pennsylvania
DEPARTMENT OF GENERAL SERVICES

Protocol #15

Electrical Safety

DGS Accident and Illness Prevention Program (AIPP)

I. 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 General Services (DGS).

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. Unqualified Persons shall not be exposed to energized equipment.

II. References

The following documents are referred to in this procedure. The documents provide important information that is integral for the implementation of this procedure. It is not the intention of this procedure to restate all the requirements of the referenced documents. It is also not the intent of this program to provide guidance on the methods of electrical wiring installations or connections. It is assumed that use of this program is by a qualified electrician with knowledge of the requirements of the National Electrical Code (NEC). DGS has adopted the use of NFPA 70E-2018. The requirements of the referenced documents are adopted by reference herein.

A. Occupational Safety and Health Administration (OSHA) 29 CFR 1910 Subpart S Electrical

B. National Fire Protection Association (NFPA) - Standard For Electrical Safety in the Workplace

C. DGS Lockout/Tag-out Program, AIPP Protocol #5

III. Responsibilities

A. Supervisors shall ensure employees who may work on energized systems are trained as Qualified Persons and have the proper safety equipment and PPE to do the required operations safely.

B. Supervisors shall ensure their personnel are familiar with these procedures and adhere to its guidelines.

C. Supervisors are responsible for the implementation of this program and for the annual inspection of all related equipment.

D. Employees are responsible to know the hazards of electrical systems, understand the requirements of this program, and use the safety equipment and PPE as required.

E. The Safety Coordinator, Bureau Directors, and Consultant are available to provide guidance and the Bureau Directors are responsible for ensuring the implementation of this procedure throughout DGS.

IV. General Safety Requirements

A. Batteries and Battery Rooms

1. Restricted Access

Battery room access should be restricted to authorized personnel. The room should be kept locked unless occupied.

The battery rooms should not be used for storage.

2. Ventilation Requirements

Ventilation in the battery rooms should be sufficient to prevent liberated hydrogen gas from exceeding a concentration of 1 percent (10,000 ppm). Refer to NFPA 70E Section 240.1 and Section 320 for design requirements of the ventilation systems and battery rooms.

3. PPE

The following PPE shall be available to employees performing battery maintenance:

- Goggles and face shield
- Chemical resistant gloves
- Protective aprons
- Protective overshoes or boots
- Portable or stationary eyewash facilities

4. Tools and Equipment

Tools and equipment for working on batteries should be non-sparking and voltage rated for the maximum working voltage.

B. Electrical Rooms and Enclosures

1. Restricted Access

Doors to electrical rooms must be kept locked at all times and access must be restricted to qualified and authorized personnel.

2. Enclosure Construction

   Outdoor installations shall be enclosed with a fence that is 7 feet high or 6 feet high with 3 strands of barbed wire on top. Access to the fenced enclosure shall be controlled by a lock and key. For voltages of 601 to 13,799 volts, the minimum distance to live parts is 10 feet. For voltages up to 230,000, the minimum distance to live parts is 15 feet.

   In indoor installations, all electrical equipment shall be enclosed in metal cabinets inside locked fire-resistant rooms. The rooms shall have a minimum fire rating of 3 hours.

3. Separation from Low-Voltage Equipment

   Where low voltage equipment such as switches, cutouts, or lighting panels are in rooms where there are exposed high voltage parts, the low voltage parts must be separated by a panel, fence or screen.

4. Warning Signs

   Where voltages exceed 600 volts, equipment or rooms must be posted with permanent and conspicuous warning signs with the following language:

   "DANGER---HIGH VOLTAGE---KEEP OUT"

C. Tools and Equipment

1. All tools, equipment and PPE must be voltage rated and provide protection for the voltages worked on. This includes all electrical test equipment.

2. All tools, equipment and PPE must be visually inspected before each use and at a minimum at least annually.

3. All tools, equipment and PPE must be electrically tested at least every 3 years.

4. Discard any equipment that is visually damaged, blistered, cracked, discolored, or fails the electrical testing.

V. Procedures

A. De-Energizing Electrical Systems

When possible, electrical parts must be de-energized and placed in an electrically safe work condition. The parts must be locked out according to the DGS Lockout/Tag-out program (AIPP Protocol #5) for low voltage equipment and by following equipment

specific switching orders for high voltage equipment. The Qualified Person must verify the system is de- energized by voltage testing before beginning work on the part or equipment.

B. Hazard/Risk Evaluation

Before any work is started on or near live parts operating at 50 volts or more, or where an electrical hazard exists, the Supervisor or Foreman shall conduct a hazard/risk evaluation.

The hazard/risk evaluation 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 protective equipment and clothing
- The knowledge and understanding of the hazards by the Qualified Persons

C. Pre-Job Briefing

Before starting each job, the Supervisor or Foreman shall conduct a job briefing that will include a discussion of:

- Hazards of the job or operation
- Work procedures
- Special precautions
- Energy source controls
- A review of whether energized equipment can be or is properly locked out
- PPE

D. Selection of PPE (See Appendixes)

Appendix B provides the minimum approach distances for Qualified Persons working on exposed energized electrical conductors or circuit parts. It outlines the arc flash boundary distances for different voltage levels. The boundary helps determine the required PPE for workers. Refer to the limits included in Tables 130.7(C)(15)(a) for ac electrical systems or 130.7(C)(15)(b) for dc electrical systems. The limits in these tables set the maximum available fault current and the maximum operating time of the overcurrent protective device. The minimum working distance is also given. If any of these conditions are not within the limits of the tables, the table method cannot be used to select arc-rated clothing and PPE. If the limits are within the table requirements, proceed to Appendix C, Table 130.7(C)(15)(c).

In Appendix C, use Table 130.7(C)(15)(c) to select the appropriate arc-rated clothing, PPE and non-arc-rated PPE for the task and circuit conditions. Note that these values are being estimated and no arc flash warning labels will be present.

In Appendix D, Table 130.5(C) may be used to determine the likelihood of the occurrence of an arc flash. This table may not be suitable for all work conditions and circumstances and must be used with caution. Best safe work practices would require a complete risk assessment, while using Table 130.5(C) to verify or supplement the results of the risk assessment. Table 130.5(C) contains only the likelihood of an arc flash, while Table 130.7(C)(15)(a) in Appendix B only contains the arc-rated PPE category requirements and limits.

Refer to NFPA 70E for more details or for other specific situations. As the hazard increases, the requirements for more fire and flash resistant clothing increases.

E. Working on Equipment over 600 volts

1. Permit System

   All work on energized high voltage parts or equipment must be completed using an Energized Work Permit and authorized by a High Voltage Electrical Supervisor. Appendix E serves as a sample Energized Work Permit.

2. Switching Orders

   All switching of high voltage electrical systems must be done according to specific Switching Orders developed by a High Voltage Electrical Supervisor. The switching orders will include step by step instructions for de-energizing, grounding, testing, and re-energizing equipment. The switching orders will include PPE requirements, two-worker policy, and notification requirements and permit requirements. All Switching Orders shall be retained in a file and shall be reviewed before each operation. The Supervisor shall audit the performance of the Switching Orders and shall review the procedures with Qualified Employees at least annually. The Switching Orders shall be reviewed and updated as necessary and at least annually.

3. Only Qualified Persons who are specifically trained in High Voltage Electrical Safety may do work on systems with over 600 volts energized parts. These employees must have and been trained in the specific work practices and PPE required for high voltage work. The employees must have the appropriate PPE and practice the use of the PPE before working on energized systems.

V. Training

A. Qualified Persons

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, PPE, 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 considered 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 the following:

(a) The skills and techniques necessary to distinguish exposed energized parts from other parts of electric equipment
(b) The skills and techniques necessary to determine the nominal voltage of exposed energized parts
(c) The approach distances and the corresponding voltages to which the Qualified Person will be exposed
(d) The decision-making process necessary to determine the degree and extent of the hazard and the PPE and job planning necessary to perform the task safely
(e) Periodicity of training is dependent on the level of hazard

B. Unqualified Persons

Unqualified persons shall be trained in and be familiar with any of the electrical safety-related practices that might not be addressed specifically but are necessary for their safety.

Appendix A

Definitions (NFPA 70E)

Arc Rating. The value attributed to materials that describes their performance to exposure to an electrical arc discharge. The arc rating is expressed in cal/cm2 and is derived from the determined value of the arc thermal performance value (ATPV) or energy of breakopen threshold (EBT) (should a material system exhibit a breakopen response below the ATPV value). Arc rating is reported as either ATPV or EBT, whichever is the lower value.

De-energized. 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.

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

Informational Note: Class 2 power supplies, listed low voltage lighting systems, and similar sources are examples of circuits or systems that are not considered an electrical hazard.

Electrically Safe Work Condition. A state in which an electrical conductor or circuit part has been disconnected from energized parts, locked/tagged in accordance with established standards, tested to the absence of voltage, and, if necessary, temporarily grounded for personnel protection.

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

Enclosure. The case or housing of apparatus — or the fence or walls surrounding an installation to prevent personnel from unintentionally contacting energized electrical conductors or circuit parts or to protect the equipment from physical damage.

Energized. Electrically connected to, or is, a source of voltage.

Exposed (as applied to energized electrical conductors or circuit parts). Capable of being inadvertently touched or approached nearer than a safe distance by a person. It is applied to electrical conductors or circuit 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

Fault Current. The amount of current delivered at a point on the system during a short-circuit condition.

Fault Current, Available. The largest amount of current capable of being delivered at a point on the system during a short-circuit condition.

Qualified Person. One who has demonstrated skills and knowledge related to the construction and operation of electrical equipment and installations and has received safety training to identify the hazards and reduce the associated risk.

Appendix B
Arc-Flash PPE Categories
Table: 130.7(C)(15)(a)

Table 130.7(C)(15)(a) Arc-Flash PPE Categories for Alternating Current (ac) Systems

Equipment	Arc-Flash PPE Category	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 455 mm (18 in.)	1	485 mm (19 in.)
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 455 mm (18 in.)	2	900 mm (3 ft)
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 455 mm (18 in.)	2	1.5 m (5 ft)
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 455 mm (18 in.)	4	4.3 m (14 ft)
600-volt class switchgear (with power circuit breakers or fused switches) and 600-volt class switchboards Parameters: Maximum of 35 kA available fault current; maximum of up to 0.5 sec (30 cycles) fault clearing time; minimum working distance 455 mm (18 in.)	4	6 m (20 ft)
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 455 mm (18 in.)	2	1.5 m (5 ft)
NEMA E2 (fused contactor) motor starters, 2.3 kV through 7.2 kV Parameters: Maximum of 35 kA available fault current; maximum of up to 0.24 sec (15 cycles) fault clearing time; minimum working distance 910 mm (36 in.)	4	12 m (40 ft)
Metal-clad switchgear, 1 kV through 15 kV Parameters: Maximum of 35 kA available fault current; maximum of up to 0.24 sec (15 cycles) fault clearing time; minimum working distance 910 mm (36 in.)	4	12 m (40 ft)
Arc-resistant switchgear 1 kV through 15 kV [for clearing times of less than 0.5 sec (30 cycles) with an available fault current not to exceed the arc-resistant rating of the equipment], and metal-enclosed interrupter switchgear, fused or unfused of arc-resistant-type construction, 1 kV through 15 kV Parameters: Maximum of 35 kA available fault current; maximum of up to 0.24 sec (15 cycles) fault clearing time; minimum working distance 910 mm (36 in.)	N/A (doors closed) 4 (doors open)	N/A (doors closed) 12 m (40 ft)
Other equipment 1 kV through 15 kV Parameters: Maximum of 35 kA available fault current; maximum of up to 0.24 sec (15 cycles) fault clearing time; minimum working distance 910 mm (36 in.)	4	12 m (40 ft)

Note: For equipment rated 600 volts and below and protected by upstream current-limiting fuses or current-limiting 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.

Informational Note to Table 130.7(C)(15)(a): The following are typical fault clearing times of overcurrent protective devices:
(1) 0.5 cycle fault clearing time is typical for current limiting fuses 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 an instantaneous integral trip.
(3) 3.0 cycle fault clearing time is typical for insulated case circuit breakers rated less than 1000 volts with an 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 in 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.

Informational Note No. 1: See Table 1 of IEEE 1584TM, *Guide for Performing Arc Flash Hazard Calculations*, for further information regarding Notes b through d.

Informational Note No. 2: An example of a standard that provides information for arc-resistant switchgear referred to in Table 130.7(C)(15)(a) is IEEE C37.20.7, *Guide for Testing Metal-Enclosed Switchgear Rated Up to 38 kV for Internal Arcing Faults*.

Appendix B (continued)

Table: 130.7(C)(15)(b)

Table 130.7(C)(15)(b) Arc-Flash PPE Categories for Direct Current (dc) Systems

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

Notes

(1) Apparel that can be expected to be exposed to electrolyte must meet both of 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 Specifications for Arc Rated 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.

Informational Note No. 1: When determining available fault current, the effects of cables and any other impedances in the circuit should be included. Power system modeling is the best method to determine the available short-circuit current at the point of the arc. Battery cell short-circuit current can be obtained from the battery manufacturer. See Informative Annex D.5 for the basis for table values and alternative methods to determine dc incident energy. Methods should be used with good engineering judgment.

Informational Note No. 2: The methods for estimating the dc arc-flash incident energy that were used to determine the categories for this table are based on open-air incident energy calculations. Open-air calculations were used because many battery systems and other dc process systems are in open areas or rooms. If the specific task is within an enclosure, it would be prudent to consider additional PPE protection beyond the value shown in this table. Research with ac arc flash has shown a multiplier of as much as 3× for arc-in-a-box [508 mm (20 in.) cube] versus open air. Engineering judgment is necessary when reviewing the specific conditions of the equipment and task to be performed, including the dimensions of the enclosure and the working distance involved.

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Appendix C
Personal Protective Equipment and Arc Flash Categories
Table 130.7(C)(15)(c)

Table 130.7(C)(15)(c) Personal Protective Equipment (PPE)

Arc-Flash PPE Category	PPE
1	**Arc-Rated Clothing, Minimum Arc Rating of 4 cal/cm² (16.75 J/cm²)[a]** Arc-rated long-sleeve shirt and pants or arc-rated coverall Arc-rated face shield[b] or arc flash suit hood Arc-rated jacket, parka, rainwear, or hard hat liner (AN) **Protective Equipment** Hard hat Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts)[c] Heavy-duty leather gloves[d] Leather footwear (AN)
2	**Arc-Rated Clothing, Minimum Arc Rating of 8 cal/cm² (33.5 J/cm²)[a]** Arc-rated long-sleeve shirt and pants or arc-rated coverall Arc-rated flash suit hood or arc-rated face shield[b] and arc-rated balaclava Arc-rated jacket, parka, rainwear, or hard hat liner (AN) **Protective Equipment** Hard hat Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts)[c] Heavy-duty leather gloves[d] Leather footwear
3	**Arc-Rated Clothing Selected so That the System Arc Rating Meets the Required Minimum Arc Rating of 25 cal/cm² (104.7 J/cm²)[a]** Arc-rated long-sleeve shirt (AR) Arc-rated pants (AR) Arc-rated coverall (AR) Arc-rated arc flash suit jacket (AR) Arc-rated arc flash suit pants (AR) Arc-rated arc flash suit hood Arc-rated gloves[d] Arc-rated jacket, parka, rainwear, or hard hat liner (AN) **Protective Equipment** Hard hat Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts)[c] Leather footwear
4	**Arc-Rated Clothing Selected so That the System Arc Rating Meets the Required Minimum Arc Rating of 40 cal/cm² (167.5 J/cm²)[a]** Arc-rated long-sleeve shirt (AR) Arc-rated pants (AR) Arc-rated coverall (AR) Arc-rated arc flash suit jacket (AR) Arc-rated arc flash suit pants (AR) Arc-rated arc flash suit hood Arc-rated gloves[c] Arc-rated jacket, parka, rainwear, or hard hat liner (AN) **Protective Equipment** Hard hat Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts)[c] Leather footwear

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] If rubber insulating gloves with leather protectors are used, additional leather or arc-rated gloves are not required. The combination of rubber insulating gloves with leather protectors satisfies the arc flash protection requirement.

Appendix D

Likelihood of Occurrence of an Arc Flash Incident for ac and dc Systems Table 130.5(C)

Table 130.5(C) Estimate of the Likelihood of Occurrence of an Arc Flash Incident for ac and dc Systems

Task	Equipment Condition	Likelihood of Occurrence*
Reading a panel meter while operating a meter switch. Performing infrared thermography and other non-contact inspections outside the restricted approach boundary. This activity does not include opening of doors or covers. Working on control circuits with exposed energized electrical conductors and circuit parts, nominal 125 volts ac or dc, or below without any other exposed energized equipment over nominal 125 volts ac or dc, including opening of hinged covers to gain access. Examination of insulated cable with no manipulation of cable. For dc systems, insertion or removal of individual cells or multi-cell units of a battery system in an open rack. For dc systems, maintenance on a single cell of a battery system or multi-cell units in an open rack.	Any	No
For ac systems, work on energized electrical conductors and circuit parts, including voltage testing. For dc systems, working on energized electrical conductors and circuit parts of series-connected battery cells, including voltage testing. Removal or installation of CBs or switches. Opening hinged door(s) or cover(s) or removal of bolted covers (to expose bare, energized electrical conductors and circuit parts). For dc systems, this includes bolted covers, such as battery terminal covers. Application of temporary protective grounding equipment, after voltage test. Working on control circuits with exposed energized electrical conductors and circuit parts, greater than 120 volts. Insertion or removal of individual starter buckets from motor control center (MCC). Insertion or removal (racking) of circuit breakers (CBs) or starters from cubicles, doors open or closed. Insertion or removal of plug-in devices into or from busways. Examination of insulated cable with manipulation of cable. Working on exposed energized electrical conductors and circuit parts of equipment directly supplied by a panelboard or motor control center. Insertion or removal of revenue meters (kW-hour, at primary voltage and current). Removal of battery conductive intercell connector covers. For dc systems, working on exposed energized electrical conductors and circuit parts of utilization equipment directly supplied by a dc source. Opening voltage transformer or control power transformer compartments. Operation of outdoor disconnect switch (hookstick operated) at 1 kV through 15 kV. Operation of outdoor disconnect switch (gang-operated, from grade) at 1 kV through 15 kV.	Any	Yes
Operation of a CB, switch, contactor, or starter. Voltage testing on individual battery cells or individual multi-cell units. Removal or installation of covers for equipment such as wireways, junction boxes, and cable trays that does not expose bare, energized electrical conductors and circuit parts. Opening a panelboard hinged door or cover to access dead front overcurrent devices. Removal of battery nonconductive intercell connector covers.	Normal	No
Maintenance and testing on individual battery cells or individual multi-cell units in an open rack Insertion or removal of individual cells or multi-cell units of a battery system in an open rack. Arc-resistant switchgear Type 1 or 2 (for clearing times of less than 0.5 sec with a prospective fault current not to exceed the arc-resistant rating of the equipment) and metal enclosed interrupter switchgear, fused or unfused of arc resistant type construction, 1 kV through 15 kV. Insertion or removal (racking) of CBs from cubicles; Insertion or removal (racking) of ground and test device; or Insertion or removal (racking) of voltage transformers on or off the bus.	Abnormal	Yes

(continues)

Table 130.5(C) *Continued*

Task	Equipment Condition	Likelihood of Occurrence*
Equipment condition considered to be "normal" if all of the following circumstances apply: (1) The equipment is properly installed in accordance with the manufacturer's recommendations and applicable industry codes and standards. (2) The equipment is properly maintained in accordance with the manufacturer's recommendations and applicable industry codes and standards. (3) The equipment is used in accordance with instructions included in the listing and labeling and in accordance with manufacturer's instructions. (4) Equipment doors are closed and secured. (5) Equipment covers are in place and secured. (6) There is no evidence of impending failure such as arcing, overheating, loose or bound equipment parts, visible damage, or deterioration.		

*As defined in this standard, the two components of risk are the likelihood of occurrence of injury or damage to health and the severity of injury or damage to health that results from a hazard. Risk assessment is an overall process that involves estimating both the likelihood of occurrence and severity to determine if additional protective measures are required. The estimate of the likelihood of occurrence contained in this table does not cover every possible condition or situation, nor does it address severity of injury or damage to health. Where this table identifies "No" as an estimate of likelihood of occurrence, it means that an arc flash incident is not likely to occur. Where this table identifies "Yes" as an estimate of likelihood of occurrence, it means that additional protective measures are required to be selected and implemented according to the hierarchy of risk control identified in 110.1(H).

Informational Note No. 1: An example of a standard that provides information for arc-resistant switchgear referred to in Table 130.5(C) is IEEE C37.20.7, *Guide for Testing Metal-Enclosed Switchgear Rated Up to 38 kV for Internal Arcing Faults*.

Informational Note No. 2: Improper or inadequate maintenance can result in increased fault clearing time of the overcurrent protective device, thus increasing the incident energy. Where equipment is not properly installed or maintained, PPE selection based on incident energy analysis or the PPE category method might not provide adequate protection from arc flash hazards.

Informational Note No. 3: Both larger and smaller available fault currents could result in higher incident energy. If the available fault current increases without a decrease in the fault clearing time of the overcurrent protective device, the incident energy will increase. If the available fault current decreases, resulting in a longer fault clearing time for the overcurrent protective device, incident energy could also increase.

Informational Note No. 4: The occurrence of an arcing fault inside an enclosure produces a variety of physical phenomena very different from a bolted fault. For example, the arc energy resulting from an arc developed in the air will cause a sudden pressure increase and localized overheating. Equipment and design practices are available to minimize the energy levels and the number of procedures that could expose an employee to high levels of incident energy. Proven designs such as arc-resistant switchgear, remote racking (insertion or removal), remote opening and closing of switching devices, high-resistance grounding of low-voltage and 5000-volt (nominal) systems, current limitation, and specification of covered bus or covered conductors within equipment are available to reduce the risk associated with an arc flash incident. See Informative O for safety-related design requirements.

Informational Note No. 5: For additional direction for performing maintenance on overcurrent protective devices, see Chapter 2, Safety-Related Maintenance Requirements.

Informational Note No. 6: See IEEE 1584, *Guide for Performing Arc Flash Calculations*, for more information regarding incident energy and the arc flash boundary for three-phase systems.

(3) Changes in Scope. Employees shall be instructed to be alert for changes in the job or task that could lead the person outside of the electrically safe work condition or expose the person to additional hazards that were not part of the original plan.

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

(C) Illumination.

(1) General. Employees shall not enter spaces where electrical hazards exist 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 within the limited approach boundary of energized electrical conductors or circuit parts operating at voltages equal to or greater than 50 volts or where an electrical hazard exists.

Appendix E
Sample Energized Work Permit

ENERGIZED ELECTRICAL WORK PERMIT

PART I: TO BE COMPLETED BY THE REQUESTER:

Job/Work Order Number _____

(1) Description of circuit/equipment/job location: _____

(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: _____

_____ _____
Requester/Title Date

PART II: TO BE COMPLETED BY THE ELECTRICALLY QUALIFIED PERSONS *DOING* THE WORK:

Check when complete

(1) Detailed description of the job procedures to be used in performing the above detailed work: ☐

(2) Description of the safe work practices to be employed: ☐

(3) Results of the shock risk assessment:
- (a) Voltage to which personnel will be exposed ☐
- (b) Limited approach boundary ☐
- (c) Restricted approach boundary ☐
- (d) Necessary shock, personal, and other protective equipment to safely perform assigned task ☐

(4) Results of the arc flash risk assessment:
- (a) Available incident energy at the working distance or arc flash PPE category ☐
- (b) Necessary arc flash personal and other protective equipment to safely perform the assigned task ☐
- (c) Arc flash boundary ☐

(5) Means employed to restrict the access of unqualified persons from the work area: _____ ☐

(6) Evidence of completion of a job briefing, including discussion of any job-related hazards: _____ ☐

(7) Do you agree the above-described work can be done safely? ❑ Yes ❑ No (If *no*, return to requester.)

_____ _____
Electrically Qualified Person(s) Date

_____ _____
Electrically Qualified Person(s) Date

PART III: APPROVAL(S) TO PERFORM THE WORK WHILE ELECTRICALLY ENERGIZED:

_____ _____
Manufacturing Manager Maintenance/Engineering Manager

_____ _____
Safety Manager Electrically Knowledgeable Person

_____ _____
General Manager Date

Note: Once the work is complete, forward this form to the site Safety Department for review and retention.

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