

1 INTENT

The purpose of this program is to establish safe work practices for University at Albany (UAlbany) employees who may be exposed to electrical hazards.

This Electrical Safety Program is based on the National Fire Protection Association (NFPA) *Standard for Electrical Safety in the Workplace* (NFPA 70E). NFPA 70E was developed at the request of the Occupational Safety and Health Administration (OSHA) to define safe work practices that should be used in general industry.

The program is based on four protective strategies:

1. **Creating an electrically safe work condition** – if the source of energy is removed, then no risk of injury exists.
2. **Training employees** – if employees are trained to recognize and avoid the potential for injury, the change of injury is reduced.
3. **Planning the task** – when employees take the time to consider each step in the process of executing a work task and all potential results from each action, they are less likely to be surprised by a result.
4. **Selecting and using Personal Protective Equipment (PPE)** – although PPE is generally the least effective strategy in mitigating hazards, it is an essential component of avoiding injury.

2 SCOPE

This program addresses electrical safety-related work practices necessary for safeguarding UAlbany employees during activities such as installation, inspection, operation, maintenance, and demolition of electrical equipment.

The work practices described in this program do not cover electrical installation requirements; they are instead intended to work in conjunction with the NFPA 70 *National Electrical Code* and NFPA 70B *Recommended Practice for Electrical Equipment Maintenance*.

3 RESPONSIBILITIES

3.1 Office of Environmental Health and Safety (EH&S)

EH&S has the following responsibilities:

1. Review and update this Electric Safety Program as necessary.
2. Provide recommendations for control methods where deemed necessary to protect employees from electrical hazards.
3. Provide general Arc Flash Electrical Safety training and maintain records of such training.

3.2 Supervisors

Supervisors have the following responsibilities:

1. Ensure that employees comply with the Electric Safety Program.
2. Ensure that electrical equipment is labeled with appropriate arc flash warning labels.
3. Ensure that employees receive job-specific training appropriate to their assigned electrical tasks, and perform a documented annual evaluation on each Qualified Person.
4. Ensure that employees are provided with and use appropriate protective equipment.

3.3 Employees

Employees have the following responsibilities:

1. Follow the work practices described in this document, including the use of appropriate protective equipment and tools.
2. Attend all training required relative to this program.
3. Immediately report any concerns related to electrical safety to supervision.

4 DEFINITIONS

4.1 Arc Flash Hazard

A dangerous condition associated with the possible release of energy caused by an electric arc. If the thermal hazard is of a severity that might expose a person to 1.2 calories per square centimeter (cal/cm^2) or more of incident (thermal) energy, the hazard is considered to be significant.

Arc flash is different from the **arc blast**, which is the supersonic shockwave produced when the uncontrolled arc vaporizes metal conductors. Although both are part of the same arc fault, from a safety standpoint they are often treated separately. For example, PPE can be used to effectively shield a worker from the thermal hazard of an arc flash, but that same PPE may likely be ineffective against the flying objects, molten metal, and violent concussion of an arc blast.

4.2 Arc Flash Suit

A complete arc-rating clothing and equipment system that covers the entire body, except for the hands and feet. An arc flash suit may include pants or overalls, a jacket or a coverall, and a hood fitted with a face shield (or balaclava and a hard hat fitted with a face shield). The hands and feet must be protected by other equipment.

4.3 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 as either the arc thermal performance value (ATPV) or the energy of breakopen threshold (E_{BT}), whichever is the lower.

Arc-rated clothing or equipment indicates that it has been tested for exposure to an electric arc. Flame-resistant clothing without an arc rating has not been tested for exposure to an electric arc.

Manufacturers determine the arc rating for protective equipment. Labels on arc-rated clothing should include the rating.

4.4 Energized

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

4.5 Incident energy

The amount of thermal energy impressed on a surface, a certain distance from the source, generated during an electrical arc event. Incident energy is typically expressed in calories per square centimeter (cal/cm²).

4.6 Qualified Person

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

A Qualified Person must have the ability to recognize all electrical hazards that might be associated with the work task being considered. An employee could be qualified to perform one work task and not qualified to perform a different task. To meet OSHA's definition of a Qualified Person, which includes the phrase "has demonstrated skills," the person has to demonstrate that he/she can perform the task safely.

5 CREATING AN ELECTRICALLY SAFE WORK CONDITION

This Electrical Safety Program is founded on the principle of avoiding energized work unless it is absolutely necessary.

Electrical equipment will be de-energized before an employee works on or near it in accordance with the UAlbany Lockout/Tagout Policy unless one of the following conditions apply:

1. De-energizing introduces additional or increased hazards. Examples include deactivation of emergency alarm systems or shutdown of hazardous location ventilation systems.
2. De-energizing is not possible due to equipment design or operational limitations. For example, tasks such as testing, troubleshooting, and voltage measuring must often be conducted while the equipment is live.
3. Live parts are operating at less than 50 volts to ground and there is no increased exposure to electrical burns or to explosion due to electrical arcs.

6 ENERGIZED ELECTRICAL WORK

If live parts are not placed in an electrically safe condition, work to be performed shall be considered energized electrical work.

6.1 Energized Electrical Work Permit

Energized electrical work will be performed by written permit only.

The intent of the permit is to ensure that all appropriate safety precautions are taken prior to starting energized electrical work. The Energized Electrical Work Permit can be found in Appendix A of this document and will be included in the work order system for applicable projects. A separate permit/standard operating procedure (Appendix B) has been incorporated into the work order system for routine single branch circuit work in areas where the power cannot be shut down.

The Energized Electrical Work Permit is originated by the individual requesting that the energized work be completed; this will normally be the supervisor of the employee performing the work. The requestor is responsible for completing Section 1 of the permit. The Qualified Persons completing the task are responsible for completing Section 2 of the permit. The supervisor must approve the permit prior to commencing work. An approval signature must be obtained in Section III of the permit.

The permit must be posted in the area where the energized work is taking place for the duration of the task. Energized electrical work permits must be kept on file by the supervisor upon completion of the task.

A permit is **NOT** required under the following conditions if the Qualified Person is provided with and uses appropriate safe work practices and PPE:

1. Testing, troubleshooting, or voltage measuring
2. Thermography, ultrasound, or visual inspections if the restricted approach boundary is not crossed (see section 6.3)
3. Access to and egress from an area with energized electrical equipment if no electrical work is performed and the restricted approach boundary is not crossed
4. General housekeeping and miscellaneous non-electrical tasks if the restricted approach boundary is not crossed

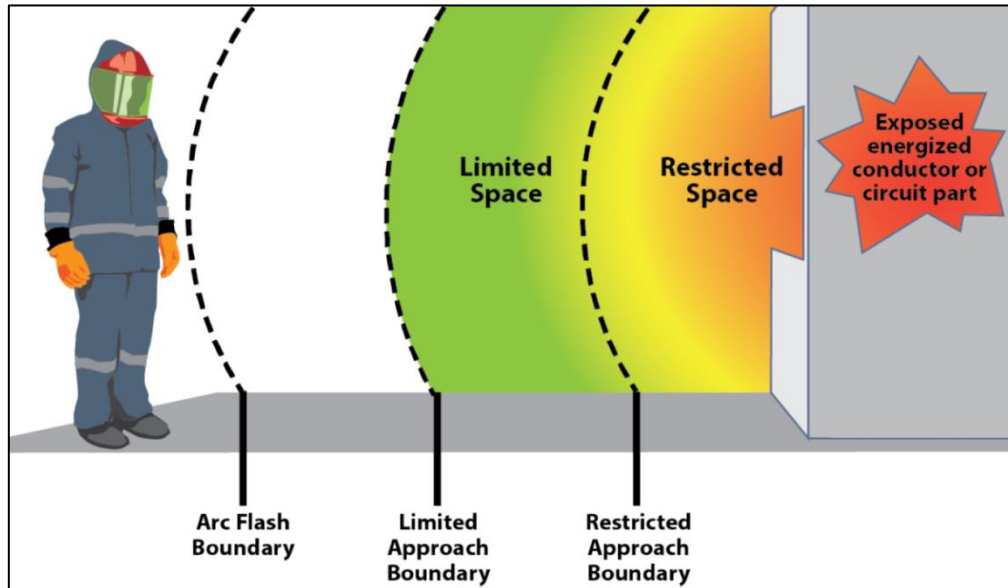
6.2 Job Briefing

A job briefing is required before the start of each job involving energized electrical work. Each Qualified Person shall be briefed on the job. At a minimum the briefing must cover the following items: associated electrical hazards, work procedures, special precautions, isolation points and procedures, emergency response, PPE requirements, and other work in the immediate area. Additional job briefings shall be held if changes that might affect the safety of employees occur during the course of the work.

6.3 Approach Boundaries to Live Parts

Observing a safe approach distance from exposed energized parts is an effective means of electrical safety. As the distance between an individual and live parts increases, the potential for electrical injury decreases.

NFPA 70E defines three approach boundaries: the **Limited Approach Boundary** and **Restricted Approach Boundary** are shock protection boundaries, while the outer **Arc Flash Boundary** is based on calculations of incident energy. The three boundaries are described in more detail below.



Safe approach boundaries are posted on the arc flash label on electrical equipment. If a piece of equipment does not have an arc flash label, refer to the label on the panel that feeds it.

6.3.1 **Arc Flash Boundary**

Distance from an exposed live part within which a person could receive a second-degree burn if an electrical arc flash were to occur. This distance is based on incident energy calculations. A second degree burn is possible by exposure of unprotected skin to an electrical arc flash above the incident energy level of 1.2 cal/cm^2 . All body parts within the arc flash boundary must be protected from the potential thermal effects of the hazard with arc flash gear.

6.3.2 **Limited Approach Boundary**

Distance from an exposed live part within which a shock hazard exists. A Qualified Person must use the appropriate PPE and be trained to perform the required work to cross the limited approach boundary and enter the limited space. An unqualified person may not cross this boundary unless they are continuously under the supervision of a qualified worker and using proper PPE.

6.3.3 **Restricted Approach Boundary**

Distance from an exposed live part within which there is an increased risk of shock (due to electrical arc-over combined with inadvertent movement) for personnel working in close proximity to the live part. This boundary may only be crossed by a Qualified Person who is safely insulated or guarded from the live parts. Requirements are the same as if working on or near energized circuits. Applicable arc flash PPE and insulated tools are required within this boundary.

6.4 Other Precautions for Personnel Activities

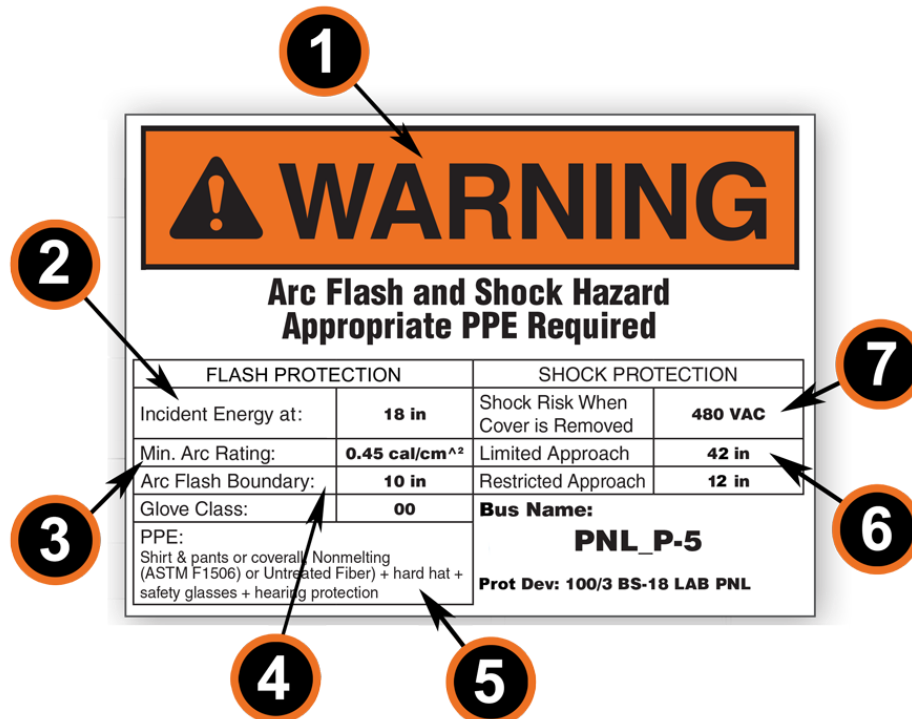
Employees must follow these additional procedures during electrical work:

1. Ensure that the rated test instrument is operating properly through verifying on a known voltage.
2. Do not reach blindly into areas that might contain exposed live parts.
3. Do not enter spaces containing live parts unless illumination is provided that allows the work to be performed safely.
4. Conductive articles of jewelry and clothing must not be worn where they present an electrical contact hazard with exposed live parts.
5. Conductive materials and tools that are in contact with any part of an employee's body shall be handled in a manner that prevents accidental contact with live parts. Such materials include, but are not limited to, ducts, pipes, scaffold parts, and structural members.
6. When an employee works in a confined space (such as a vault) that contains exposed live parts, the employee shall obtain a Confined Space Work Permit and use protective shields, barriers, or insulating materials as necessary to avoid contact with these parts. See UAlbany's Confined Space Entry Policy for more details.

7 ARC FLASH LABELS

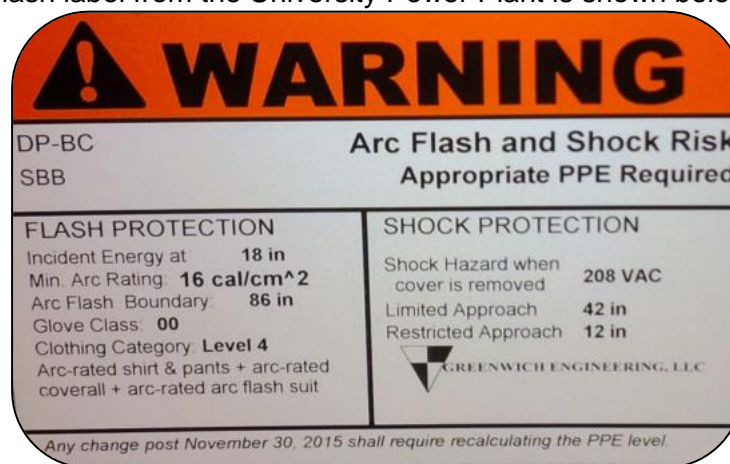
The University at Albany underwent an Arc Flash Study to measure and label the incident energy at electrical equipment likely to require examination, adjustment, servicing, or maintenance while energized. If a piece of equipment does not have an arc flash label, refer to the label on the panel that feeds it.

A typical arc flash label has the following components:



1. **Danger or Warning header**
The heading reads "Danger" when the voltage is over 600 or when the incident energy is over 40 cal/cm². If it is less than this threshold, an orange "Warning" header is used.
2. **“Incident Energy at”**
The estimated distance between the possible arc point and the head and body of the worker positioned in place to perform work.
3. **“Min. Arc Rating”**
The incident energy. A measurement in cal/cm² of thermal energy at a working distance from an arc fault. This number is used to determine the minimum arc rating of arc-rated protective clothing.
4. **Arc Flash Boundary**
This is the shortest distance at which a person working at the time of an arc-flash may receive permanent injury (the onset of a second degree burn or worse) if not properly protected by appropriately rated arc-rated clothing. This boundary is defined in more detail in section 6.3.1 of this document.
5. **Personal Protective Equipment (PPE)**
Required PPE for specific parts of the body are listed here.
Note: some labels have a clothing category ranging from 1 to 4, intended to help select the minimum arc rating of PPE; industry is moving away from these categories designations. Instead, the incident energy listing on the label (see item 3 above) will be used to determine the minimum arc rating of clothing.
6. **“Limited Approach” and “Restricted Approach” fields**
These are the Shock Hazard Approach Boundaries. These boundaries are defined in more detail in sections 6.3.2 and 6.3.3 of this document.
7. **“Shock Risk When Cover is Removed”**
The voltage of the equipment.

A sample Arc Flash label from the University Power Plant is shown below.



8 PERSONAL PROTECTIVE EQUIPMENT (PPE)

Although PPE is the least effective strategy in preventing an electrical injury, it is an essential component of avoiding injury.

8.1 General Requirements

1. Employees working in areas where electrical hazards are present shall be provided with, and shall use, PPE that is designed and constructed for the specific body part to be protected and for the work to be performed.
2. The University at Albany will provide PPE required by this program at no cost to employees. Such equipment shall include arc-rated apparel, eye protection, head protection, hand protection, face shields, and insulated footwear where necessary. The University at Albany is not responsible for providing under layers of clothing or regular work shoes.
3. All protective equipment shall be maintained in a safe, reliable condition by the employee/shop to whom it is assigned.

8.2 PPE Selection

PPE, and the arc-rating of such equipment as applicable, shall be selected based on the arc flash label of the equipment being serviced, as discussed in section 7 of this document.

Arc-rating clothing and other PPE may include the following items, depending on the estimated incident energy and requirements on the arc flash label:

- Arc-rated clothing with an arc rating equal to or greater than the estimated incident energy (discussed further in section 8.3)
- Heavy-duty leather gloves, arc-rated gloves, or rubber insulating gloves with leather protectors (discussed further in section 8.4)
- Long-sleeve shirt and pants, coveralls, or arc flash suit
- Arc-rated face shield and arc-rated balaclava or arc flash suit hood
- Arc-rated outerwear (e.g., jacket, parka, rainwear, hard hat liner)
- Hard hat
- Safety glasses or safety goggles
- Hearing protection

8.3 Arc Flash Clothing General Requirements

When arc-rated apparel is worn to protect an employee, it shall cover all ignitable clothing and allow for movement and visibility. Arc-rated apparel must cover potentially exposed areas as completely as possible. Shirt and coverall sleeves shall be fastened at the wrists, shirts shall be tucked into pants, and shirts, coveralls, and jackets shall be closed at the neck. Garments worn as outer layers over arc-rated apparel (i.e. jackets or rainwear) must also be made from arc-rated material.

Apparel made from materials that are not arc-rated must not be worn. For example, hair nets, ear warmers, or head covers could melt onto an employee's hair and head unless properly rated.

Non-melting, flammable fiber garments (i.e. cotton, wool, rayon, silk, or blends of these materials) may be used as under layers beneath arc-rated apparel. Meltable fibers such as acetate, nylon, polyester, polypropylene, and spandex shall not be permitted in fabric under layers (an incidental amount of elastic used on under layers or socks shall be permitted).

Arc-rated apparel shall be visually inspected before each use. Arc-rated apparel that is damaged or becomes contaminated with flammable or combustible liquids shall not be used. The garment manufacturer's instructions for care and maintenance of arc-rated apparel shall be followed.

8.4 Insulated Gloves

Employees must wear rubber insulating gloves with heavy duty leather protectors and rubber insulating sleeves where there is a danger of hand and arm injury from electric shock due to contact with exposed energized electrical parts.

Rubber insulating gloves shall be permitted to be used without heavy duty leather protectors only under the following conditions:

1. There shall be no activity performed that risks damaging the gloves.
2. The rubber insulating gloves shall be electrically retested by a third party before reuse.
3. The voltage rating of the rubber insulating gloves shall be reduced by 50% for class 00 and by one whole class for classes 0 through 4.

The table below summarizes the class ratings found on voltage rated gloves:

CLASS	TAG COLOR	MAXIMUM USE VOLTAGE (AC)	MAXIMUM USE VOLTAGE (DC)
00	Beige	500 V	700 V
0	Red	1,000 V	1,500 V
1	White	7,500 V	11,250 V
2	Yellow	17,000 V	25,500 V
3	Green	26,500 V	39,750 V
4	Orange	36,000 V	54,000 V

Rubber insulating gloves must be electrically tested by a third party before first issue and every six months thereafter. If the insulating equipment has been electrically tested but not issued for service, it may not be placed into service unless it has been electrically tested within the previous 12 months.

Insulating equipment must also be inspected for damage before each day's use and immediately following any incident that could have caused damage. An air test must be performed on rubber insulating gloves before each use. To complete an air test, manually fill the glove with air. Fold over the cuff to seal the air inside the glove. Detect any leaking air by either listening for escaping air or feeling the escaping air by holding the glove near the face.

Insulating equipment found to have defects that might affect its insulating properties must either be replaced or removed from service until testing indicates that it is acceptable for continued use.

Rubber insulating equipment must be stored in an area protected from light, temperature extremes, excessive humidity, ozone, and other substances and conditions that may cause damage.

8.5 Insulated Tools & Equipment

Employees shall use insulated tools or handling equipment, or both, when working inside the restricted approach boundary of exposed energized electrical conductors or circuit parts where tools or handling equipment might make unintentional contact.

The following requirements apply:

- Insulated tools shall be rated for the voltages on which they are used.
- Insulated tools shall be designed and constructed for the environmental to which they are exposed and the manner in which they are used.
- Insulated tools and equipment shall be inspected prior to each use. The inspection shall look for damage to the insulation or damage that can limit the tool from performing its intended function or could increase the potential for an incident (e.g., damaged tip on a screwdriver).
- Employees shall use portable ladders that have nonconductive side rails when used within the limited approach boundary or where the employee or ladder could contact exposed energized electrical conductors or circuit parts.

9 TRAINING

A Qualified Person shall be trained and knowledgeable in all of the following topics:

1. Construction and operation of equipment on which work is assigned.
2. Skills and techniques necessary to distinguish exposed energized parts from other parts of electrical equipment.
3. Skills necessary to determine the nominal voltage of exposed live parts.
4. The approach distances specified in this document and the corresponding voltages to which the qualified employee will be exposed.
5. The process necessary to determine the degree and extent of electrical hazards along with the PPE and job planning necessary to perform the task safely.
6. A person can be considered qualified with respect to certain equipment and methods but unqualified for others.

EH&S will provide arc flash electrical safety (NFPA 70E) training for Qualified Persons. Re-training pertaining to NFPA 70E shall occur every 3 years, as well as when any of the following conditions exist:

- The supervision or annual evaluations indicate that the employee is not complying with safety-related work practices.
- New technology, new types of equipment, or changes in procedures necessitate the use of safety-related work practices that are different from those that the employee would normally use.
- The employee needs to review safety-related work practices not normally used by the employee during regular job duties.

Supervisors will ensure employees receive specific training appropriate to their assigned electrical tasks. Supervisors will perform a documented annual evaluation on each Qualified Person's skills and knowledge related to the construction and safe operation of electrical equipment relevant to that competent person's job duties. This evaluation is built into the AiM system.

If medical services are not reasonably accessible or available within 4 minutes of the workplace, employees who perform electrical work on electrical equipment 50 volts or higher must be trained in first aid, cardiopulmonary resuscitation (CPR), and automatic external defibrillator (AED). First Aid/CPR/AED training course must be conducted by either the American Red Cross (ARC) or American Heart Association (AHA) certified trainer.

APPENDIX A

ENERGIZED ELECTRICAL WORK PERMIT



Energized Electrical Work Permit

Section 1: To be completed by the requestor or supervisor of the job

Date:	Issue Date/Time:	Expiration Date/Time:
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Personnel performing the work:	Job location:
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Description of work to be done:

Justification of why the circuit cannot be de-energized:

Section 2: To be completed by the Qualified Person(s) completing the work

Shock Risk Assessment (see equipment label)	Voltage personnel exposed to (<i>volts</i>)	
	Limited approach boundary (<i>inches</i>)	
	Restricted approach boundary (<i>inches</i>)	
Arc Flash Risk Assessment (see equipment label)	Arc flash boundary (<i>inches</i>)	
	Incident energy (<i>cal/in²</i>)	

Safe work practice to be used:

Required PPE:

Hearing protection
 Arc-rated clothing
 Safety glasses
 Hard hat
 Voltage-rated gloves
 Arc-rated face shield
 Other _____

How are unqualified persons restricted from the area?

Have people that may be in/near the area and may be impacted been informed?

YES NO (do not proceed)

Do you agree the above work can be done safely?

YES NO (return to requestor)

Signature(s):

Qualified Person: _____ Date: _____

Qualified Person: _____ Date: _____

Qualified Person: _____ Date: _____

Section 3: To be completed by supervisor(s)

A supervisor must approve all energized work before the work begins.

PRINT NAME	SIGNATURE	JOB TITLE	DATE

APPENDIX B

STANDARD OPERATING PROCEDURE (SOP) FOR ROUTINE BRANCH WIRING

Whenever possible, always power down an electrical panel prior to removing the cover. If you must work on a live panel in areas where the power cannot be shut down, follow these steps.

Adding a circuit to a live panel

1. Work from load source back to panel, leaving open panel work the final step to energizing the new circuit.
2. After cabling from load source to panel, refer to the arc flash label on the panel and put on the proper PPE defined on the label.
3. Remove panel cover.
4. Cover live components of panel with insulating blanket to limit exposure.
5. Knock out KO and install connector.
6. Carefully bring cable through connector and secure.
7. First land mechanical ground under the ground bar.
8. Next land neutral cable under neutral bar.
9. If installing a bolt on breaker, first install breaker and use an insulated screwdriver to secure in place.
10. Make sure breaker is off and affix line cable into breaker and tighten.
11. If installing a snap on breaker, first affix wire to breaker and then snap breaker in place.
12. Re-cover panel and energize breaker.

Working with Conduit in a live panel

1. Refer to the arc flash label on the panel and put on the proper PPE defined on the label.
2. Remove panel cover.
3. Cover live components of panel using insulated blanket.
4. Knock out KO and install connector.
5. Recover panel and begin conduit run.
6. Once conduit run to load is complete, you are ready to pull cabling.
7. Again, suit up into proper PPE.
8. Remove cover.
9. Cover live components using insulated blanket.
10. Only use nonconductive snake for wire pull.
11. Carefully run snake from load (or first pull box) to panel. Have a second Electrician at panel to catch snake prior to it entering the box.
12. Fasten load wires to snake making sure to stay safely clear of live source.
13. First Electrician pull snake as second Electrician stationed at panel box feeds cabling.
14. First complete load side wiring.
15. Once load side wiring is complete, first land mechanical ground under the ground bar.
16. Next land neutral cable under neutral bar.
17. If installing a bolt on breaker, first install breaker and use an insulated screwdriver to secure in place.
18. Make sure breaker is off and affix line cable into breaker and tighten.
19. If installing a snap on breaker, first affix wire to breaker and then snap breaker in place.
20. Re-cover panel and activate breaker.