BEI

Energized Electrical Work

Safety Procedures

1.0 Purpose

The safest way to conduct electrical work is to shut off electric power and work on de-energized equipment. At BEI our intent and standard practice will be to avoid energized electrical work. In virtually all cases it should be possible to shut off power and utilize proper lock out procedures, thus conducting work in the safest manner possible.

However, extraordinary circumstances may arise that necessitate work on energized equipment. For example: when a shutdown would create a significant safety or health hazard or when work must be conducted near, but not on, live equipment. Diagnostic procedures also often require energized electrical work.

The following general approach will be used when conducting energized electrical work.

• Only authorized workers will be allowed to perform electrical work.

• For a worker to be authorized, training through BEI on the standards of NFPA 70e will be required with no exceptions.

- Prohibition of work: in recognition of the fact that we can anticipate more likely hazard or failure when working on certain older or less well characterized equipment, we may prohibit live work in certain situations.

- There are two basic hazards when performing live work, electric shock and electrical explosion (arc flash). Arc flash can cause burns and explosive force trauma injury. These hazards can be controlled using structured safety procedures and appropriate Personal Protective Equipment (PPE).

This document describes the administrative procedures and PPE required for conducting energized electrical work safely.

2.0 Responsibilities

The following persons / entities have responsibilities as delineated below for implementation of this procedure:

2.1 Safety Coordinator and Safety Committee

It is the responsibility of **Safety Coordinator and Safety Committee** to:

a) Maintain and update this procedure as necessary.

b) Provide consultation regarding program compliance. The office can provide consultation on such issues as: hazard identification and evaluation; procedures for correcting unsafe conditions; systems for communicating with employees; employee training programs; compliance strategies; and record keeping.

2.2 Safety Coordinator and Safety Committee

It is the responsibility **Safety Coordinator and Safety Committee** to:

a) Develop and maintain written departmental procedures as necessary and ensure that each employee adheres to these procedures.

b) Develop and implement an education and training program designed to instruct employees in safe work practices related to preventing injuries from electrical hazards.

c) Provide to employee's necessary safety equipment, including personal protective equipment designed to prevent electrical and arc flash injuries at no cost to the employee.

2.3 Safety Coordinator, Safety Committee, and Job Foreman

It is the responsibility of **Safety Coordinator, Safety Committee, and Job Foreman** to:

a) Develop workplace procedures to ensure effective compliance with this and other Safety Procedures.

b) Ensure that each employee adheres to adopted procedures.

c) Instruct employees in the recognition and avoidance of unsafe conditions. Ensure that newly hired, newly assigned or reassigned employees are properly trained in all safety procedures associated with their new duties.

2.4 Employees

It is the responsibility of all employees, including student employees to:

a) Read and comply with procedures and guidelines provided by their Job Foreman.

b) Inform their Job Foreman of workplace hazards without fear of reprisal.

c) Attend established education and training sessions; understand and comply with all applicable safety requirements. Failure to comply with established safety rules may be reflected in performance evaluations and may lead to disciplinary action consistent with procedures.

d) Ask questions of their Job Foreman when there is concern about an unknown or potentially hazardous situation.

3.0 Definitions

Accessible (as applied to equipment). Admitting close approach; not guarded by locked doors, elevation, or other effective means.

Accessible (as applied to wiring methods). Capable of being removed or exposed without damaging the building structure or finish or not permanently closed in by the structure or finish of the building.

Accessible, Readily (Readily Accessible). Capable of being reached quickly for operation, renewal, or inspections without requiring those to whom ready access is requisite to climb over or remove obstacles or to resort to portable ladders, and so forth.

Attachment Plug (Plug Cap) (Plug). A device that, by insertion in a receptacle, establishes a connection between the conductors of the attached flexible cord and the conductors connected permanently to the receptacle

Branch Circuit. The circuit conductors between the final overcurrent device protecting the circuit and the outlet(s).

Conductor, Bare. A conductor having no covering or electrical insulation whatsoever.

Conductor, Insulated. A conductor encased within material of composition and thickness that is recognized by the NEC as electrical insulation.

Deenergized. Free from any electrical connection to a source of potential difference and from electrical charge; not having a potential different from that of the earth.

Disconnecting Means. A device, or group of devices, or other means by which the conductors of a circuit can be disconnected from their source of supply.

Electrical Single-Line Diagram. A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used in the circuit or system.

Electrically Safe Work Condition. A state in which the conductor or circuit part to be worked on or near has been disconnected from energized parts, locked/tagged in accordance with established standards, tested to ensure the absence of voltage, and grounded if determined necessary.

Enclosed. Surrounded by a case, housing, fence, or wall(s) that prevents persons from accidentally contacting energized parts.

Enclosure. The case or housing of apparatus, or the fence or walls surrounding an installation to prevent personnel from accidentally contacting energized parts, or to protect the equipment from physical damage.

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

Exposed (as applied to live parts). Capable of being inadvertently touched or approached nearer than a safe distance by a person. It is applied to parts that are not suitably guarded, isolated, or insulated.

Exposed (as applied to wiring methods). On or attached to the surface or behind panels designed to allow access

Feeder. All circuit conductors between the service equipment, the source of a separately derived system, or other power supply source and the final branch-circuit overcurrent device.

Guarded. Covered, shielded, fenced, enclosed, or otherwise protected by means of suitable covers, casings, barriers, rails, screens, mats, or platforms to remove the likelihood of approach or contact by persons or objects to a point of danger.

Insulated. Separated from other conducting surfaces by a dielectric (including air space) offering a high resistance to the passage of current.

Limited Approach Boundary. An approach limit at a distance from an exposed live part within which a shock hazard exists.

Live Parts. Energized conductive components.

Prohibited Approach Boundary. An approach limit at a distance from an exposed live part within which work is considered the same as making contact with the live part.

Properly Trained Employee. An employee who has skills and knowledge related to the construction and operation of the electrical equipment and installations and has received safety training on the hazards involved.

Qualified Electrical Worker. A qualified person who by reason of a minimum of two years of training and experience with circuits and equipment over 50 volts and who has demonstrated by performance familiarity with the work to be performed and the hazards involved.

Qualified Person. One who has skills and knowledge related to the construction and operation of the electrical equipment and installations and has received safety training on the hazards involved.

Restricted Approach Boundary. An approach limit at a distance from an exposed live part within which there is an increased risk of shock, due to electrical arc over combined with inadvertent movement, for personnel working in close proximity to the live part.

Voltage (of a Circuit). The greatest root-mean-square (rms) (effective) difference of potential between any two conductors of the circuit concerned.
FPN: Some systems, such as 3-phase 4-wire, single-phase 3-wire, and 3-wire direct-current, may have various circuits of various voltages.

Voltage, Nominal. A nominal value assigned to a circuit or system for the purpose of conveniently designating its voltage class (e.g., *120/240* volts, *480Y/277* volts, 600 volts). The actual voltage at which a circuit operates can vary from the nominal within a range that permits satisfactory operation of equipment.

Voltage to Ground. For grounded circuits, the voltage between the given conductor and that point or conductor of the circuit that is grounded; for ungrounded circuits, the greatest voltage between the given conductor and any other conductor of the circuit.

Working Near (live parts). Any activity inside a Limited Approach Boundary.

Working On (live parts). Coming in contact with live parts with the hands, feet, or other body parts, with tools, probes, or with test equipment, regardless of the personal protective equipment a person is wearing

Scope

This procedure applies to all electrical conductors and equipment operating at 50 volts nominal, or greater. This procedure also applies to live parts operating at less than 50 volts nominal, if there is an increased risk of exposure to electrical burns or to explosion due to electrical arcs.

4.0 Authorized Workers

4.1 Only persons trained through BEI on NFPA 70e standards will be authorized by the Safety Coordinator, or the Safety Committee. Job Foreman and/or Authorized employees may install, modify, repair, or work on electrical conductors and live electrical equipment in or on BEI job sites. Authorization is hereby granted to employees in the following classifications with number one being mandatory for approval.

(a) Two classifications must be met for authorization.
(1) **All must be trained through BEI on NFPA 70e standards (Mandatory)**
(2) Job Foreman
(3) Journeyman Electrician
(4) Years of experience (Level of experience will be determined by BEI)

4.2 Any non-BEI employee performing work on electrical conductors and equipment must be a licensed electrical contractor or recognized as a qualified Journeyman electrician. In addition, any work must be done under an approved Building Permit or contract issued by BEI.

EXCEPTION: Properly trained employees may work on BEI-owned electrically powered equipment (such as power tools, wire feeders, wire tuggers, etc.) which has been disconnected from the electrical system by one of the following means:

a) Disconnection of the power cord from the electrical outlet (providing plug and cord are in the immediate control of the employee working on the equipment).
b) Operation and lockout of a mechanical disconnecting means to disconnect the equipment from the source of supply. The BEI lockout procedure must be followed and this lockout may ONLY be performed by a BEI authorized electrical employee.

5.0 Approach Boundaries to Live Parts (NFPA 70e, 130.2)

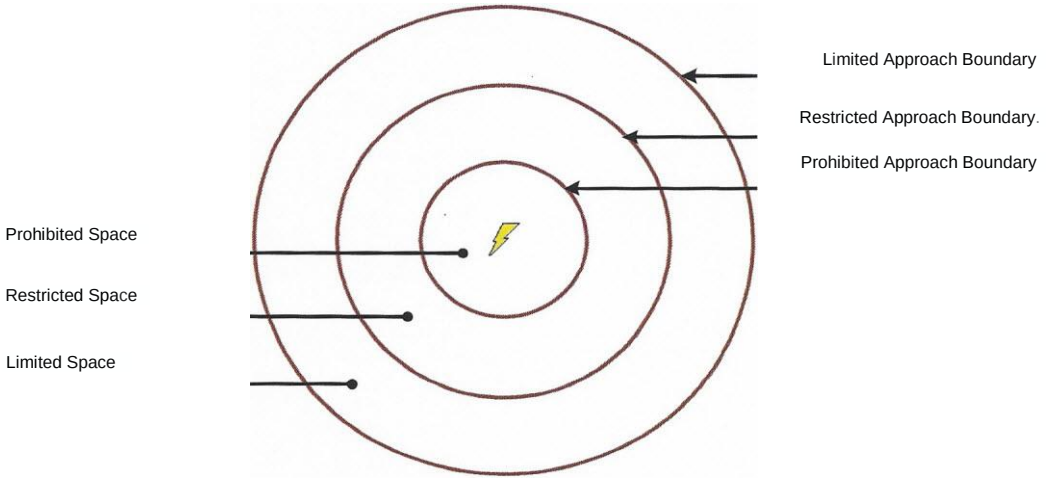
5.1 A properly trained employee shall not approach or take any conductive object closer to exposed live parts (operating at 50 volts or more) than the Restricted Approach Boundary listed in Table 1 (below) unless ANY of the following apply:

(a) The properly trained employee is insulated or guarded from the live parts operating at 50 volts or more and no uninsulated part of the employee's body crosses the Prohibited Approach Boundary listed in Table l.
(b) The live part operating at 50 volts or more is insulated from the employee and from any other conductive object at a different potential.

5.2 Approach by untrained persons. When an untrained person is working at or close to the Limited Approach Boundary, the Job Foreman in charge of the job shall advise the untrained person of the electrical hazard.

Table 1: Approach Boundaries to Live Parts for Shock Protection

	Limited Approach		Restricted Approach
Voltage Range Phase to Phase	*Exposed Movable Conductor*	*Exposed Fixed Circuit Part*	
Less than 100V	Not Specified	Not Specified	Not Specified
100V to 300V	10 feet 0 inches	3 feet 6 inches	Avoid Contact
301V to 1kV	10 feet 0 inches	3 feet 6 inches	1 foot 0 inches
1.1kV to 5kV	10 feet 0 inches	5 feet 0 inches	1 foot 5 inches
5kV to 15kV	10 feet 0 inches	5 feet 0 inches	2 feet 2 inches
15.1kV to 45 kV	10 feet 0 inches	6 feet 0 inches	2 feet 9 inches
45.1 kV to 75 kV	10 feet 0 inches	8 feet 0 inches	3 feet 2 inches



*6.0 **Working** On or Near Live Parts*

6.1 **Justification for Work.**

Live parts to which an employee might be exposed shall be put into an electrically safe work condition before an employee works on or near them, unless the employer can demonstrate that de-energizing introduces additional or increased hazards or is infeasible due to equipment design or operational limitations. Energized parts that operate at less than 50 volts to ground shall not be required to be de-energized if there will be no increased exposure to electrical burns or to explosion due to electric arcs.

Examples of increased or additional hazards include, but are not limited to, interruption of life support equipment, deactivation of emergency alarm systems, and shutdown of hazardous location ventilation equipment.

Examples of work that might be performed on or near exposed energized electrical conductors or circuit parts because of infeasibility due to equipment design or operational limitations include performing diagnostics and testing (e.g., start-up or troubleshooting) of electric circuits that can only be performed with the circuit energized and work on circuits that form an integral part of a continuous process that would otherwise need to be completely shut down in order to permit work on one circuit or piece of equipment.

7.0 **Energized Electrical Work Permit**

(1) Where Required. If live parts are not placed in an electrically safe work condition (i.e., for the reasons of increased or additional hazards or infeasibility per 6.1), work to be performed shall be considered energized electrical work and shall be performed by written permit only.

(2) Elements of Work Permit. The energized electrical work permit shall include the following items:

(a) A description of the circuit and equipment to be worked on and their location
(b) Justification for why the work must be performed in an energized condition
(c) A description of the safe work practices to be employed
(d) Results of the shock hazard analysis
(e) Determination of shock protection boundaries
(f) Results of the flash hazard analysis
(g) The Flash Protection Boundary
(h) The necessary personal protective equipment to safely perform the assigned task
(i) Means employed to restrict the access of unqualified persons from the work area
(j) Evidence of completion of a job briefing, including a discussion of any job-specific hazards
(k) Energized work approval signatures (Board Member, Safety Coordinator or General Superintendent).

(3) Exemptions to Work Permit. Work performed on or near live parts by qualified persons related to tasks such as testing, troubleshooting, voltage measuring, etc., shall be permitted to be performed without an energized electrical work permit, provided appropriate safe work practices and personal protective equipment in accordance with this procedure is provided and used.

7.1 Flash Hazard Analysis

A flash hazard analysis shall be done in order to protect personnel from the possibility of being injured by an arc flash. The analysis shall determine the Flash Protection Boundary and the personal protective equipment that people within the Flash Protection Boundary shall use.

(A) Flash Protection Boundary. For systems that are 600 volts or less, the Flash Protection Boundary shall be 4.0 ft., based on the product of clearing times of 2 cycles (0.033 second) and the available bolted fault current of 50 kA or any combination not exceeding 100 kA cycles. For clearing times and bolted fault currents other than 300 kA cycles, or under engineering supervision, the Flash Protection Boundary shall alternatively be permitted to be calculated in accordance with the following general formula:

$$Dc = [2.65 \times MVA_{bf} \times t]\ ½\ [D.2.1(d)]$$

Or

$$Dc = [53 \times MVA \times t\}\ 1/2\ [D.2.1(e)]$$

Where:
D, = distance in feet from an arc source for a second-degree burn

MVA_{bf} = bolted fault capacity available at point involved (in mega volt-amps)

MVA = capacity rating of transformer (mega volt-amps). For transformers with MVA ratings below 0.75 MVA, multiply the transformer MV A rating by 1.25.
t = time of arc exposure (in seconds).

At voltage levels above 600 volts, the Flash Protection Boundary is the distance at which the incident energy equals 5 J/cm^2(1.2 cal/cm^2). For situations where fault clearing time is 0.1 second (or faster), the Flash Protection Boundary is the distance at which the incident energy level equals 6.24 J/cm^2(1.5 cal/ cm^2).

(B) Protective Clothing and Personal Protective Equipment for Application with a Flash Hazard Analysis. Where it has been determined that work will be performed within the Flash Protection Boundary by 7.3(A), the flash hazard analysis shall determine, and the supervisor shall document, the incident energy exposure of the worker (in calories per square centimeter). The incident energy exposure level shall be based on the working distance of the employee's face and chest areas from a prospective arc source for the specific task to be performed. Flame-resistant (FR) clothing and personal protective equipment (PPE) shall be used by the employee based on the incident energy exposure associated with the specific task. Recognizing that incident energy increases as the distance from the arc flash decreases, additional PPE shall be used for any parts of the body that are closer than the distance at which the incident energy was determined. As an alternative, the PPE requirements of7.4 shall be permitted to be used in lieu of the detailed flash hazard analysis approach described in 7.3(A).

Note: For information on estimating the incident energy, see NFPA 70E Appendix D

7.2 Personal and Other Protective Equipment.

(A) General. Employees working in areas where electrical hazards are present shall be provided with, and shall use, protective equipment that is designed and constructed for the specific part of the body to be protected and for the work to be performed.
(B) Care of Equipment. Protective equipment shall be maintained in a safe, reliable condition. The protective equipment shall be visually inspected before each use.
Note: Specific requirements for periodic testing of electrical protective equipment are given in the ANSI and ASTM standards referenced in sections 130.7(C)(8) and 130.7(F) of NFPA 70E.
(C) Personal Protective Equipment.
(1) General. *When an employee is working within the Flash Protection Boundary he/she shall wear protective clothing and other personal protective equipment in accordance with section 7.2.*

(2) Movement and Visibility. When flame-resistant (FR) clothing is worn to protect an employee, it shall cover all ignitable clothing and shall allow for movement and visibility.

(3) Head, Face, Neck, and Chin Protection. Employees shall wear nonconductive head protection wherever there is a danger of head injury from electric shock or burns due to contact with live parts or from flying objects resulting from electrical explosion. Employees shall wear nonconductive protective equipment for the face, neck, and chin whenever there is a danger of injury from exposure to electric arcs or flashes or from flying objects resulting from electrical explosion.

Note: See 7.3(C)(l3)(b) for arc flash protective requirements for face protection.

(4) Eye Protection. Employees shall wear protective equipment for the eyes whenever there is danger of injury from electric arcs, flashes, or from flying objects resulting from electrical explosion.

(5) Body Protection. Employees shall wear FR clothing wherever there is possible exposure to an electric arc flash above the threshold incident-energy level for a second-degree burn, 5 J/cm^2 (1.2 cal/ cm^2).

Exception: For incident-energy exposures 8.36 *J/* cm^2 (2 *cal/* cm^2*) and below, employees may wear non-melting clothing described in Hazard/Risk Category* 0 *in Table 4.*

Note: Such clothing can be provided as shirt and trousers, or as coveralls, or as a combination of jacket and trousers, or, for increased protection, as coveralls with jacket and trousers. Various weight fabrics are available. Generally, the higher degree of protection is provided by heavier weight fabrics and/or by layering combinations of one or more layers of FR clothing. In some cases, one or more layers of FR clothing are worn over flammable, non-melting clothing. Non-melting, flammable clothing, used alone, can provide protection at low incident energy levels of 8.36 J/cm^2 (2.0 cal/ cm^2) and below.

(6) Hand and Arm Protection. Employees shall wear rubber insulating gloves where there is danger of hand and arm injury from electric shock due to contact with live parts. Hand and arm protection shall be worn where there is possible exposure to arc flash burn. The apparel described in 7.3(C)(l3)(c) shall be required for protection of hands from burns. Arm protection shall be accomplished by apparel described in 7.3(C)(5).

(7) Foot and Leg Protection. Where insulated footwear is used as protection against step and touch potential, dielectric overshoes shall be required. Insulated soles shall not be used as primary electrical protection.

(8) Standards for Personal Protective Equipment. Personal protective equipment shall conform to the standards given in Table 130.7(C)(8) of NFPA 70E.

(9) Selection of Personal Protective Equipment.

(a) When Required for Various Tasks. When selected in lieu of the flash hazard analysis of 7.3(A), Table 2 shall be used to determine the hazard/risk category for a task. The assumed short-circuit current capacities and fault clearing times for various tasks are listed in the text and notes to Table 2. For tasks not listed, or for power systems with greater than the assumed short-circuit current capacity or with longer than the assumed fault clearing times, a flash hazard analysis shall be required in accordance with 7.3.

Note No.1: Both larger and smaller available short-circuit currents could result in higher available arc-flash energies. If the available short-circuit current increases without a decrease in the opening time of the overcurrent protective device, the arc-flash energy will increase. If the available short-circuit current decreases, resulting in a longer opening time for the overcurrent protective device, arc-flash energies could also increase.

Note No.2: Energized parts that operate at less than 50 volts are not required to be de-energized to satisfy an "electrically safe work condition." Consideration should be given to the capacity of the source, any overcurrent protection between the energy source and the worker, arid whether the work task related to the source operating at less than 50 volts increases exposure to electrical bums or to explosion from an electric arc.

(10) Protective Clothing and Personal Protective Equipment Matrix.

Once the Hazard/Risk Category has been identified, Table 3 shall be used to determine the required personal protective equipment (PPE) for the task. Table 3 lists the requirements for protective clothing and other protective equipment based on Hazard/Risk 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 No.1: See Appendix B for a suggested simplified approach to ensure adequate PPE for electrical workers within facilities with large and diverse electrical systems.

Note No.2: The PPE requirements of this section are intended to protect a person from arc-flash and shock hazards. While some situations could result in burns to the skin, even with the protection described in Table 3, bum injuries should be reduced and survivable. Due to the explosive effect of some arc events, physical

trauma injuries could occur. The PPE requirements of this section do not provide protection against physical trauma other than exposure to the thermal effects of an arc flash.

(11) Protective Clothing Characteristics.

Table 4 lists examples of protective clothing systems and typical characteristics including the degree of protection for various clothing. The protective clothing selected for the corresponding hazard/risk category number shall have an arc rating of at least the value listed in the last column of Table 4.

Note: The arc rating for a particular clothing system can be obtained from the FR clothing manufacturer.

(12) Factors in Selection of Protective Clothing.

Clothing and equipment that provide worker protection from shock and arc flash hazards shall be utilized. Clothing and equipment required for the degree of exposure shall be permitted to be worn alone or integrated with flammable, non-melting apparel. If FR clothing is required, it shall cover associated parts of the body as well as all flammable apparel while allowing movement and visibility. All personal protective equipment shall be maintained in a sanitary and functionally effective condition. Personal protective equipment items will normally be used in conjunction with one another as a system to provide the appropriate level of protection.

Note: Protective clothing includes shirts, pants, coveralls, jackets, and parkas worn routinely by workers who, under normal working conditions, are exposed to momentary electric arc and related thermal hazards. Flame-resistant rainwear worn in inclement weather is included in this category of clothing.

(a) Layering. Non-melting, flammable fiber garments shall be permitted to be used as under layers in conjunction with FR garments in a layered system for added protection. If non-melting, flammable fiber garments are used as under layers, the system arc rating shall be sufficient to prevent breakopen of the innermost FR layer at the expected arc exposure incident energy level to prevent ignition of flammable under layers.

Note: A typical layering system might include cotton underwear, a cotton shirt and trouser, and a FR coverall. Specific tasks might call for additional FR layers to achieve the required protection level.

(b) Outer Layers. Garments worn as outer layers over FR clothing, such as jackets or rainwear, shall also be made from FR material.

(c) Under layers. Meltable fibers such as acetate, nylon, polyester, polypropylene, and spandex shall not be permitted in fabric under layers (underwear) next to the skin.

Exception: An incidental amount of elastic used on non-melting fabric underwear or socks shall be permitted.

Note No.1: FR garments (e.g., shirts, trousers, and coveralls) worn as under layers that neither ignite nor melt and drip in the course of an exposure to electric arc and related thermal hazards generally provide a higher system arc rating than non-melting, flammable fiber under layers.

Note No.2: FR underwear or undergarments used as under layers generally provide a higher system arc rating than non-melting, flammable fiber underwear or undergarments used as under layers.

(d) Coverage. Clothing shall cover potentially exposed areas as completely as possible. Shirt sleeves shall be fastened at the wrists, and shirts and jackets shall be closed at the neck.

(e) Fit. Tight-fitting clothing shall be avoided. Loose- fitting clothing provides additional thermal insulation because of air spaces. FR apparel shall fit properly such that it does not interfere with the work task.

(f) Interference. The garment selected shall result in the least interference with the task but still provide the necessary protection. The work method, location, and task could influence the protective equipment selected.

(13) Arc Flash Protective Equipment.

(a) Flash Suits. Flash suit design shall permit easy and rapid removal by the wearer. The entire flash suit, including the hood's face shield, shall have an arc rating that is suitable for the arc flash exposure. When exterior air is supplied into the hood, the air hoses and pump housing shall be either covered by FR materials or constructed of non-melting and nonflammable materials.

(b) Face Protection. Face shields shall have an arc rating suitable for the arc flash exposure. Face shields without an arc rating shall not be used. Eye protection (safety glasses or goggles) shall always be worn under face shields or hoods.

Note: Face shields made with energy-absorbing formulations that can provide higher levels of protection from the radiant energy of an arc flash is available, but these shields are tinted and can reduce visual acuity.

Additional illumination of the task area might be necessary when these types of arc protective face shields are used.

(c) Hand Protection. Leather or FR gloves shall be worn where required for arc flash protection. Where insulating rubber gloves are used for shock protection, leather protectors shall be worn over the rubber gloves.

Note: Insulating rubber gloves and gloves made from layers of flame-resistant material provide hand protection against the arc flash hazard. Heavy-duty leather (e.g., greater than 12 oz./ yd^{2}') gloves provide protection suitable up to Hazard/Risk Category 2. The leather protectors worn over insulating rubber gloves provide additional arc flash protection for the hands. During high arc flash exposures leather can shrink and cause a decrease in protection.

(d) Foot Protection. Heavy-duty leather work shoes provide some arc flash protection to the feet and shall be used in all tasks in Hazard/Risk Category 2 and higher.

(14) Clothing Material Characteristics. FR clothing shall meet the requirements described in 7.3(C)(l4)(a) through 7.3(C)(l5).

Note: FR materials, such as flame-retardant treated cotton, meta-aramid, para-aramid, and poly-benzimidazole (PBI) fibers, provide thermal protection. These materials can ignite but will not continue to burn after the ignition source is removed. FR fabrics can reduce burn injuries during an arc flash exposure by providing a thermal barrier between the arc flash and the wearer. In aramid and PBI blends, Para-aramid adds strength to a fabric to prevent the fabric from breaking open due to the blast shock wave and high thermal energy of the arc.

(a) Melting. Clothing made from flammable synthetic materials that melt at temperatures below 315°C (600°F), such as acetate, nylon, polyester, polypropylene, and spandex, either alone or in blends, shall not be used.

Note: These materials melt as a result of arc flash exposure conditions, form intimate contact with the skin, and aggravate the burn injury.

Exception: Fiber blends that contain materials that melt, such as acetate, nylon, polyester, polypropylene, and spandex, shall be permitted if such blends in fabrics meet the requirements of ASTM F 1506, Standard Performance Specification for Textile Material for Wearing Apparel for Use by Electrical Workers Exposed to Momentary Electric Arc and Related Thermal Hazards, and if such blends in fabrics do not exhibit evidence of a melting and sticking hazard during arc testing according to ASTM F 1959 [see also 7.4(C)(15)]. Non-flame-resistant synthetic materials, such as acetate, nylon, polyester, rayon, either alone or in blends with non-flame-resistant cotton, can melt into the skin when exposed to high temperatures and aggravate the burn injury.

(b) Flammability. Clothing made from non-melting flammable natural materials, such as cotton, wool, rayon, or silk, shall be permitted for Hazard/Risk Categories 0 and -1 considered acceptable if it is determined by flash hazard analysis that the exposure level is 8.36 J/cm^{2} (2.0 cal/cm/) or less, and that the fabric will not ignite and continue to burn under the arc exposure hazard conditions to which it will be exposed (using data from tests done in accordance with ASTM F 1958.) See also 7.3(C)(12)(a) for layering requirements.

Note No.1: Non-FR cotton, polyester-cotton blends, nylon, nylon-cotton blends, silk, rayon, and wool fabrics are flammable. These fabrics could ignite and continue to burn on the body, resulting in serious burn injuries.

Note No.2: Rayon is a cellulose-based (wood pulp) synthetic fiber that is a flammable but non-melting material.

(15) Clothing Not Permitted. Clothing made from materials that do not meet the requirements of 7.3(C)(l4)(a) regarding melting, or made from materials that do not meet the flammability requirements of 7.3(C)(l4)(b), shall not be permitted to be worn.

FPN: Some flame-resistant fabrics, such as non-FR modacrylic and nondurable flame-retardant treatments of cotton, are not recommended for industrial electrical or utility applications.

Exception: Non-melting, flammable (non-FR) materials shall be permitted to be used as under layers to FR clothing, as described in 7.4(C)(J 4)(a) and also shall be permitted to be used for Hazard/Risk Category 0 *and -1 as described in Table 3.*

(16) Care and Maintenance of FR Clothing and FR Flash Suits.

(a) Inspection. FR apparel shall be inspected before each use. Work clothing or flash suits that are contaminated, or damaged to the extent their protective qualities are impaired, shall not be used. Protective

items that become contaminated with grease, oil, or flammable liquids or combustible materials shall not be used.

(b) Manufacturer's Instructions. The garment manufacturer's instructions for care and maintenance of FR apparel shall be followed.

(D) Other Protective Equipment.

(1) Insulated Tools and Equipment. Employees shall use insulated tools and/or handling equipment when working inside the Limited Approach Boundary of exposed live parts where tools or handling equipment might make accidental contact. Insulated tools shall be protected from damage to the insulating material.

(a) Requirements for Insulated Tools. The following requirements shall apply to insulated tools:

(1) Insulated tools shall be rated for the voltages on which they are used.

(2) Insulated tools shall be designed and constructed for the environment to which they are exposed and the manner in which they are used.

(b) Fuse or Fuse Holding Equipment. Fuse or fuse holder handling equipment, insulated for the circuit voltage, shall be used to remove or install a fuse if the fuse terminals are energized.

(c) Ropes and Handlines. Ropes and handlines used near exposed live parts operating at 50 volts or more, or used where an electrical hazard exists, shall be nonconductive.

(d) Fiberglass-Reinforced Plastic Rods. Fiberglass reinforced plastic rod and tube used for live line tools shall meet the requirements of ASTM F 711, *Standard Specification for Fiberglass-Reinforced Plastic (FRP) Rod and Tube Used; in Live Line Tools*, 1989 (R 1997).

(e) Portable Ladders. Portable ladders shall have nonconductive side rails if they are used where the employee or ladder could contact exposed live parts operating at 50 volts or more or where an electrical hazard exists. Nonconductive ladders shall meet the requirements of ANSI standards for ladders listed in NFPA 70E, Table 130.7(F).

(f) Protective Shields. Protective shields, protective barriers, or insulating materials shall be used to protect each employee from shock, burns, or other electrically related injuries while that employee is working near live parts that might be accidentally contacted or where dangerous electric heating or arcing might occur. When normally enclosed live parts are exposed for maintenance or repair, they shall be guarded to protect unqualified persons from contact with the live parts.

(g) Rubber Insulating Equipment. Rubber insulating equipment used for protection from accidental contact with live parts shall meet the requirements of the ASTM standards listed in NFPA 70E, Table 130.7(F).

(h) Voltage Rated Plastic Guard Equipment. Plastic guard equipment for protection of employees from accidental contact with live parts, or for protection of employees or energized equipment or material from contact with ground, shall meet the requirements of the ASTM standards listed in NFPA 70E, Table 130.7(F).

(i) Physical or Mechanical Barriers. Physical or mechanical (field fabricated) barriers shall be installed no closer than the restricted approach distance given in Table 1. While the barrier is being installed, the restrictive approach distance specified in Table 1 shall be maintained, or the live parts shall be placed in an electrically safe work condition.

7.3 Other Precautions for Personnel Activities

(A) Alertness.

(1) When Hazardous. Employees shall be instructed to be alert at all times when they are working near live parts operating at 50 volts or more and in work situations where unexpected electrical hazards might exist.

(2) When Impaired. Employees shall not knowingly be permitted to work in areas containing live parts operating at 50 volts or more or other electrical hazards while their alertness is recognizably impaired due to illness, fatigue, or other reasons.

(B) Blind Reaching. Employees shall be instructed not to reach blindly into areas that might contain exposed live parts where an electrical hazard exists.

(C) Illumination.

(1) General. Employees shall not enter spaces containing live parts unless illumination is provided that enables the employees to perform the work safely.

(2) Obstructed View of Work Area. Where lack of illumination or an obstruction precludes observation of the work to be performed, employees shall not perform any task near live parts operating at 50 volts or more or where an electrical hazard exists.

(D) Conductive Articles Being Worn. Conductive articles of jewelry and clothing (such as watchbands, bracelets, rings, key chains, necklaces, metalized aprons, cloth with conductive thread, metal headgear, or metal frame glasses) shall not be worn where they present an electrical contact hazard with exposed live parts.

(E) Conductive Materials, Tools, and Equipment Being Handled.

(1) General. Conductive materials, 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 live parts. Such materials and equipment include, but are not limited to, long conductive objects, such as ducts, pipes and tubes, conductive hose and rope, metal-lined rules and scales, steel tapes, pulling lines, metal scaffold parts, structural members, bull floats, and chains.

(2) Approach to Live Parts. Means shall be employed to ensure that conductive materials approach exposed live parts no closer than that permitted by Table 1.

(F) Confined or Enclosed Work Spaces. When an employee works in a confined or enclosed space (such as a manhole or vault) that contains exposed live parts operating at 50 volts or more or an electrical hazard exists, the employer shall provide, and the employee shall use, protective shields, protective barriers, or insulating materials as necessary to avoid inadvertent contact with these parts. Doors, hinged panels, and the like shall be secured to prevent their swinging into an employee and causing the employee to contact exposed live parts operating at 50 volts or more or where an electrical hazard exists.

(G) Housekeeping Duties. Where live parts present an electrical contact hazard, employees shall not perform housekeeping duties inside the Limited Approach Boundary where there is a possibility of contact, unless adequate safeguards (such as insulating equipment or barriers) are provided to prevent contact. Electrically conductive cleaning materials (including conductive solids such as steel wool, metalized cloth, and silicon carbide, as well as conductive liquid solutions) shall not be used inside the Limited Approach Boundary unless procedures to prevent electrical contact are followed.

(H) Occasional Use of Flammable Materials. Where flammable materials are present only occasionally, electric equipment capable of igniting them may not be used, unless measures are taken to prevent hazardous conditions from developing. Such materials include, but are not limited to, flammable gases, vapors, or liquids; combustible dust; and ignitable fibers or flying's.

(I) Anticipating Failure. When there is evidence that electric equipment could fail and injure employees, the electric equipment shall be de-energized unless the employer can demonstrate that de-energizing introduces additional or increased hazards or is infeasible because of equipment design or operational limitation. Until the equipment is de-energized or repaired, employees shall be protected from hazards associated with the impending failure of the equipment.

(J) Routine Opening and Closing of Circuits. Load-rated switches, circuit breakers, or other devices specifically designed as disconnecting means shall 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 shall not be permitted to be used for such purposes, except in an emergency.

(K) Reclosing Circuits After Protective Device Operation.

After a circuit is de-energized by a circuit protective device, the circuit shall not be manually reenergized until it has been determined that the equipment and circuit can be safely energized. The repetitive manual reclosing of circuit breakers or reenergizing circuits through replaced fuses shall be prohibited. When it is determined from the design of the circuit and the overcurrent devices involved that the automatic operation of a device was caused by an overload rather than a fault condition, examination of the circuit or connected equipment shall not be required before the circuit is reenergized.

TABLE 2

Hazard / Risk Category Classifications Task (Assumes Equipment Is Energized, and Work Is Done Within the Flash Protection Boundary)	**Hazard / Risk Category**	**V-rated Gloves**	**V-rated Tools**
Panelboards Rated 240 V and Below – Notes 1 and 3			
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 parts, including voltage testing	1	Y	Y
Remove/install CBs or fused switches	1	Y	Y
Removal of bolted covers (to expose bare, energized parts)	1	N	N
Opening hinged covers (to expose bare, energized parts)	0	N	N
Panelboards or Switchboards Rated >240 V and up to 600 V (with molded case or insulated case circuit breakers) — Notes 1 and 3			
CB or fused switch operation with covers on	0	N	N
CB or fused switch operation with covers off	1	N	N
Work on energized parts, including voltage testing	2*	Y	Y
600 V Class Motor Control Centers (MCCs) —Notes 2 (except as indicated) and 3			
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 parts, including voltage testing	2*	Y	Y
Work on control circuits with energized parts 120 V or below, exposed	0	Y	Y
Work on control circuits with energized parts >120 V, exposed	2*	Y	Y
Insertion or removal of individual starter “buckets” from MCC — Note 4	3	Y	N
Application of safety grounds, after voltage test	2*	Y	N
Removal of bolted covers (to expose bare, energized parts)	2*	N	N
Opening hinged covers (to expose bare, energized parts)	1	N	N

TABLE 2 (CONTINUED)

Task (Assumes Equipment Is Energized, and Work Is Done Within the Flash Protection Boundary)	Hazard / Risk Category	V-Rated Gloves	V-Rated Tools
600 V Class Switchgear (with power circuit breakers or fused switches) — Notes 5 and 6			
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 parts, including voltage testing	2*	Y	Y
Work on control circuits with energized parts 120 V or below, exposed	0	Y	Y
Work on control circuits with energized parts >120 V, exposed	2*	Y	Y
Insertion or removal (racking) of CBs from cubicles, doors open	3	N	N
Insertion or removal (racking) of CBs from cubicles, doors closed	2	N	N
Application of safety grounds, after voltage test	2*	Y	N
Removal of bolted covers (to expose bare, energized parts)	3	N	N
Opening hinged covers (to expose bare, energized parts)	2	N	N
Other 600 V Class (277 V through 600 V, nominal) Equipment — Note 3			
Lighting or small power transformers (600 V, maximum)	--	--	--
Removal of bolted covers (to expose bare, energized parts)	2*	N	N
Opening hinged covers (to expose bare, energized parts)	1	N	N
Work on energized parts, including voltage testing	2*	Y	Y
Application of safety grounds, 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 parts, including voltage testing	2*	Y	Y
Application of safety grounds, after voltage test	2*	Y	N

c)

TABLE 2 (CONTINUED)

Task (Assumes Equipment Is Energized, and Work Is Done Within the Flash Protection Boundary)	Hazard / Risk Category	V-Rated Gloves	V-Rated Tools
NEMA E2 (fused contactor) Motor Starters, 2.3 kV Through 7.2 kV			
Contactor operation with enclosure doors closed	0	N	N
Reading a panel meter while operating a meter switch	0	N	N
Contactor operation with enclosure doors open	2*	N	N
Work on energized parts, including voltage testing	3	Y	Y
Work on control circuits with energized parts 120 V or below, exposed	0	Y	Y
Work on control circuits with energized parts >120 V, exposed	3	Y	Y
Insertion or removal (racking) of starters from cubicles, doors open	3	N	N
Insertion or removal (racking) of starters from cubicles, doors closed	2	N	N
Application of safety grounds, after voltage test	3	Y	N
Removal of bolted covers (to expose bare, energized parts)	4	N	N
Opening hinged covers (to expose bare, energized parts)	3	N	N
Metal Clad Switchgear, 1 kV and Above			
CB or fused switch operation with enclosure doors closed	2	N	N
Reading a panel meter while operating a meter switch	0	N	N
CB or fused switch operation with enclosure doors open	4	N	N
Work on energized parts, including voltage testing	4	Y	Y
Work on control circuits with energized parts 120 V or below, exposed	2	Y	Y
Work on control circuits with energized parts >120 V, exposed	4	Y	Y
Insertion or removal (racking) of CBs from cubicles, doors open	4	N	N
Insertion or removal (racking) of CBs from cubicles, doors closed	2	N	N
Application of safety grounds, after voltage test	4	Y	N
Removal of bolted covers (to expose bare, energized parts)	3	N	N
Opening hinged covers (to expose bare, energized parts)	3	N	N
Opening voltage transformer or control power transformer compartments	4	N	N

TABLE 2 (CONTINUED)

Task (Assumes Equipment Is Energized, and Work Is Done Within the Flash Protection Boundary)	Hazard / Risk Category	V-Rated Gloves	V-Rated Tools
Other Equipment 1 kV and Above			
Metal clad load interrupter switches, fused or unfused	--	--	--
Switch operation, doors closed	2	N	N
Work on energized parts, including voltage testing	4	Y	Y
Removal of bolted covers (to expose bare, energized parts)	4	N	N
Opening hinged covers (to expose bare, energized parts)	3	N	N
Outdoor disconnect switch operation (hook-stick operated)	3	Y	Y
Outdoor disconnect switch operation (gang-operated, from grade)	2	N	N
Insulated cable examination, in manhole or other confined space	4	Y	N
Insulated cable examination, in open area	2	Y	N

Note:
V-rated Gloves are gloves rated and tested for the maximum line-to-line voltage upon which work will be done.
V-rated Tools are tools rated and tested for the maximum line-to-line voltage upon which work will be done.
2* means that a double-layer switching hood and hearing protection are required for this task in addition to the other Hazard/Risk Category 2 requirements of Table 130.7(C)(lO).
Y = yes (required)
N = no (not required)
Notes:
1. 25 kA short circuit current available, 0.03 second (2 cycle) fault clearing time.
2.65 kA short circuit current available, 0.03 second (2 cycle) fault clearing time.
3. For Q 10 kA short circuit current available, the hazard/risk category required may be reduced by one number.
4.65 kA short circuit current available, 0.33 second (20 cycle) fault clearing time.
5.65 kA short circuit current available, up to 1.0 second (60 cycle) fault clearing time.

TABLE 3
PROTECTIVE CLOTHING AND PERSONAL PROTECTIVE EQUIPMENT (PPE) MATRIX

Protective Clothing and Equipment	Protective Systems for Hazard / Risk Category					
Hazard / Risk Category Number	-1 (Note 3)	0	1	2	3	4
Non-melting (according to ASTM F 1506-00) or Untreated Natural Fiber						
a. T-shirt (short-sleeve)	X			X	X	X
b. Shirt (long-sleeve)		X				
c. Pants (long)	X	X	X (Note 4)	X (Note 6	X	X
FR Clothing (Note 1)						
a. Long-sleeve shirt			X	X	X (Note 9)	X
b. Pants			X (Note 4)	X (Note 6)	X (Note 9)	X
c. Coverall			(Note 5)	(Note 7)	X (Note 9)	(Note 5)
d. Jacket, parka, or rainwear			AN	AN	AN	AN
FR Protective Equipment						
a. Flash suit jacket (multilayer)						X
b. Flash suit pants (multilayer)						X
c. Head protection						
1. Hard hat			X	X	X	X
2. FR hard hat liner					AR	AR
d. Eye protection						
1. Safety glasses	X	X	X	AL	AL	AL
2. Safety goggles				AL	AL	AL
e. Face and head area protection						
1. Arc-rated face shield, or flash suit hood				X (Note 8)		
2. Flash suit hood					X	X
3. Hearing protection (ear canal inserts)				X (Note 8)	X	X
f. Hand protection						
Leather gloves (Note 2)			AN	X	X	X
g. Foot protection						
Leather work shoes			AN	X	X	X

AN = As needed
AL = Select one in group
AR = As required
X = Minimum required

Notes:

I. See Table 130. 7(C)(ll). Arc rating for a garment is expressed in cal/ cm^2,

2. If voltage-rated gloves are required, the leather protectors worn external to the rubber gloves satisfy this requirement.

3. Hazard/Risk Category Number "-1" is only defined if determined by Notes 3 or 6 of Table 130.7(C)(9)(a).

4.Regular weight (minimum 12 oz./yd2 fabric weight), untreated, denim cotton blue jeans are acceptable in lieu of FR pants. The FR pants used for Hazard/Risk Category 1 shall have a minimum arc rating of 4.

5. Alternate is to use FR coveralls (minimum arc rating of 4) instead of FR shirt and FR pants.

6. If the FR pants have a minimum arc rating of8, long pants of non-melting or untreated natural fiber are not required beneath the FR pants.

7. Alternate is to use FR coveralls (minimum arc rating of 4) over non-melting or untreated natural fiber pants and T-shirt.

8.A face shield with a minimum arc rating of8, with wrap-around guarding to protect not only the face, but also the forehead, ears, and neck (or, alternatively, a flash suit hood), is required.

9. Alternate is to use two sets of FR coveralls (the inner with a minimum arc rating of 4 and outer coverall with a minimum arc rating of 5) over non-melting or untreated natural fiber clothing, instead of FR coveralls over FR shirt and FR pants over non-melting or untreated natural fiber clothing.

d)

TABLE 4

PROTECTIVE CLOTHING CHARACTERISTICS

TYPICAL PROTECTIVE CLOTHING SYSTEMS

Hazard / Risk Category	Clothing Description (Typical number of clothing layers is given in parentheses)	Required Minimum Arc Rating of PPE [J/cm2(cal/cm^2)]
0	Non-melting, flammable materials (i.e., untreated cotton, wool, rayon, or silk, or blends of these materials) with a fabric weight at least 4.5 oz./yd2(1)	N/A
1	FR shirt and FR pants or FR coverall (1)	16.74 (4)
2	Cotton underwear - conventional short sleeve and brief/shorts, plus FR shirt and FR pants (1 or 2)	33.47 (8)
3	Cotton underwear plus FR shirt and FR pants plus FR coverall, or cotton underwear plus two FR coveralls (2 or 3)	104.6 (25)
4	Cotton underwear plus FR shirt and FR pants plus multilayer flash suit (3 or more)	167.36 (40)

Note: Arc rating is defined in Article 100 and can be either A TPV or E". A TPV is defined in ASTM F 1959-99 as the incident energy on a fabric or material that results in sufficient heat transfer through the fabric or material to cause the onset of a second-degree burn based on the Stoll curve. E" is defined in ASTM F 1959-99 as the average of the five highest incident energy exposure values below the Stoll curve where the specimens do not exhibit breakopen. Ear is reported when A TPV cannot be measured due to FR fabric breakopen.

APPENDIX A

ENERGIZED ELECTRICAL WORK PERMIT FORM

Part I: TO BE COMPLETED BY THE ELECTRICALLY QUALIFIED PERSON DOING THE WORK:

Work Order Number: _____ _

1) Description of circuit _____ _

Name of equipment _____ _

Identification: _____ _

Location: _____ _

Fed from: _____ _

2) Description of work to be done: _____ _

3) Justification of why the circuit/equipment cannot be de-energized or the work deferred until the next scheduled outage:

4) Shock Hazard Analysis

Electrical energy source hazards (check all that apply)

[ ] Less than 50 volts
[ ] 120 volts
[ ] 208 volts
[ ] 240 volts
[ ] 277 volts
[ ] 480 volts
[ ] 600 volts
[ ] other (describe) _____ _
[ ] Emergency power
[ ] Remote control _____ _
[ ] DC _____ _
[ ] Foreign _____ _

5) Determination of Shock Protection Boundaries (Table 1): _____ _

6)Determination of the Flash Protection Boundary (see 7.3): _____ _

Flash Protection Boundary (check method used)

[ ] 4.0 feet (systems less than 600 volts, with 0.1 see clearing time, Ibf < 50kA or 5000 A-sec)
[ ] Physical boundaries of the substation or enclosure (for systems> 600 volts)
[ ] Other - contact electric shop for assistance _____ _

7) Results of the Flash Hazard Analysis (If no flash hazard calculation, go to #8 below and use alternate procedures):

Incident Energy: ____ __ Arc rating of PPE: _____

8) Alternate procedures to detailed flash hazard analysis for selection of PPE (section 7.4):

8a) Voltage _____ Short Circuit current capacity _____

Fault clearing device (name) _____ (description) _____

Manufacturers Model or type number _____

Fault clearing time (seconds) _____

8b) Hazard/Risk Category (Table 2) _____

8c) Protective clothing (Table 3) _____

8c) Other PPE (rated gloves, tools etc.)

9) Means employed to restrict access by unqualified persons:

[ ] Locked access
[ ] Barrier tape/ stanchions
[ ] Electrical Hazard Signs
[ ] Safety Watch Required
[ ] Other means to restrict access (describe) _____

Part II: APPROVAL TO PERFORM WORK WHILE ELECTRICALLY ENERGIZED:

Name of electrically qualified person performing work	Signature	Date
	Print	
Name of electrically qualified person performing work	Signature	Date
	Print	
Name of person giving authorization to perform work	Signature	Date
	Print	

APPENDIXB

SIMPLIFIED, TWO-CATEGORY, FLAME RESISTANT CLOTHING SYSTEM

(NFPA 70E ANNEX H)

Table B.1 can be used as a simplified approach to assure adequate PPE for electrical workers on campus. The clothing listed in Table B.1 fulfills the minimum FR clothing requirements of Table 3 and Table 4. The clothing systems listed in this table should be used with the other PPE appropriate for the Hazard! Risk Category (see Table 4).

Table B.t Simplified, Two-Category, Flame-Resistant Clothing System

CLOTHING*	APPLICABLE TASK
Everyday Work Clothing FR long-sleeve shirt (minimum arc rating of 4) worn over an untreated cotton T-shirt with FR pants (minimum arc rating of8) ***or*** FR coveralls (minimum arc rating of 4) worn over an untreated cotton T-shirt (or an untreated natural fiber long-sleeve shirt) with untreated natural fiber pants.	All Hazard/Risk Category 1 and 2 tasks listed in Table 3. On systems operating at less than 1000 volts, these tasks include work on all equipment *except-* • Insertion or removal of low-voltage motor starter "buckets" • Insertion or removal of power circuit breakers from switchgear cubicles or • Removal of bolted covers from switchgear On systems operating at 1000 volts or greater, tasks also include the operation of switching devices *with the equipment enclosure doors closed.*
Electrical "Switching Clothing Multilayer FR flash jacket and FR bib overalls worn over either FR coveralls (minimum arc rating of 4) or FR long-sleeve shirt and FR pants (minimum arc rating of 4), worn over untreated natural fiber long-sleeve shirt and pants, worn over an untreated cotton T-shirt Or Insulated FR coveralls (with a minimum arc rating 0[25, independent of other layers) worn over untreated natural fiber long-sleeve shirt with untreated denim cotton blue jeans ("regular weight," minimum 12 oz./yd. fabric weight), worn over an untreated cotton T-shirt.	All Hazard! Risk Category 3 and 4 tasks listed in Table 3. On systems operating at 1000 volts or greater, these tasks include work on exposed live parts of all equipment. On systems of less than 1000 volts, tasks include insertion or removal of low-voltage motor starter MCC "buckets," insertion or removal of plug-in devices into or from busway, insertion or removal of power circuit breakers and removal of bolted covers from switchgear.

* Note other PPE required for the specific tasks listed in Table 2 and Table 3, which include arc-rated face shields or flash suit hoods, FR hardhat liners, safety glasses or safety goggles, hard hat, hearing protection, leather gloves, voltage-rated gloves, and voltage-rated tools.