



ILLINOIS STATE UNIVERSITY ELECTRICAL SAFETY PROCEDURE

Revised 6/2023

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1. PURPOSE AND SCOPE

The purpose of Illinois State University's (ISU) Electrical Safety Procedure is to protect employees from the hazards associated with electricity. Electricity is a serious workplace hazard, capable of causing both employee injury and property damage. This program applies to employees who, while performing their duties, are required to work on electrical systems throughout campus. All Facilities Management departments are required to follow the practices and procedures outlined in this procedure.

2. REFERENCES

- OSHA 29CFR 1910 Subpart S
- OSHA 29CFR 1926 Subpart K
- NFPA 70 E

3. RESPONSIBILITIES

a. ENVIRONMENTAL HEALTH AND SAFETY

- Review and update the Illinois State University Electrical Safety Procedure to conform to current Occupational Safety and Health Administration regulations.
- Monitor compliance with standards set forth in the program by periodic inspections.
- Facilities Safety Officer/Facilities Management will ensure that all training is completed as set forth in procedure.
- Provide guidance for the proper selection and use of appropriate electrical equipment and personal protective equipment to meet the requirements of this program.

b. SUPERVISORS

- Ensure that all employees perform their assigned duties as outlined in this procedure.
- Ensure employees are trained for the appropriate electrical tasks assigned to them (i.e. qualified person).
- Ensure employees are provided with and use appropriate protective equipment.
- Ensure that all equipment is in proper working order and has undergone all required dielectric testing.

c. EMPLOYEES

- Follow the work practices described in this document.

- Attend all training required relative to the Electrical Safety Procedure.
- Immediately report any concerns related to electrical safety to supervision.

4. DEFINITIONS

Arc rating – Indicates the amount of thermal energy a clothing apparel protects against. This rating is assigned to electrical protective clothing and is normally expressed in calories per square centimeter (cal/cm²).

Electrically safe work condition – A state in which the conductor or circuit part to be worked on has been disconnected from energized parts, locked/tagged in accordance to ISU policy, tested to ensure the absence of voltage, and grounded if determined necessary.

Energized – Electrically connected to or having a source of voltage.

Exposed – Capable of being inadvertently touched or approached from closer than a safe distance by a person.

Flash hazard analysis – A study investigating a worker's potential exposure to arc-flash energy.

Flash protection boundary – the distance at which PPE is needed to prevent incurable burns (2nd degree or worse) if an arc flash occurs.

Flash suit – Fire resistant clothing and equipment system that covers the entire body, except for hands and feet.

FR apparel – Flame resistant apparel; describes a broad category of clothing designed to protect employees from electrical arc events.

Limited approach boundary – the closest distance an unqualified person can approach, unless accompanied by a qualified person.

Energized parts – Energized conductive components.

Prohibited approach boundary – the minimum approach distance to exposed energized parts to prevent flashover or arcing.

PPE – Personal protective equipment.

Qualified person – One who has skills and knowledge related to the construction and operation of the electrical equipment and installation and has received training on the hazards involved.

Restricted approach boundary – the closest distance to exposed energized parts a qualified person can approach without proper PPE and tools.

Unqualified person – Any person who does not meet the definition of a qualified person.

5. TRAINING

- Employees who as part of their work responsibilities are exposed to an electrical hazard must be trained on this procedure.
- Training must be provided before the employee is assigned duties that involve work near or on electrical systems. This training must be completed upon initial assignment or when there is a change that presents a hazard to which employees have not been trained.
- A “qualified person” shall be trained and knowledgeable in all the following topics:
 - Construction and operation of equipment on which work is assigned.
 - Skills and techniques necessary to distinguish exposed energized parts from other parts of electrical equipment.
 - Skills and techniques necessary to determine the nominal voltage of exposed energized parts.
 - The approach distances specified in this document and the corresponding voltages to which the qualified employee will be exposed.
 - The knowledge and skill necessary to determine the degree and extent of electrical hazards along with the personal protective equipment and job planning necessary to perform the task safely.
- A person can be considered qualified with respect to certain equipment and methods but unqualified for others.

6. PROCEDURES

a. Working On or Near Exposed De-energized Parts

- All employees must follow the Universities/Facilities Energy Control Procedure (Lockout/Tagout) while working on/with de-energized parts.
- Energized parts to which an employee may be exposed will be de-energized. See 8.2 for specific exceptions.
- A “qualified person” must verify the equipment is in an electrically safe condition.
- 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.
- Stored electrical energy that might endanger personnel must be released prior to the work.

b. Working on or Near Energized Parts

- If energized parts are not placed in an electrically safe condition, work to be performed shall be considered energized electrical work and cannot be performed without prior approval from a foreman.

- Energized parts to which an employee may be exposed will be de-energized before the employee works on or near them unless:
 - De-energizing introduces additional or increased hazards.
 - De-energizing is not possible due to equipment design or operational limitations.
 - Energized parts operating at less than 50 volts to ground and there is no increased exposure to electrical burns or to explosion due to electric arcs.
 - Testing, troubleshooting, and voltage measuring is being performed. This must be performed by a qualified person.
- Employees working in areas where electrical hazards are present shall be provided with, and shall use, personal protective equipment.
- If de-energizing exposed energized parts is not possible, other approved work practices must be used to protect employees.
- Employees shall not reach blindly into areas that might contain exposed energized parts.
- Employees shall not enter spaces containing energized parts unless illumination is provided that allows the work to be performed safely.
- Conductive articles of jewelry and clothing (i.e. watchbands, bracelets, rings, ect.) shall not be worn where they present an electrical contact hazard with exposed energized parts.
- Conductive material, tools, and equipment that are in contact with any part of an employee's body shall be handled in a manner that prevents accidental contact with energized parts.

c. Approach Boundaries to Energized Parts

- Safe approach distances to fixed energized parts can be determined by referring to Attachment 1, or NFPA 70 E table 130.4 (E) (a) and 130.4 (E) (b).
- Unqualified persons may only cross the "limited approach boundary" when they are under the direct supervision of a qualified person.
- Qualified persons may not cross or take any conductive object closer than the "restricted approach boundary" unless one of the following conditions apply:
 - The qualified person is insulated or guarded from energized parts and no un-insulated part of the qualified person's body crosses the "prohibited approach boundary".
 - The energized parts are insulated from the qualified person and from any other conductive object.

- Crossing the “prohibited approach boundary” is considered the same as making contact with energized parts. Qualified persons may only cross this boundary when all of the following precautions have been taken:
 - The qualified person has specific training to work on energized parts.
 - The qualified person uses PPE appropriate for working on energized parts which is rated for the voltage and energy level involved.

d. Flash Protection Boundary

- Personal protective equipment shall be provided to and used by all employees working within the “flash protection boundary”.
- For systems that are at 600 volts or less, the “arc flash boundary” shall be a minimum of three feet.
- For systems that are above 600 volts, the “arc flash boundary” shall be a minimum of five feet. See NFPA 70 E table 130.7 (c) (15) (a) for correct distance.
- The specific protective equipment to be worn within the “flash protection boundary” can be determined by either of the following two methods:
 - A complete flash hazard analysis.
 - Refer to NFPA 70 E table 130.7 (c) (15) (a) and NFPA 70 E table 130.7 (c) (15) (b), *Arc Flash PPE Categories*

7. PERSONAL PROTECTIVE EQUIPMENT

- Employees working in areas where electrical hazards exist as defined by this procedure shall be provided with, and shall use, protective equipment.
- Illinois State University will provide electrical protective equipment required by this program at no cost to employees. Such equipment shall include 8 calorie, and 40 calorie rated arc flash apparel, eye protection, head protection, hand protection, and face shields where necessary. Illinois State University is not responsible for providing under garments.
- Clothing made from flammable synthetic materials such as acetate, nylon, polyester, polypropylene, and spandex either alone or in blends, shall not be worn unless protected by FR apparel.
- All protective equipment shall be maintained in a safe, reliable condition by the employee to whom it is issued.
- All personal protective equipment must be stored in an area protected from sunlight, temperature extremes, excessive humidity, and ozone as this will cause damage to the equipment.

- Employees shall wear nonconductive head protection whenever there is a danger of head injury from electric shock or burns due to contact with energized parts.
- Employees shall wear rubber insulated gloves when there is a danger of hand and arm injury due to contacts with energized parts.
- Insulated gloves must be air tested and inspected for damage before each use. Equipment found to have defects must be reported to a supervisor and taken out of service.
- Rubber insulated gloves must be sent out for testing every six months.
- Face shields without an arc rating will not be used for electrical work. Safety glasses or goggles must always be worn underneath face shields.
- Insulated tools or handling equipment must be used by employees working near exposed energized conductors or circuits if the tools or handling equipment might make contact with conductors.
- Insulated tools or equipment must be inspected before each shift's use.

8. TOOLS

- Test instruments, equipment, and their accessories shall be rated for circuits and equipment to which they will be connected.
- Test instruments, equipment, and their accessories shall be calibrated according to manufacturer's recommendations.
- Portable ladders shall have nonconductive side rails if they are used where the employee or ladder could be exposed to energized parts.
- Shotgun sticks, fuse poles, and other similar tools shall be tested every two years (or when a defect is noted or suspected). Testing shall be done in accordance with IEEE Std 978-1984.

9. ALERTING TECHNIQUES

- Barricades and danger tape shall be used with safety signs to control access to work areas containing energized parts in easily accessible or high traffic areas

10. CONTRACT EMPLOYEES

- Contractors will be required to comply with all applicable OSHA Safety and Health Regulations.

Illinois State University Facilities Management



NFPA 70E **Standard for Electrical Safety Requirements for** **Employees Workplace**

1	<p>Arc-Rated Clothing ,minimum Arc Rating of 4 cal/cm² (16.75 J/cm²) Arc-rated long-sleeved shirt and pants or arc-rated coverall Arc-rated face shield or arc flash suit hood Arc-rated jacket, parka, high-visibility apparel, rainwear, or hard hat liner (AN)^f Protective Equipment Hard hat Safety glasses or safety goggles (SR) Hearing Protection (ear-canal inserts)^c Heavy-duty leather gloves, arc-rated gloves, or rubber insulating gloves with leather protectors (SR)^d</p>
2	<p>Arc-rated clothing, Minimum Arc Rating of 8 cal/cm² (33.5J/cm²)^a Arc-rated long-sleeved shirt and pants or arc-rated coverall Arc-rated flash suit hood or arc-rated face shield and arc-rated balaclava Arc-rated jacket, parka, high-visibility apparel, rainwear, or hard hat liner (AN)^f Protective Equipment Hard hat Safety glasses or safety goggles (SR) Hearing Protection (ear-canal inserts)^c Heavy-duty leather gloves, arc-rated gloves, or rubber insulating gloves with leather protectors (SR)^d Leather footwear</p>
3	<p>Arc-rated Clothing Selected so That the System Arc Rating Meets the Required Minimum Arc Rating of 25 cal/cm² (104.7J/cm²)^a Arc-rated long-sleeved shirt (AR) Arc-rated pants (AR) Arc-rated coverall (AR) Arc-rated flash suit jacket (AR) Arc-rated flash suit pants (AR) Arc-rated gloves or rubber insulating gloves with leather protectors (SR)^d Arc-rated jacket, parka, high-visibility apparel, rainwear, or hard hat liner (AN)^f Protective Equipment Hard hat Safety glasses or safety goggles (SR) Hearing Protection (ear-canal inserts)^c Leather footwear</p>
4	<p>Arc-rated Clothing Selected so That the System Arc Rating Meets the Required Minimum Arc Rating of 40 cal/cm² (167.5J/cm²)^a Arc-rated long-sleeved shirt (AR) Arc-rated pants (AR) Arc-rated coverall (AR) Arc-rated flash suit jacket (AR) Arc-rated flash suit pants (AR) Arc-rated flash suit hood (AR) Arc-rated gloves or rubber insulating gloves with leather protectors (SR)^d Arc-rated jacket, parka, high-visibility apparel, rainwear, or hard hat liner (AN)^f Protective Equipment Hard hat Safety glasses or safety goggles (SR) Hearing Protection (ear-canal inserts)^c Leather footwear</p>

AN: As needed (optional). AR: As required. SR: Selection required. ^a Arc rating is defined in Article 100.

^b Face shields are to have wrap-around guarding to protect not only the face but also the forehead, ears, and neck, or alternatively, an arc-rated arc flash suit hood is required to be worn.

^c Other types of hearing protection are permitted to be used in lieu of or in addition to ear canal inserts provided they are worn under an arc-rated arc flash suit hood.

^d Rubber insulating gloves with leather protectors provide arc flash protection in addition to shock protection. Higher class rubber insulating gloves with leather protectors, due to their increased material thickness, provide arc flash protection.

^e Footwear other than leather or dielectric shall be permitted to be used provided it has been tested to demonstrate no ignition, melting or dripping at the minimum arc rating for the respective arc flash PPE category.

^f The arc rating of the outer layers worn over arc-rated clothing as protection from elements or for other safety purposes, and that are not used as part of a layered system, shall not be required to be equal to or greater than the estimated incident energy exposure.

Arc Flash PPE Categories for Alternating Current (ac)

Systems

Equipment	Arc Flash PPE Cat.	Arc Flash Boundary
Panelboards or other equipment rated 240 volts and below Parameters: Maximum of 25 kA available fault current; maximum of 0.03 sec (2 cycles) fault clearing time; minimum working distance 455mm (18 in.)	1	485mm (19in)
Panelboards or other equipment rated greater than 240 volts and up to 600 volts Parameters: Maximum of 25 kA available fault current; maximum of 0.03 sec (2 cycles) fault clearing time; minimum working distance 455mm (18 in.)	2	900mm (3ft)
600 volt class motor control centers (MCCs) Parameters: Maximum of 65 kA available fault current; maximum of 0.03 sec (2 cycles) fault clearing time; minimum working distance 455mm (18 in.)	2	1.5 m (5ft)
600 volt class motor control centers (MCCs) Parameters: Maximum of 42 kA available fault current; maximum of 0.33 sec (20 cycles) fault clearing time; minimum working distance 455mm (18 in.)	4	4.3 m (14ft)
600 volt class switchgear (with power circuit breakers or fused switches) and 600 volt class switch boards Parameters: Maximum of 35 kA available fault current; maximum of 0.5 sec (30 cycles) fault clearing time; minimum working distance 455mm (18 in.)	4	6 m (20ft)
Other 600 volt class (277 volts through 600 volts, nominal) equipment Parameters: Maximum of 65 kA available fault current; maximum of 0.03 sec (2 cycles) fault clearing time; minimum working distance 455mm (18 in.)	2	1.5m (5ft)
NEMA E2 (fused contractor) motor starters, 2.3 kV through 7.2 kV Parameters: Maximum of 35 kA available fault current; maximum of 0.24 sec (15 cycles) fault clearing time; minimum working distance 910mm (36 in.)	4	12 m (40ft)
Metal-clad switchgear, 1 kV through 15kV Parameters: Maximum of 35 kA available fault current; maximum of 0.24 sec (15 cycles) fault clearing time; minimum working distance 910mm (36 in.)	4	12 m (40ft)
Metal enclosed interrupter switchgear, fused or un-fused type construction, 1 kV through 15 kV Parameters: Maximum of 35 kA available fault current; maximum of 0.24 sec (15 cycles) fault clearing time; minimum working distance 910mm (36 in.)	4	12 m (40ft)
Other equipment 1 kV through 15 kV Parameters: Maximum of 35 kA available fault current; maximum of 0.24 sec (15 cycles) fault clearing time; minimum working distance 910mm (36 in.)	4	12 m (40ft)
Arc-resistant equipment up to 600 volt class Parameters: DOORS CLOSED and SECURED; with an available fault current and a fault clearing time that does not exceed the arc-resistant rating of the equipment*	N/A	N/A
Arc-resistant equipment 1 kV through 15 kV Parameters: DOORS CLOSED and SECURED; with an available fault current and a fault clearing time that does not exceed the arc-resistant rating of the equipment*		

Note: N/A: Not Applicable

For equipment rated 600 volts and below and protected by upstream current-limiting fuses or current-limiting molded case circuit breakers sized at 200 amperes or less, the arc flash PPE category can be reduced by one number but not below arc flash PPE Category 1

* For DOORS OPEN refer to the corresponding non-arc-resistant equipment section of this table.

Informational Note No. 1 to Table 130.7©(15)(a): The following are typical fault clearing times of overcurrent protection devices:

- (1) 0.5 cycle fault clearing time is typical for current-limiting fuses and current-limiting molded case circuit breakers when the fault current is within the current limiting range.
- (2) 1.5 cycle fault clearing time is typical for molded case circuit breakers rated less than 1000 volts with the instantaneous integral trip.
- (3) 3.0 cycle fault clearing time is typical for insulated case circuit breakers rated less than 1000 volts with the instantaneous integral trip or relay operated trip.

(4) 5.0 cycle fault clearing time is typical for relay operated circuit breakers rated 1 kV to 35 kV when the relay operates on the instantaneous range (i.e. "no intentional delay")

(5) 20 cycle fault clearing time is typical for low-voltage power and insulated case circuit breakers with a short time fault clearing delay for motor inrush.

(6) 30 cycle fault clearing time is typical for low-voltage power and insulated case circuit breakers with a short time fault clearing delay without instantaneous trip.

Arc Flash PPE Categories for (dc) Systems

Equipment	Arc Flash PPE Cat.	Arc Flash Boundary
Storage batteries, dc switchboards, and other dc supply sources Parameters: Greater than or equal to 100 volts and less than or equal to 250 volts Maximum arc duration and minimum working distance: 2 sec @ 455 mm (18 in)		
Available fault current less than 4 kA	2	900 mm (3ft)
Available fault current greater than or equal to 4 kA and less than 7 kA	2	1.2 m (4ft)
Available fault current greater than or equal to 7 kA and less than 15 kA	3	1.8 m (6ft)
Storage batteries, dc switchboards, and other dc supply sources Parameters: Greater than 250 volts and less than or equal to 600 volts Maximum arc duration and minimum working distance: 2 sec @ 455 mm (18 in)		
Available fault current less than 1.5 kA	2	900 mm (3ft)
Available fault current greater than or equal to 1.5 kA and less than 3 kA	2	1.2 m (4ft)
Available fault current greater than or equal to 3 kA and less than 7 kA	3	1.8 m (6ft)
Available fault current greater than or equal to 7 kA and less than 10 kA	4	2.5 m (8ft)

Notes:

(1) Apparel that can be expected to be exposed to electrolyte must meet both the following conditions:

(a) Be evaluated for electrolyte protection

Informational note: ASTM F1296, Standard Guide for *Evaluating Chemical Protective Clothing*, contains information on evaluating apparel for protection from electrolyte.

(b) Be arc rated

Informational note: ASTM F1891, Standard Specification for Arc and Flame Resistant Rainwear, contains information on evaluating arc rated apparel.

(2) A two-second arc duration is assumed if there is no overcurrent protective device (OCPD) or if the fault clearing time is not known. If the fault clearing time is known and is less than 2 seconds, an incident energy analysis could provide a more representative result.

Limited Approach Boundary AC

Nominal System Voltage Range, Phase to Phase	Exposed Movable Conductor ^c	Exposed Fixed Circuit Part	Restricted Approach Boundary; Includes Inadvertent Movement Adder
Less than 50 V	Not specified	Not specified	Not specified
50 V- 150 V ^d	3.0 M (10 ft 0 in)	1.0 m (3 ft 6 in)	Avoid contact
151 V - 750 V	3.0 M (10 ft 0 in)	1.0 m (3 ft 6 in)	0.3 m (1ft 0 ft)
751 V - 15kV	3.0 M (10 ft 0 in)	1.5 m (5 ft 0 in)	0.7 m (2 ft 2 in)
15.1 kV - 36 kV	3.0 M (10 ft 0 in)	1.8 m (6 ft 0 in)	0.8 m (2 ft 9 in)
36.1 kV - 46 kV	3.0 M (10 ft 0 in)	2.5 m (8 ft 0 in)	0.8 m (2 ft 9 in)
46.1 kV - 72.5 kV	3.0 M (10 ft 0 in)	2.5 m (8 ft 0 in)	1.0 m (3 ft 6 in)
72.6 kV - 121 kV	3.3 m (10 ft 8 in)	2.5 m (8 ft 0 in)	1.0 m (3 ft 6 in)
138 kV - 145 kV	3.4 m (11 ft 0 in)	3.0 m (10 ft 0 in)	1.2 m (3 ft 10 in)
161 kV - 169 kV	3.6 m (11 ft 8 in)	3.6 m (11 ft 8 in)	1.3 m (4 ft 3 in)
230 kV - 242 kV	4.0 m (13 ft 0 in)	4.0 m (13 ft 0 in)	1.7 m (5 ft 8 in)
354 kV - 362 kV	4.7 m (15 ft 4 in)	4.7 m (15 ft 4 in)	2.8 m (9 ft 2 in)
500 kV - 550 kV	5.8 m (19 ft 0 in)	5.8 m (19 ft 0 in)	3.6 m (11 ft 8 in)
765 kV - 800 kV	7.2 m (23 ft 9 in)	7.2 m (23 ft 9 in)	4.9 m (15 ft 11 in)

Notes:

(1) For arc flash boundaries see 130.5E.

(2) All dimensions are distance from exposed energized electrical conductors or circuit to employee.

^a For single-phase systems above 250 volts, select the range that is equal to the system's maximum phase-to-ground voltage multiplied by 1.732.

^b See definition in Article 100 and text in 130.4(D)(2) and Informative Annex C for elaboration.

^c *Exposed movable conductors* describes a condition in which the distance between the conductor and a person is not under the control of the person.

The term is normally applied to overhead line conductors supported by poles.

^d This includes circuits where the exposure does not exceed 120 volts nominal.

Limited Approach Boundary DC

Nominal System Voltage Range, Phase to Phase	Exposed Movable Conductor ^c	Exposed Fixed Circuit Part	Restricted Approach Boundary; Includes Inadvertent Movement Adder
Less than 50 V	Not specified	Not specified	Not specified
50 V - 300 V	3.0 m (10 ft 0 in)	1.0 m (3 ft 6 in)	Avoid Contact
301 V - 1kV	3.0 m (10 ft 0 in)	1.0 m (3 ft 6 in)	0.3 m (1ft 0 in)
1.1 kV - 5 kV	3.0 m (10 ft 0 in)	1.5 m (5 ft 0 in)	0.5 m (1 ft 5 in)
5 kV - 15 kV	3.0 m (10 ft 0 in)	1.5 m (5 ft 0 in)	0.7 m (2 ft 2 in)
15.1 kV - 45 kV	3.0 m (10 ft 0 in)	2.5 m (8 ft 0 in)	0.8 m (2 ft 9 in)
45.1 kV - 75 kV	3.0 m (10 ft 0 in)	2.5 m (8 ft 0 in)	1.0 m (3 ft 6 in)
75.1 kV - 150 kV	3.0 m (10 ft 0 in)	3.0 m (10 ft 0 in)	1.2 m (3 ft 10 in)
150.1 kV - 250 kV	3.6 m (11 ft 8 in)	3.6 m (11 ft 8 in)	1.6 m (5 ft 3 in)
250.1 kV - 500 kV	6.0 m (20 ft 0 in)	6.0 m (20 ft 0 in)	3.5 m (11 ft 6 in)
500.1 kV - 800 kV	8.0 m (26 ft 0 in)	8.0 m (26 ft 0 in)	5.0 m (16 ft 5 in)

Note: All dimensions are distance from exposed energized electrical conductors or circuit parts to worker.

*Exposed movable conductor describes a condition in which the distance between the conductor and the person is not under the control of the person.