonate tinted face shield			Portable ladders		
Fire Resistant Clothing level ___			Conductive work apparel[1]		
Flash suit Level _____			Interlock considerations[1]		
Voltage rated insulated gloves			Housekeeping requirements[1]		
Voltage rated insulated blankets			2 Qualified-person teams		
Voltage rated insulated matting			Other:		
Voltage rated insulated shielding			Other:		
Grounding cables			Other:		
Bonding cables			(1 ***List in a written procedure***)		

SECTION 3.

Reviewed By: _____ **Date** _____
Electric Shop Supervisor

Approved By: _____ **Date** _____
Director Utility Services

SECTION 4.

_____ Date	_____ Date	_____ Date
Qualified Worker	Qualified Worker	Qualified Worker
_____ Date	_____ Date	_____ Date
Qualified Worker	Qualified Worker	Qualified Worker

Appendix A (cont'd)

Energized Electrical Work Permit Instructions

SECTION 1:

- The requester shall briefly describe what work they believe needs to be performed energized.
- The requester shall justify, by checking all reasons that apply, why the electrical work needs to be performed in an energized state.
- The requester shall sign, print his/her title and date the request.

SECTION 2:

- A Facilities Electric Shop Supervisor, (or qualified designee), shall review the request and evaluate if it is necessary to work energized.
- If the supervisor (or qualified designee), concurs that it is necessary to work energized, he/she will then establish the Hazard Risk Category (0, 1, 2, 3, 4), the Minimum Approach Safe Distance and establish the technical requirements in Section 2 to perform the work with proper precautions.
- If a written procedure is needed for the operation, the supervisor (or qualified designee), will write the procedure (in consultation with the UConn Architectural & Engineering Services Electrical Engineer, if necessary),.
- Written procedures shall include descriptions or detailed list of the technical requirements noted on the permit (e.g., housekeeping requirements, limited work space, conductive material, conductive work apparel, or interlock considerations). Procedures will outline the steps necessary to complete the work safety along with any special precautionary "NOTES" or "WARNINGS". The written procedures shall be reviewed in a job briefing and attached to the permit.

SECTION 3: The permit is approved by a Facilities Electric Shop Supervisor (or qualified designee), and Energy Services Manager (or his/her supervisor) before work may begin.

SECTION 4: Qualified Workers assigned to the energized work shall sign and date the permit to indicate that they have read and understand the work precautions and any associated procedures.

PERMIT EXPIRATION: The permit will expire when:

1- work operations covered by this permit have been completed; or

2- the technical requirements listed on the permit are no longer suitable for the hazards present; or

3- if the hazard category changes.

Hazard/Risk Category Determination

When selected in lieu of the *flash hazard analysis* of NFPA 70E 130.3(B)(1), Table 130.7(C)(15)(a) shall be used to determine the hazard/risk category and requirements for use of rubber insulating gloves and insulated hand tools for a task. The assumed maximum *short circuit current* capacities and fault-clearing times for various tasks are listed in the text and notes to Table 130.7(C)(15). For tasks not listed, or for power systems with greater than the assumed maximum short-circuit current capacity or with longer than the assumed maximum fault-clearing times, a *flash hazard analysis* shall be required in accordance with 130.3

Table 130.7(C)(15)(a) Hazard Risk Category Classifications

Task (Assumes Equipment is Energized, and Work is Done Within the Flash Protection Boundary)	***Hazard/Risk Category***	***Rubber Insulating Gloves***	***Insulated and Insulating Hand Tools***
Panelboards or Other Equipment rated 240 V and below Parameters: Maximum of 25 kA short circuit current available; maximum of 0.03 sec (2 cycle) fault clearing time; minimum 18 in. working distance Potential arc flash boundary with exposed energized conductors or circuit parts using above parameters: 19 in.			
Perform infrared thermography and other non-contact inspections outside the restricted approach boundary	0	N	N
Circuit breaker (CB) or fused switch operation with covers on	0	N	N
CB or fused switch operation with covers off	0	N	N
Work on energized electrical conductors and circuit parts, including voltage testing	1	Y	Y
Remove / install CBs or fused switches	1	Y	Y
Removal of bolted covers (to expose bare, energized electrical conductors and circuit parts)	1	N	N
Opening hinged covers (to expose bare, energized electrical conductors and circuit parts)	0	N	N
Work on energized electrical conductors and circuit parts of utilization equipment fed directly by a branch circuit of the panelboard	1	Y	Y
Panelboards or other equipment rated > 240 V and up to 600 V Parameters: Maximum of 25 kA short circuit current available; maximum of 0.03 sec (2 cycle) fault clearing time; minimum 18 in. working distance Potential arc flash boundary with exposed energized conductors or circuit parts using above parameters: 30 in.			
Perform infrared thermography and other non-contact inspections outside the Restricted Approach Boundary	1	N	N
Circuit breaker (CB) or fused switch operation with covers on	0	N	N
Circuit breaker (CB) or fused switch operation with covers off	1	Y	N
Work on energized electrical conductors and circuit parts, including voltage testing	2	Y	Y
Remove/install CBs or fused switches	2	Y	Y

Removal of bolted covers (to expose bare, energized electrical conductors and circuit parts)	1	N	N
Opening hinged covers (to expose bare, energized electrical conductors and circuit parts)			
Work on energized electrical conductors and circuit parts of utilization equipment fed directly by a branch circuit of the panelboard or switchboard	2	Y	Y
600V Class Motor Control Centers (MCC's) Parameters: Maximum of 65 kA short circuit current available; maximum of 0.03 sec (2 cycle) fault clearing time; minimum 18 in. working distance Potential arc flash boundary with exposed energized conductors or circuit parts using above parameters: 53 in.			
Perform infrared thermography and other non-contact inspections outside the restricted approach boundary	1	N	N
CB or fused switch or starter operation with enclosure doors closed	0	N	N
Reading a panel meter while operating a meter switch	0	N	N
CB or fused switch or starter operation with enclosure doors open	1	N	N
Work on energized electrical conductors and circuit parts, including voltage testing	2	Y	Y
Work on control circuits with energized electrical conductors and circuit parts 120 V or below, exposed	0	Y	Y
Work on control circuits with energized electrical conductors and circuit parts >120 V, exposed	2	Y	Y
Application of temporary protective grounding equipment, after voltage test	2	Y	N
Work on energized electrical conductors and circuit parts of utilization equipment fed directly by a branch circuit of the motor control center	2	Y	Y
600 V Class Motor Centers (MCC's) Parameters: Maximum of 42 kA short circuit current available; maximum of 0.33 sec (20 cycle) fault clearing time; minimum 18 in. working distance Potential arc flash boundary with exposed energized conductors or circuit parts using above parameters: 165 in.			
Insertion or removal of individual starter "buckets" from MCC	4	Y	N
Removal of bolted covers (to expose bare, energized electrical conductors and circuit parts)	4	N	N
Opening hinged covers (to expose bare, energized electrical conductors and circuit parts)	1	N	N
600 V class switchgear (with power circuit breakers or fused switches) and 600 V class switchboards Parameters: Maximum of 35 kA short circuit current available; maximum of up to 0.5 sec (30 cycle) fault clearing time; minimum 18 in. working distance Potential arc flash boundary with exposed energized conductors or circuit parts using above parameters: 233 in.			
Perform infrared thermography and other non-contact inspections outside the restricted approach boundary	2	N	N

CB or fused switch operation with enclosure doors closed	0	N	N
Reading a panel meter while operating a meter switch	0	N	N

CB or fused switch operation with enclosure doors open	1	N	N
Work on energized electrical conductors and circuit parts, including voltage testing	2	Y	Y
Work on control circuits with energized electrical conductors and circuit parts 120 V or below, exposed	0	Y	Y
Work on control circuits with energized electrical conductors and circuit parts >120 V, exposed	2	Y	Y
Insertion or removal (racking) of CBs from cubicles, doors open or closed	4	N	N
Application of temporary protective grounding equipment after voltage test	2	Y	N
Removal of bolted covers (to expose bare, energized electrical conductors and circuit parts)	4	N	N
Opening hinged covers (to expose bare, energized electrical conductors and circuit parts)	2	N	N
Other 600 V Class (277 V through 600 V, nominal) Equipment Parameters: Maximum of 65 kA short circuit current available; maximum of 0.03 sec (2 cycle) fault clearing time; minimum 18 in. working distance (except as indicated) Potential arc flash boundary with exposed energized electrical conductors or circuit parts using above parameters: 53 in.			
Lighting or small power transformers (600 V, maximum)			
Removal of bolted covers (to expose bare, energized electrical conductors and circuit parts)	2	N	N
Opening hinged covers (to expose bare, energized electrical conductors and circuit parts)	1	N	N
Work on energized electrical conductors and circuit parts, including voltage testing	2	Y	Y
Application of temporary protective grounding equipment, after voltage test	2	Y	N
Revenue meters (kW-hour, at primary voltage and current)—insertion or removal	2	Y	N
Cable trough or tray cover removal or installation	1	N	N
Miscellaneous equipment cover removal or installation	1	N	N
Work on energized electrical conductors and circuit parts, including voltage testing	2	Y	Y
Application of safety grounds, after voltage test	2	Y	N
Insertion or removal of plug-in devices into or from busways	2	Y	N
NEMA E2 (fused contactor) Motor Starters, 2.3 kV Through 7.2 kV Parameters: Maximum of 35 kA short circuit current available; maximum of up to 0.2 sec (12 cycle) fault clearing time; minimum 36 in. working distance Potential arc flash boundary with exposed energized conductors or circuit parts using above parameters: 422 in.			
Perform infrared thermography and other non-contact inspections outside the restricted approach boundary	3	N	N
600 V class switchgear (with power circuit breakers or fused switches) and 600 V class switchboards Parameters: Maximum of 35 kA short circuit current available; maximum of up to 0.5 sec (30 cycle) fault clearing time;			

minimum 18 in. working distance Potential arc flash boundary with exposed energized conductors or circuit parts using above parameters: 233 in.			
Perform infrared thermography and other non-contact inspections outside the restricted approach boundary	2	N	N
CB or fused switch operation with enclosure doors closed	0	N	N
Reading a panel meter while operating a meter switch	0	N	N
CB or fused switch operation with enclosure doors open	1	N	N
Work on energized electrical conductors and circuit parts, including voltage testing	2	Y	Y
Work on control circuits with energized electrical conductors and circuit parts 120 V or below, exposed	0	Y	Y
Work on control circuits with energized electrical conductors and circuit parts >120 V, exposed	2	Y	Y
Insertion or removal (racking) of CBs from cubicles, doors open or closed	4	N	N
Application of temporary protective grounding equipment after voltage test	2	Y	N
Removal of bolted covers (to expose bare, energized electrical conductors and circuit parts)	4	N	N
Opening hinged covers (to expose bare, energized electrical conductors and circuit parts)	2	N	N
Other 600 V Class (277 V through 600 V, nominal) Equipment Parameters: Maximum of 65 kA short circuit current available; maximum of 0.03 sec (2 cycle) fault clearing time; minimum 18 in. working distance (except as indicated) Potential arc flash boundary with exposed energized electrical conductors or circuit parts using above parameters: 53 in.			
Lighting or small power transformers (600 V, maximum)			
Removal of bolted covers (to expose bare, energized electrical conductors and circuit parts)	2	N	N
Opening hinged covers (to expose bare, energized electrical conductors and circuit parts)	1	N	N
Work on energized electrical conductors and circuit parts, including voltage testing	2	Y	Y
Application of temporary protective grounding equipment, after voltage test	2	Y	N
Revenue meters (kW-hour, at primary voltage and current)—insertion or removal	2	Y	N
Cable trough or tray cover removal or installation	1	N	N
Miscellaneous equipment cover removal or installation	1	N	N
Work on energized electrical conductors and circuit parts, including voltage testing	2	Y	Y
Application of safety grounds, after voltage test	2	Y	N
Insertion or removal of plug-in devices into or from busways	2	Y	N

References

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