pennsylvania DEPARTMENT OF PUBLIC WELFARE	Department of Public Welfare Accident and Illness Prevention Program Manual		
P.1.b. Electrical Safety			
By Direction of: Glenn Williams, Director, Bureau of Administrative Services			
Issue Date:	***May 12, 2011***	**Effective Date:**	**Immediately**
Category:	***Electrical Safety***		

Implementing Instructions:
This policy becomes effective immediately. Please share this information with your local Safety Coordinator or Manager and other local supervisors and managers as appropriate.

Comments and Questions Regarding This Accident & Illness Prevention Program Manual Section Should Be Directed To:
The Bureau of Administrative Services, Division of Emergency Planning & Safety Operations; Safety and Environmental Operations Section, at 717-772-2076.

A. General

The Electrical Safety Program addresses practices and procedures for employee protection from electrical hazards in DPW operated hospitals, centers, camps and facilities (ODP, OMHSAS, and OCYF).

B. Policy

This operating procedure provides the basic requirements for Electrical Safety for Qualified Persons working at facilities controlled and operated by the PA Department of Public Welfare (DPW). The Department Policy is that only Qualified Persons will work on electrical equipment and installations. Work will be done on de-energized equipment whenever possible. If work must be done on energized equipment, Qualified Persons must use appropriate procedures, equipment, and personal protective equipment (PPE) as described in this program and in the referenced documents. The only presence of high voltage is to incoming utility service to the facility substation. No work will be done on high voltage equipment.

C. Standards/References/Resources

The following documents were used as resources when writing this protocol and may be referred to throughout this document. The use of this program shall be utilized by a qualified person. This document does not restate all the protective measures contained in the referenced documents listed below, nor does it provide guidance on the methods of wiring installation or connection.

- OSHA 29 CFR 1910 Subpart S – Electrical
- NFPA 70 – National Electrical Code (NEC)
- NFPA 70E –Standard for Electrical Safety in the Workplace
- ANSI
- PA DPW – AIPP Manual P.5 Lockout/Tagout Program

D. Responsibilities

1. The facility's Chief Executive Officer (CEO)/Director has overall responsibility for the local Electrical Safety program.

2. The Chief Operating Officer (COO)/Assistant Director shall ensure compliance with all sections of this policy.

3. Facility Maintenance Manager/Institutional Safety Manager shall share responsibility to ensure:

    a. personnel are familiar with these procedures and adhere to its guidelines.
    b. employees who may work on energized systems are trained as Qualified Persons
    c. proper safety equipment and personal protective equipment are supplied to perform the required operations by familiarizing themselves and utilizing Attachments 1, 2 & 3.

4. Electrical Foreman/Supervisors are responsible for the implementation of this program and for the inspection of all related equipment.

5. Employees are responsible to know the hazards of electrical systems, understand the requirements of this program, and use the safety equipment and personal protective equipment as required. Employees, i.e. qualified persons, to work with electricity must also follow the guidelines set forth by the policy as well as those in the DPW Lockout/Tagout program.

6. Technical questions shall be referred to the Division of Facilities & Property Management and Pennsylvania State Facilities Engineering Institute (PSFEI).

E. Definitions

- **De-energized** – Free from any electrical connection to a source of potential difference and from electrical charge; not having a potential differece from that of earth.

- **Electrical Hazard** – A dangerous condition such that contact or equipment failure can result in electric shock, arc flash, burn, thermal burn, or blast.

- **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 according to the DPW Lockout/Tagout Program, tested to ensure the absence of voltage, and grounded if determined necessary.

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

- **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. This applies to parts that are not properly guarded, isolated, or insulated.

- **Flame-Resistant (FR)** – The property of clothing or protective equipment that prevents, terminates, or inhibits combustion. For FR clothing there are degrees of protection.

- **Flash Suit** – A complete FR clothing and equipment system that includes pants, jacket, and hood with a face shield.

- **High Voltage** – Voltage potential which is rated at greater than 23,000 volts

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

- **Low Voltage** – Voltage potential which is rated at 600 volts or lower.

- **Medium Voltage** – Voltage potential which is rated at 601- 23,000 volts.

- **Personal Protective Equipment (PPE)** – Protective equipment and clothing worn by staff personnel designed and constructed to protect the specific part of the body related to the work that is being performed.

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

- **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.

F. Training

1. **Qualified Persons** – Prior to assignment a qualified person shall be trained and knowledgeable of the construction and operation of equipment or a specific work method, and be trained to recognize and avoid the electrical hazards that might be present with respect to that equipment or work method. Such persons shall also be familiar with the proper use of special precautionary techniques, personal protective equipment, insulating and shielding materials, and insulated tools and test equipment. A person can be considered qualified with respect to certain equipment and methods, but still be unqualified for others. Such persons permitted to work within limited approach of exposed energized conductors and circuit parts shall, at a minimum, be additionally trained in all of the following:
    - The skills and techniques necessary to distinguish exposed energized parts from other parts of electric equipment.
    - The skills and techniques necessary to determine the nominal voltage of exposed energized parts
    - The approach distances and the corresponding voltages to which the qualified person will be exposed
    - The decision-making process necessary to determine the degree and extent of the hazard and the personal protective equipment and job planning necessary to perform the task safely
    - The requirement of the Electrical Safety Program.

G. Safety Procedures

1. **De-Energizing Electrical Systems** - Electrical parts must be de-energized and placed in an electrically safe work condition. The parts must be locked out according to the DPW Lockout/Tag-out program for low voltage equipment and medium voltage equipment. The Qualified Person must verify the system is de-energized by voltage testing before beginning work on the part or equipment.

2. **Pre-Job Review** - Before any work is started on energized equipment, or where an electrical hazard exists, the Medium Voltage Electrician, Supervisor or Foreman shall conduct a Pre-Job Review with the qualified person(s) performing the work. This shall include a review of:
    - Voltage of the equipment that will be worked on
    - Potential for arc flash and/or electric shock
    - Availability of appropriate personal protective equipment
    - The knowledge and understanding of the hazards by the qualified person(s)

- Work procedures/Special precautions
- Energy source controls
- A review of whether energized equipment can be or is properly locked out
- Refer to Attachments 1 and 2.

3. **Selection of PPE** *(See Attachments 1, 2, & 3)* - Table 130.7(C)(9)(a) in Attachment 1 is organized by Task and Hazard Category. The Hazard Category then defines the specific PPE that is required for the task in Table 130.(C)(10) in Attachment 2 - Refer to NFPA 70E for more details or for other specific situations. The following Sections 4, 5, and 6 present some typical situations and the selection of appropriate tools and PPE. As the hazard increases, the requirements for more fire and flash resistant clothing increase. Utilize Attachments 1 – 3 as guidelines and recommended work practices.

4. **Working on Energized Panel boards** *(240 volts and below, including voltage testing)*
    - Operating circuit breakers or fused switch operation with covers on or covers off:
        - Hazard Category 0
        - No voltage rated gloves or tools needed
        - Long sleeve shirts and long pants required
        - Safety glasses required

    - Working on energized parts, including voltage testing, removing or installing circuit breakers:
        - Hazard Category 1
        - Voltage rated tools and gloves required
        - Fire rated shirt and blue jeans or fire rated pants required, or use fire rated coveralls.
        - Hard hat and safety glasses required

5. **Working on Energized Panel boards or Switchboards** (>240 volts up to 600 volts)
    - Operating circuit breakers or fused switch operation with covers on:
        - Hazard Category 0
        - No voltage rated gloves or tools needed
        - Long sleeve shirts and long pants required
        - Safety glasses required

    - Operating circuit breakers or fused switch operation with covers off:
        - Hazard Category 1
        - Voltage rated tools and gloves not required
        - Fire rated shirt and blue jeans or fire rated pants required, or use fire rated coveralls.
        - Hard hat and safety glasses required

- Working on energized parts, including voltage testing
  - Hazard Category 2
  - Voltage rated tools and gloves required
  - T shirt, pants, fire rates coveralls required
  - Safety glasses or goggles required
  - Arc rated face shield or flash suit hood required
  - Ear plugs are required
  - Leather gloves over the voltage rated gloves are required
  - Leather work shoes are required
  - Energized work permit required

6. **Equipment over 600 volts** – Medium voltage equipment shall be de-energized prior to performing any work. Troubleshooting tasks can be performed to determine whether equipment is energized by utilizing proper medium voltage sensors (i.e. tic tracer), hot stick, ANSI/ASTM medium voltage safety gloves with rubber insulating glove protector and other PPE as determined.

7. **Work Order System**
   - All work on energized parts or equipment must be completed using a Work Order in conjunction with the DPW Work Order/Preventative Maintenance System.

8. **Installation, Examination and Documentation**
   - All electrical equipment shall be installed and examined to ensure it is free from recognized hazards that are likely to cause serious physical harm to DPW employees. Proper safety can be determined by using the following considerations:
     - Suitable installation of Underwriters Laboratory (UL) list and labeled equipment per OSHA standard 29 CFR 1910, Subpart S, and the NEC, NFPA-20
     - Proper mechanical strength and durability, including parts enclosing and protecting equipment
     - Protection from heating effects under normal usage.
     - Arc protection
     - Proper classification by type, size, voltage, current capacity, and specific use
     - Any other factors that should be considered to ensure employee safety such as electrical checklists.

9. **Splices** – Electrical conductors must be spiced or securely joined by splicing devices suitable for that use, or by brazing, welding, or soldering with a suitable metal alloy. All splices and free ends of conductors must be covered with insulation equivalent to that of the conductor or a suitable insulating device.

10. **Arcing Parts** – All parts of electrical equipment, which in normal operation may produce arcs, sparks, flames, or molten metal, must be enclosed or separated and isolated from all combustible material.

11. **Marking and Labeling** – Electrical equipment must not be used unless it is marked with the manufactures name, trademark, or other markings identifying who is responsible for manufacturing the product. Other markings or labels should be provided indicating voltage, current, wattage, or other ratings necessary. The markings and labels should be kept visible and legible at all times. Do not remove or cover up any markings or labels.

12. **Identification of Disconnects** – Each electrical disconnect switch and its service required for motors and appliances must be legibly marked indicating its purpose, unless located so the purpose is evident.

13. **Working Clearances** – Indoor areas containing electrical equipment such as disconnects and electrical panels shall be maintained in a clean and orderly fashion, shall not be used as storage areas and will have adequate illumination. Under no circumstances shall any employee place any object within 36" in front of an electrical panel.

14. **Wiring Methods**
    - A conductor used as a grounded conductor must be permanent, continuous, identifiable, and distinguishable from all other conductors
    - No grounded conductor shall be attached to any terminal or lead so as to reverse designated polarity. Grounding must not be used for any other purpose but grounding.
    - All non-current-carrying metal parts of portable equipment and fixed equipment, including associated equipment, must be grounded.
    - Temporary wiring of an electrical classification required for permanent wiring may be used during remodeling, maintenance, repair, or demolition of buildings, structures, or equipment, and similar activities. They may also be used for experimental and/or developmental work and must not exceed a ninety day period.
    - Open conductors must be separated from contact with walls, floors, wood cross members, or partitions through which they pass by tubes or bushings of noncombustible, nonabsorbent insulated material.
    - All conductors within seven feet from the floor are exposed to physical damage and must be protected. Flexible cords and cable must be approved and suitable for the conditions of use and location, and used only in continuous lengths without spice or tape.
    - Flexible cords must be connected to devices and fittings so the strain relief is provided.

H. Location Safety Requirements

1. **Electrical Rooms and Enclosures** (601 volts or more)
    - **Restricted Access** – Doors to these areas must be kept locked at all times and access must be restricted to qualified and authorized personnel.
    - **Enclosure Construction** – Outdoor installations shall be enclosed with a fence that is 7ft high or 6ft high with 3 strands of barbed wire on top. Access is controlled by a lock and key. The minimum distance to live parts with voltages from 601 to 13,799 is 10 ft. For any voltages higher, up to 230,000 volts, the minimum distance is 15 ft.
        - Indoor installations must be enclosed in metal cabinets, inside locked fire-resistant rooms. These rooms must have a minimum fire rating of 2 hours. No combustible storage is permitted in either inside or outside areas.
    - **Separation from Low-Voltage Equipment** – Where low voltage equipment is in rooms with exposed voltage parts (greater than 600 volts), the low voltage parts must be separated by a panel, fence, or screen.
    - **Fire-Sprinkler Systems** – According to NFPA these rooms do not require a fire sprinkler system, however, should the building requirements call for sprinklers in every room then sprinklers must be provided in these voltage rooms.
    - **Warning Signs** – Equipment or rooms must be posted with permanent and conspicuous warning signs that read "DANGER-HIGH VOLTAGE-KEEP OUT".

2. **Low Voltage Electrical Rooms and Enclosures** (600 volts or less)
    - **Restricted Access** – The door may be left unlocked from the outside depending on type of facility and location of the electrical room. The door is to stay unlocked from the inside in case of emergencies. Access should be limited to authorized personnel.
    - **Enclosure Construction** – There is no minimum fire-rating needed for these types of electrical rooms unless local building codes call for a certain rating. Installing a two-hour fire-rated enclosure including protection for penetrations is recommended. No combustible storage is permitted in the room.
    - **Fire-Sprinkler Systems** – According to NFPA these rooms do not require a fire sprinkler system, however, should the building requirements call for sprinklers in every room then sprinklers must be provided in these low voltage rooms.
    - **Warning Signs** – Equipment or rooms must be posted with permanent and conspicuous warning signs that read "Electrical Room - Keep Door Closed".

3. **Batteries and Battery Rooms**
    - Restricted Access - doors to battery rooms must be kept locked at all times and access must be restricted to qualified and authorized personnel.
    - Ventilation Requirements – must efficiently prevent liberated hydrogen gas from exceeding the recommended 1 percent (10,000 ppm) concentration.
    - PPE – the following PPE must be readily available and worn by employees performing battery maintenance:
        - Goggles and face shield
        - Chemical resistant gloves
        - Protective aprons
        - Protection overshoes or boots
        - A portable or stationary eyewash station must be located nearby.

4. **Hazardous Locations**
    - All equipment used in wet or damp locations must be approved for purpose and water-tight. The electrical components must not contact with water.
    - Classified Hazardous Locations for electricity depend on the properties of flammable vapors, liquids or gases, or combustible dusts or fibers, which may be present normally or in case of an accidental release. All electrical equipment for these areas must be approved for the specific hazard.

I. Tools and Equipment

- All tools, equipment, and PPE must be voltage rated and provide protection for the voltages worked on. This includes electrical test equipment.
- All tools, equipment, and personal equipment must be visually inspected before each use and at a minimum annually.
- All tools, equipment and PPE must be electrically tested at least every three years.
- Discard any equipment that is visually damaged, blistered, cracked discolored, or fails the electrical testing.

J. Record Keeping

- Electrical Safety Inspections
    - Inspections should be documented and maintained in the Maintenance Department.
- Training
    - The Safety Department must maintain records of Electrical Safety Training. The following minimum data must be recorded:
        - Employee Name and employee number
        - Date of training
        - Instructor name
        - Training summary

K. Attachments

1. Hazard/Risk Category Classification NFPA 70E table 130.7 (c) (9) (a)
2. Protective Clothing and PPE Matrix NFPA 70E table 130.7 (c) (10)
3. Protective Clothing Characteristics NFPA 70E table 130.7 (c) (11)

L. Program Review

For the purposes of ensuring programs and policies are kept current and effective, the following reviews will be conducted:

1. Annual review of local policy by ISM

2. Periodic program review according to AIPP Manual Element O. Methods for Determining and Evaluating AIPP Program Effectiveness

pennsylvania
DEPARTMENT OF PUBLIC WELFARE

Pennsylvania Department of Public Welfare

ATTACHMENT 1
Hazard/Risk Category Classifications
NFPA 70E table 130.7(c)(9)(a)

Task (Assumes equipment is energized, anad work is done flash protection boundary)	Hazard/Risk Category	V-rated Gloves	V-rated Tools
Panelboards Rated 240V and Below - Notes 1 & 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
Open hinged covers (to expose bare energized parts)	0	N	N
Panelboards or Switchboards rated >240V and up to 600V (with molded case or insulated circuit breakers) – Notes 1&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
600V 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 120V or below, exposed	0	Y	Y
Work on control circuits with energized parts >120V, 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
600V 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 120V or below, exposed	0	Y	Y
Work on control circuits with energized parts >120V, 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

ATTACHMENT 1
Hazard/Risk Category Classifications
NFPA 70E table 130.7(c)(9)(a) – continued

Task (Assumes equipment is energized, and work is done flash protection boundary)	Hazard/Risk Category	V-rated Gloves	V-rated Tools
Other 600V Class (277V through 600V, nominal) Equipment - Note 3			
Lighting or small power transformers (600V, maximum)	-	-	-
Removal of bolted covers (to expose bare, energized parts)	2*	N	N
Open 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 and 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
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 120V or below, exposed	0	Y	Y
Work on control circuits with energized parts >120V, exposed	3	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	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 operation 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 120V or below, exposed	2	Y	Y
Work on control circuits with energized parts >120V, 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)	4	N	N
Opening hinged covers (to expose bare, energized parts)	3	N	N
Opening voltage transformer or control power transformer compartments	4	N	N

ATTACHMENT 1
Hazard/Risk Category Classifications
NFPA 70E table 130.7(c)(9)(a) - continued

Task (Assumes equipment is energized, and work is done 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 test	4	Y	Y
Removal of bolted covers (to expose bare, energized parts)	4	N	N
Opening hinge covers (to expose bare, energized parts)	3	N	N
Outdoor disconnect switch operation (hookstick 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

Notes:

- *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 the task in addition to other Hazard/Risk Category 2 requirements of Appendix E
- Y = yes (required)
- N = no (not required)

Notes:

1. 25kA short circuit current available, 0.03 second (2 cycle) fault clearing time.
2. 65kA short circuit current available, 0.03 second (2 cycle) fault clearing time.
3. For < 10 kA short circuit current available, the hazard/risk category required may be reduced by one number.
4. 65kA short circuit current available, 0.33 second (20 cycle) fault clearing time.
5. 65kA short circuit current available, up to 1 second (60 cycle) fault clearing time.
6. For < 25 kA short circuit current available, the hazard/risk category required may be reduce by one number.

ATTACHMENT 2
Protective Clothing and PPE Matrix
NFPA 70E table 130.7(c)(10)

Protective Clothing and Equipment	Protective Systems for Hazard/Risk Category					
Hazard/Risk Category Number (Note 3)	-1	0	1	2	3	4
Non-Melting 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 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		
f. Hand Protection - Leather Gloves (note 2)			AN	X	X	X
g. Foot Protection – Leather Work Boots			AN	X	X	X

Key: AN = As Needed, AL = Select one in group, AR = As Required, X = Minimum Required

Notes:

1. See Appendix D. Arc Rating for a garment is expressed in cal/cm^2
2. If voltage-rated gloves are required, the leather protectors worn external to rubber gloves will suffice.
3. Hazard/Risk Category Number "-1" is only defined if determined by Notes 3 or 6 of Appendix F.
4. Regular weight, untreated, denim cotton blue jeans are acceptable in lieu of FR pants. (arc-rating 4).
5. Alternate is to use FR coveralls (arc-rating 4) instead of FR shirt and FR pants.
6. If fire rated pants have minimum arc-rating of 8, then long pants are not required beneath FR pants.
7. Alternate is to use FR coveralls (arc-rating 4) over non-melting, untreated natural fiber pants and shirt.
8. A facehield with a minimum arc-rating 8, with wrap-around guarding to protect not ony the face, but also the forehead, ears, and neck (or, alternately, a flash suit hood) is required.
9. Alternate is to use two sets of FR coveralls (inner arc rating min.4 and out arc rating min.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.

ATTACHMENT 3

Protective Clothing Characteristics
NFPA 70E table 130.7(c)(11)

Harard/Risk Category	Clothing Description (Typical number of clothing layers is given in paraenthesis)	Required Minimum Arc Rating of PPE [J/cm^2(cal/cm^2)]
0	Non-melting, flammable materials with a fabric weight at least 4.5 oz/yd^2 (1)	N/A
1	FR shirt and FR pants or FR coveralls (1)	16.74 (4)
2	Cotton underwear – conventional short sleeve and briefs/shorts, plus category 1 requirements (1 or 2)	33.47 (8)
3	Cotton underwear plus FR shirt and FR pants plus FR coveralls, or cotton underwear with 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)