PROCEDURE 1.0—LOCKOUT/TAGOUT PROGRAM (& OTHER ELECTRICAL SAFETY CONSIDERATIONS)

1.1 INTRODUCTION

Purpose

Lockout/tagout programs are designed to prevent the accidental startup of machines or equipment during servicing or maintenance activities, thus preventing the release of stored energy. Through the use of specific procedures that involve the application of energy isolating devices, locks and/or tags, equipment and machinery may be isolated from energy sources and injuries to workers prevented. Where certain activities or conditions require work to be performed on live/energized electrical circuits, systems or equipment, thereby making the use of lockout/tagout procedures impractical or not feasible, the work will be performed in accordance with Section 1.7 below.

Scope & Application

The Federal Occupational Safety and Health Regulations (29 CFR 1910.147) require employers to implement systems to control hazardous energy during servicing and/or maintenance of machines and equipment. This procedure is intended to provide the Hamilton College Physical Plant with the guidance necessary to comply with these requirements. The OSHA standard can be accessed HERE.

Authority

The subject material in this procedure is based upon requirements of federal law, generally recognized occupational health and safety practices, and/or criteria established by the National Institute of Occupational Safety and Health (NIOSH).

Exemptions

This procedure does not apply in the following situations:

- Normal machinery/equipment operations or activities that are not technically associated with maintenance and/or servicing, where minor tool changes or adjustments that are repetitive, routine and integral to the functional use of the machinery/equipment are performed. However, this exception would not apply if:
    - An employee is required to remove or bypass a guard or other safety device, or;
    - An employee is required to place any part of his/her body into an area on a machine or piece of equipment where work is actually being performed upon the material being processed (point of operation) or where an associated danger zone exists during a machine operation cycle.
- Work on cord and plug connected electrical equipment for which exposure to the hazards of unexpected energization or start up of the equipment is controlled by the unplugging of the equipment from the energy source, and the plug is under the exclusive control of the employee performing the servicing or maintenance.
- Hot tap operations involving live or pressurized transmission or distribution systems for substances such as gas, steam, water or petroleum products, provided the employer demonstrates that:
    - Continuity of service is essential;
    - Shutdown of the system is impractical; and

- Documented procedures are followed, and special equipment is used which will provide proven effective protection for employees.

1.2 RESPONSIBILITIES

Physical Plant Administrators/Shop Managers

- Evaluate machines and equipment within their areas of responsibility where this procedure will be applicable;
- Develop and maintain machine-specific procedures, in addition to machine-specific training, where necessary;
- Evaluate their areas of responsibility and procedure applicability at least annually, and perform inspections of areas under lockout/tagout periodically;
- Provide and maintain the necessary protective materials and hardware; and
- Act as the sole shop representative who may remove a lock or tag in accordance with this procedure.

Shop Supervisors/Forepersons

- Ensure employees under their supervision use lockout/tagout devices during any servicing or maintenance activities in accordance with this procedure;
- Ensure that lockout/tagout devices are not used for any other purposes;
- Assist the shop manager in performing periodic inspections of areas under lockout/tagout; and
- Do not remove lockout/tagout devices, unless they were specifically responsible for the application of the devices.

Employees

- Attend general and machine-specific training as required;
- Follow the appropriate lockout/tagout procedures described herein;
- Use lockout/tagout devices only for their intended purpose, and;
- Do not remove another employee's lock or tag under any circumstances.

Environmental Protection, Safety & Sustainability (EPS&S)

- Develop lockout/tagout procedure;
- Provide general procedural training;
- Provide assistance in evaluating machines and equipment, and;
- Provide periodic audits of the lockout/tagout procedure as necessary.

1.3 DEFINITIONS

Affected employee—An employee whose job requires him/her to operate or use a machine or equipment on which servicing or maintenance is being performed under lockout or tagout, or whose job requires him/her to work in an area in which such servicing or maintenance is being performed.

Authorized employee—A person who locks out or tags out machines or equipment in order to perform servicing or maintenance on that machine or equipment. An affected employee becomes

an authorized employee when that employee's duties include performing servicing or maintenance covered under this section.

Capable of being locked out—An energy-isolating device is capable of being locked out if it has a hasp or other means of attachment to which, or through which, a lock can be affixed, or it has a locking mechanism built into it. Other energy isolating devices are capable of being locked out, if lockout can be achieved without the need to dismantle, rebuild, or replace the energy-isolating device or permanently alter its energy control capability.

Energized—Connected to an energy source or containing residual or stored energy.

Energy isolating device—A mechanical device that physically prevents the transmission or release of energy, including but not limited to the following:

- A manually operated electrical circuit breaker;
- A disconnect switch;
- A manually operated switch by which the conductors of a circuit can be disconnected from all ungrounded supply conductors, and, in addition, no pole can be operated independently;
- A line valve;
- A block;
- And any similar device used to block or isolate energy.
- **Push buttons, selector switches and other control circuit type devices are not energy isolating devices.**

Energy source—Any source of electrical, mechanical, hydraulic, pneumatic, chemical, thermal, or other energy.

Hot tap—A procedure used in the repair, maintenance and services activities which involves welding on a piece of equipment (pipelines, vessels or tanks) under pressure, in order to install connections or appurtenances. it is commonly used to replace or add sections of pipeline without the interruption of service for air, gas, water, steam, and petrochemical distribution systems.

Lockout—The placement of a lockout device on an energy-isolating device, in accordance with an established procedure, ensuring that the energy isolating device and the equipment being controlled cannot be operated until the lockout device is removed.

Lockout device—A device that utilizes a positive means such as a lock, either key or combination type, to hold an energy isolating device in the safe position and prevent the energizing of a machine or equipment. Included are blank flanges and bolted slip blinds.

Normal production operations—The utilization of a machine or equipment to perform its intended production functions.

Servicing and/or maintenance—Workplace activities such as constructing, installing, setting up, adjusting, inspecting, modifying, and maintaining and/or servicing machines or equipment. These activities include lubrication, cleaning or unjamming of machines or equipment and making adjustments or tool changes, where the employee may be exposed to the unexpected energization or startup of the equipment or release of hazardous energy.

Setting up—Any work performed to prepare a machine or equipment to perform its normal production operation.

Tagout—The placement of a tagout device on an energy isolating device, in accordance with an established procedure, to indicate that the energy isolating device and the equipment being controlled may not be operated until the tagout device is removed.

Tagout device—A prominent warning device, such as a tag and a means of attachment, which can be securely fastened to an energy isolating device in accordance with an established procedure, to indicate that the energy isolating device and the equipment being controlled may not be operated until the tagout device is removed.

1.4 ENERGY CONTROL PROGRAM RULES

Lockout/Tagout Program Hardware
A lockout/tagout station will be established at a primary location within the Physical Plant housing the contents of this procedure, along with standardized and durable lockout and tagout devices.

Lockout Devices
All lockout devices should include lock and key type equipment that is substantial enough to prevent removal without excessive force, such as with the use of bolt cutters. Further, while most equipment and machinery manufactured today have energy isolating devices designed that easily accept a lock, various other types that are old or poorly designed do not. Therefore, an adequate supply of hardware that will support the ability to apply a lock should be available. This should include, but is not limited to, chains/cables, 6-lock hasps, ball valve lockouts, gate valve lockouts, circuit breaker lockouts, and plug lockouts.

Tagout Devices
All tagout devices should include a non-paper tag and nylon tie (or equivalent), that together are substantial enough to prevent accidental or inadvertent removal. They should be single use, hand attachable, and self-locking devices with a minimum unlocking strength of 50 pounds, and designed so as to indicate the identity of the employee applying the device.

Selecting and Applying Lockout and Tagout Devices
The application of lockout or tagout devices to control the release of hazardous energy during applicable servicing or maintenance activities shall conform to the following:

Lockout
A lockout shall consist of the application of both a lockout and tagout device, and should be selected whenever there is an energy-isolating device to apply the lockout/tagout devices to. Lockout devices shall not be used for any purposes other than those in accordance with this procedure.

Tagout
A tagout shall consist of the application of a tagout device only, and should be selected when equipment or machinery is not capable of being locked out. If a tagout is selected for equipment

or machinery that is capable of being locked out, the tagout should be placed in the same location as the lockout would normally be placed, and should provide the same full employee protection that would be provided by a lockout. Further, it must be understood that there are certain limitations to the use of a tagout system to control hazardous energy, such as:

- A tagout is essentially a warning device, and does not provide the physical restraint on those devices that is provided by a lockout;
- When a tagout is applied, it is not to be removed without authorization of the authorized person responsible for it, and it is never to be bypassed, ignored or otherwise defeated;
- Tags must be legible and understandable by all authorized employees, affected employees, and all other employees whose work operations are or may be in the area, in order to be effective;
- Tags and their means of attachment must be made of materials that will withstand the environmental conditions encountered in the workplace;
- Tags may evoke a false sense of security, and their meaning needs to be understood as part of the overall energy control program;
- Tags must be securely attached to so that they cannot be inadvertently or accidentally detached during use.

Training

The depth of training in accordance with this procedure is generally dependent upon an employees shop assignment and/or their required knowledge and skill to safely apply, use and remove energy controls. Additional training shall be provided for all authorized and affected employees whenever there is a change in their job assignments, a change in machines, equipment or processes that presents a new hazard, or when there is a change in energy control procedures. Shop managers will be responsible for ensuring that the personnel under their direction are adequately trained in accordance with the equipment/machinery energy hazards present in their areas of responsibility. Otherwise, training can be broken down into 3 categories:

<u>General Awareness Training</u>

All Physical Plant employees who may be affected by a lockout/tagout will be trained to an awareness level concerning this procedure, so that they may recognize any lockout/tagout devices that they may encounter within their work area. The Director of EPS&S will provide this training on an as needed basis.

<u>Authorized Employee Training</u>

Any Physical Plant employee who will be authorized to apply lockout/tagout devices to control hazardous energy shall be trained to the extent they possess the skills and knowledge to fully implement this general procedure. The Director of EPS&S will provide this training on an annual basis, but shop managers should consult with the Director of EPS&S if new employees require this training on a more regular basis.

<u>Machine/Equipment Specific Training</u>

As shop managers begin to identify and evaluate select machinery and equipment in their areas of responsibility where the lockout/tagout program will apply, they will be responsible for training the personnel within their department upon any specific procedures developed.

Periodic Inspections
The Director of EPS&S will be responsible for conducting a review of this procedure at least annually, or as otherwise deemed necessary, so as to correct any deviations or inadequacies identified. Similarly, designated shop managers will be responsible for the review of any shop-specific procedures developed for equipment or machinery within their work areas at least annually. Finally, shop managers and associated supervisory personnel will be responsible for inspecting areas where this procedure is being utilized, and documenting those inspections accordingly.

Corrective/Disciplinary Actions
In the event that administrative or procedural deviations or inadequacies are identified in the course of a review or inspection, the appropriate actions should be taken as soon as practicable to update or revise them accordingly. In the event an employee is discovered to have removed or otherwise defeated a lockout or tagout device that had been correctly affixed in accordance with this or other machine/equipment-specific procedures, disciplinary action up to and including immediate termination will be mandated.

1.5 LOCKOUT/TAGOUT SEQUENCING & TECHNIQUES

General
Only authorized employees may implement the lockout/tagout system to control hazardous energy. All affected employees shall be notified by an authorized employee (or a senior Physical Plant supervisor) prior to the application or lockout/tagout devices, and following the removal of lockout/tagout devices. The following sequence of events or techniques should be used as a guide to successfully implementing a lockout/tagout:

1. Preparation for Shutdown— Notify all affected employees that servicing or maintenance is required on a piece of machinery or equipment, and that a lockout/tagout will be performed to control any hazardous energy.

2. Know the Hazards—Before an authorized or affected employee turns off a machine or piece of equipment, they shall have knowledge of the type and magnitude of the energy, the hazards of the energy to be controlled, and the method or means to control the energy.

3. Machine or Equipment Shutdown—Shut the machine or equipment down in the prescribed and customary fashion (depress stop button, open switch, close valve, etc.).

4. Machine or Equipment Isolation—Locate all energy-isolating devices needed to control hazardous energy to the machine or equipment and isolate all energy sources.

5. Apply Lockout or Tagout Devices—The authorized employee(s) shall then affix lockout or tagout devices to each energy-isolating device. Lockout devices, where used, shall be affixed in a manner that will hold the energy in a "safe" or "off" position. Tagout devices, where used, shall be affixed in a manner that will clearly indicate that the operation or movement of energy-isolating devices from the "safe" or "off" position is prohibited. Where tagout devices are used on energy-isolating devices capable of being locked out, the tag shall be fastened at the same point at which a lock would normally be attached. Where a tagout cannot be affixed directly to an energy-isolating device, the tag shall be located as close as

safely possible to the device, or in a position that will be immediately obvious that the energy should not be engaged.

6. Stored or Residual Energy—Following the application of lockout or tagout devices, any stored or residual energy shall be rendered safe by any necessary means, including but not limited to grounding, bleeding down, blocking, etc.

7. Verification of Isolation—Prior to servicing or maintenance activities, verify that the isolation or de-energization of the machine or equipment has been accomplished by any necessary means, i.e. like by depressing the start button.

8. Perform Work—After verification of isolation, the machinery or equipment is effectively locked out or tagged out, and servicing or maintenance activities may begin.

9. Release from Lockout or Tagout—Before lockout or tagout devices are removed and energy is restored, inspect the work area to ensure that any nonessential items, like tools or other repair equipment, have been removed and the machine or equipment components are operationally intact. Further, ensure that all employees are safely positioned or removed, and notify any affected employees before removing lockout or tagout devices that the equipment or machinery is going to be re-energized.

10. Lockout or Tagout Device Removal—The authorized employee shall then remove each lockout or tagout device from any energy-isolating device.
    - **Exception**—In the event the authorized employee who applied the lockout or tagout device is not available to remove it, that device may be removed only by his/her shop manager in accordance with the following:
        - The shop manager must verify that the authorized employee is not on the college premises;
        - The shop manager should take reasonable efforts to contact the authorized employee to inform him/her that their lock or tag is being removed; and
        - The authorized employee must have knowledge that their lock or tag has been removed before they resume work.

Other Issues

Other situations that may arise in the course of lockout/tagout activities may necessitate additional sequencing or techniques to comply with this procedure, and are described as follows:

1. Testing or Repositioning of Machines/Equipment/Components Under Lockout/Tagout—In situations where lockout or tagout devices must be temporarily removed from energy-isolating devices for specified testing or repositioning, the following sequence of actions shall be followed:
    - Clear the machine or equipment of tools and materials;
    - Remove employees from the machine or equipment area;
    - Remove lockout or tagout devices;
    - Energize and proceed with testing or repositioning; and
    - De-energize all systems and reapply energy control measures to continue servicing and/or maintenance.

2. Non-College Personnel (Contractors)—Whenever non-college personnel are engaged in activities covered by the scope and application of this procedure, the designated college representative and the outside employer shall inform each other of their respective lockout/tagout procedures so as to maintain awareness between employees of either group. Further, while the college should strive to contract external services with organizations that have developed functional lockout/tagout procedures as necessary, non-college personnel who may be exposed to hazardous energy must be covered by this procedure if their employer does not have a lockout/tagout program of their own.

3. Group Lockout or Tagout—When servicing and/or maintenance is performed by a large crew or department, they shall utilize a procedure which affords employees a level of protection equivalent to that provided by the implementation of a personal lockout or tagout device. This shall be accomplished by:
    - The designation of a primary authorized employee (supervisor lockout/tagout) responsible for controlling all employees and/or ensuring continuity of protection, whom will normally apply a multi-lock accepting device to the energy-isolating device;
    - The primary authorized employee will then affix his/her lock or tag to the device, followed by all other authorized employees affixing their locks or tags to the device;
    - The primary authorized employee will remove his/her lock or tag only after all other authorized employees have removed their locks or tags.

4. Shift or Personnel Changes—To ensure the orderly transfer of lockout or tagout devices between departing and in-coming employees who may continue servicing or maintenance activities on machinery or equipment, the following shall apply:
    - The departing personnel shall notify in-coming personnel that the machinery or equipment is prepared for servicing/maintenance to continue;
    - The departing personnel will remove any lockout or tagout devices attached to machinery or equipment, and in-coming authorized personnel will replace with like devices as necessary to continue the work; and
    - The designated shop supervisor or manager shall coordinate activities between the 2 shifts to ensure that all hazardous energy issues rendered safe.

1.6 SITE SPECIFIC ELECTRICAL SAFETY CONSIDERATIONS RELATIVE TO HAMILTON'S 46 KV SUBSTATION

To Be Determined…

1.7 WORK ON LIVE/ENERGIZED CIRCUITS, SYSTEMS OR EQUIPMENT

If work activities are to be performed on live/energized circuits, systems or equipment, meaning instead of performing such work under the provisions of the Lockout/Tagout Program as described above, certain other criteria must first be met.

OSHA has not accepted the argument that qualified electricians can work on live energized circuits as safely as they can on de-energized circuits. Therefore, OSHA does not leave it to the employer's (or a qualified employee's) discretion as to whether or not to de-energize electrical circuits on the basis of convenience, custom or expediency. Further, OSHA requires all live parts to which an employee may be exposed be de-energized before they work on or near them, unless the employer can demonstrate:

- Additional or increased hazards, meaning:
    - Interruption of life-support equipment (like in a hospital setting);
    - Deactivation of emergency alarm systems;
    - Shutdown of hazardous location ventilation equipment (like lab fume hoods);
    - Removal of necessary illumination.
- Or, infeasibility due to equipment design or operational limitations, meaning:
    - Testing of electrical circuits that can only be performed with the circuit energized (troubleshooting);
    - Work on circuits that form an integral part of a continual industrial process.

As such, it is only under these conditions, and with direct authorization by a Physical Plant administrator, that work may be performed upon live/energized circuits, systems or equipment. It is recommended that such authorized work be approved and documented through the "Energized Electrical Work Permit" included as Attachment 1 at the end of this document. Further, the 4 tables that follow (Hazard Risk Category Classifications, Protective Clothing & PPE Matrix, Typical Protective Clothing Systems, and the Simplified Two-Category Flame Resistant Clothing System) are derived directly from NFPA 70(E)-2004 consensus standards, and pertain to the Personal Protective Equipment (PPE) considerations that apply during work live electrical work. These consensus standards, as well as the applicable OSHA standards established in 29 CFR 1910 Subpart J, shall be referenced accordingly.

Hazard Risk Category Classifications—PPE Required for Various Electrical Tasks:
When selected in lieu of conducting a flash hazard analysis (in accordance with NFPA 130.3(A)), Table 130.7(C)(9)(a) below 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 130.7(C)(9)(a). For tasks not listed, or for power systems with greater than the assumed short-circuit current capacity or with longer than the assume fault clearing times, a flash hazard analysis shall be required in accordance with 130.3

FPN 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.

FPN 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, and whether the work task related to the source operating at less than 50 volts increases exposure to electrical burns or to explosion from an electric arc.

Table 130.7(C)(9)(a) 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	**Hazard/Risk Category**	**V-rated Gloves**	**V-rated Tools**
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	**Hazard/Risk Category**	**V-rated Gloves**	**V-rated Tools**
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

Table 130.7(C)(9)(a) 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**
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) – Note 4	2*	N	N
Opening hinged covers (to expose bare, energized parts)	1	N	N
600 V Class Switchgear (with power circuit breakers or fused switches) – Notes 5 and 6	**Hazard/Risk Category**	**V-rated Gloves**	**V-rated Tools**
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 – Notes 2 (except as indicated) and 3	**Hazard/Risk Category**	**V-rated Gloves**	**V-rated Tools**
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
NEMA E2 (fused contactor) Motor Starters, 2.3 kV through 7.2 kV	**Hazard/Risk Category**	**V-rated Gloves**	**V-rated Tools**
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

Table 130.7(C)(9)(a) 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**
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	**Hazard/Risk Category**	**V-rated Gloves**	**V-rated Tools**
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)	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
Other Equipment 1 kV and above	**Hazard/Risk Category**	**V-rated Gloves**	**V-rated Tools**
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 (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

Legend:
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 Figure 4.
Y = yes (required)
N = no (not required)

Table 130.7(C)(9)(a) 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**

Notes:

1. Maximum of 25-kA short circuit current available, 0.03 second (2 cycle) fault clearing time.
2. Maximum of 65-kA 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. Maximum of 42-kA short circuit current available, 0.33 second (20 cycle) fault clearing time.
5. Maximum of 35-kA short circuit current available, up to 1.0-second (60 cycle) fault clearing time.
6. 6. For < 25 kA short circuit current available, the Hazard/Risk Category required may be reduced by one Number.

Protective Clothing and Personal Protective Equipment (PPE) Matrix:

Once the Hazard/Risk Category has been identified, Table 130.7(C)(10) shall be used to determine the required personal protective equipment (PPE) for the task. Table 130.7(C)(10) 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.

FPN No. 1: See Annex H for a suggested simplified approach to assure adequate PPE for electrical workers within facilities with large and diverse electrical systems.

FPN No. 2: The PPE requirements of this section are intended to protect a person from arc-flash and shock hazards. While some situations may result in burns to the skin, even with the protection described in Table 130.7(C)(10), burn injury should be reduced and survivable. ***Due to the explosive effect of some arc events, physical trauma injuries may occur. The PPE requirements of this do not provide protection against physical trauma other than exposure to the thermal effects of an arc flash.***

Table 130.7(C)(10) Protective Clothing and Personal Protective Equipment (PPE) Matrix						
Protective Clothing & Equipment	**Protective Systems for Hazard/Risk Category**					
Hazard/Risk Category Number	**–1 (Note 3)**	**0**	**1**	**2**	**3**	**4**
Non-melting or Untreated Natural Fiber	**–1 (Note 3)**	**0**	**1**	**2**	**3**	**4**
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)	**–1 (Note 3)**	**0**	**1**	**2**	**3**	**4**
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	**–1 (Note 3)**	**0**	**1**	**2**	**3**	**4**
a. Flash Suit Jacket (multilayer)						X
b. Flash Suit Pants (multilayer)						X
Head Protection	**–1 (Note 3)**	**0**	**1**	**2**	**3**	**4**
a. Hard Hat			X	X	X	X
b. FR Hard Hat Liner					AR	AR
Eye Protection	**–1 (Note 3)**	**0**	**1**	**2**	**3**	**4**
a. Safety Glasses	X	X	X	AL	AL	AL
b. Safety Goggles				AL	AL	AL
Face and Head Protection	**–1 (Note 3)**	**0**	**1**	**2**	**3**	**4**
Arc rated faceshield/flash suit hood				X (Note 8)		
Flash suit hood					X	X
Hearing protection (ear canal inserts)				X (Note 8)	X	X
Leather Gloves (Note 2)			AN	X	X	X
Leather Work Shoes			AN	X	X	X

Legend:

AN = As Needed

AL = Select one in group

AR = As Required

X = Minimum Required

Notes:

1. See Table 130.7(C)(11). 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 satisfies 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./yd^2 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 of 8, 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 natural fiber pants and T-shirt.
8. A faceshield with a minimum arc rating of 8, 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 ratingof 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.

Table 130.7(C)(11) Typical Protective Clothing Systems

Hazard Risk Category Number	Clothing Description (Number of clothing layers is given in parenthases)	Total Weight oz/yd2	Minimum Arc Thermal Performance Exposure Value (ATPV)* or Breakopen Threshold Energy (Ebt)* Rating of PPE cal/cm2
0	Untreated cotton (1)	4.5-7	N/A
1	FR shirt and FR pants (1)	4.5-8	4
2	Cotton underwear plus FR shirt and FR pants (2)	9-12	8
3	Cotton underwear plus FR shirt and FR pants plus FR coverall (3)	16-20	25
4	Cotton underwear plus FR shirt and FR pants plus double layer switching coat and pants (4)	24-30	40

*ATPV is defined in the ASTM P S58 standard arc test method for flame resistant (FR) fabrics as the incident energy that would just cause the onset of a second degree burn (1.2 cal/cm2). Ebt is reported according to ASTM P S58 and is defined as the highest incident energy which did not cause FR fabric breakopen and did not exceed the second-degree burn criteria. Ebt is reported when ATPV cannot be measured due to FR fabric breakopen.

Simplified Two-Category, Flame-Resistant (FR) Clothing System:
The use of this table is suggested as a simplified approach to assure adequate PPE for electrical workers within facilities with large and diverse electrical systems. The clothing listed in this table fulfills the minimum FR clothing requirements of Table 130.7(C)(10) and Table 130.7(C)(11). The clothing systems listed in this table should be used with the other PPE appropriate for the hazard/risk category. See Table 130.7(C)(11).

Table H.1 Simplified, Two-Category, Flame-Resistant (FR) Clothing System.

CLOTHING*	APPLICABLE TASKS
Everyday Work Clothing:	All Hazard/Risk Category 1 and 2 tasks listed in Table 130.7(C)(9)(a).
FR long-sleeve shirt (minimum ATPV of 4) worn over untreated cotton T-shirt with FR pants (minimum ATPV of 8) ***Or*** FR coveralls (minimum ATPV of 4) worn over untreated cotton T-shirt (or an untreated natural fiber long-sleeve shirt) with untreated natural fiber pants.	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 equipment enclosure doors closed***.
Electrical "Switching" Clothing:	All Hazard/Risk Category 3 and 4 tasks listed in Table 130.7(C)(10).
Multilayer FR flash jacket and FR bib overalls worn over either FR coveralls (minimum ATPV of 4) or FR long-sleeve shirt and FR pants (minimum ATPV 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 ATPV of 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.^{2} fabric weight), worn over an untreated cotton T-shirt.	On systems operating at 1000 volts or greater, these tasks include work on exposed energized 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 130.7(C)(10) and Table 130.7(C)(11), which include double-layer FR flash hoods, FR hardhat liners, safety glasses or safety goggles, hard hat, hearing protection, leather gloves, voltage-rated gloves, and voltage-rated tools.

ATTACHMENT 1-1
ENERGIZED ELECTRICAL WORK PERMIT
NFPA 130.1(A); NFPA 70E Annex J

JUSTIFICATION FOR THE PERFORMANCE OF LIVE ELECTRICAL WORK

De-energization: (Check all that apply)

Introduces additional or increased hazards

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

Is not feasible due to equipment design or operational limitations

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

Justification Made By: _____
Print Name Signature Date

Hazardous Risk Category _____

Minimum approach safe distance _____
Less than 600 V; 4 feet
601 V to 5,000 V; 10 feet
5,001 V to 87,500 V; 30 feet

Requirements	Yes	Done	Tools/Test Equipment	Yes	Done
Review Electrical Live Work			Approved Insulated Hand Tools		
Job Briefing Discussion			Live-line Tools		
Barricades			CAT III or IV rated Voltmeter		
Personal Protective Equipment			Approved Phasing Tester		
Class E Hard hat			Other Precautions:		
Safety glasses			Illumination		
Polycarbonate tinted face shield			Limited Work Space		
Fire Resistant Clothing			Conductive Material		
Flash suit			Portable Ladders		
Voltage rated insulated gloves			Conductive Apparel		
Voltage rated insulated blankets			Interlocks		
Voltage rated insulated matting			Housekeeping		
Voltage rated insulated shielding					
Attendant					
Other:					

Signatures of Employees Involved In Work: _____ _____
_____ _____

Supervisor Authorizing Live Electrical Work: _____
Print Name Signature Date

Attachment 1-2
Pre-Job Briefing Checklist
NFPA 70E Annex I

Identify

- The hazards
- The voltage levels involved
- Skills required
- Any secondary voltage source
- Any unusual work conditions
- Number of people needed to do the job
- The shock protection boundaries
- The available incident energy
- Potential for arc flash (conduct a flash hazard analysis?)
- Flash protection boundary

Ask

- Can equipment be de-energized?
- Are backfeeds on circuits possible?
- Is a "stand-by person" required?

Check

- Job Plans
- Single-line diagrams and vendor prints
- Status board
- Information on plant and vendor resources up to date
- Safety procedures
- Vendor info
- Individuals are familiar with the facility

Know

- What the job is
- Who else needs to know- Communicate
- Who is in charge

Think

- About the unexpected event
- Lock – Tag – Try – Test
- Test for voltage before touch
- Use the right tools and equipment/PPE
- Install and remove grounds
- Install barriers and barricades
- What else….?
- What if……?

Prepare for an emergency

- Are individuals CPR/First Aid trained?
- Emergency equipment provided and available?
- Where is nearest telephone?
- Where is fire alarm?
- Is rescue equipment available?
- What is work location?
- Emergency shut-off for equipment?
- Emergency telephone numbers known or posted?
- Where is fire extinguisher?
- Are radio communications available?