Electrical Safety Program

2023

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1.0 INTRODUCTION

1.1 Purpose

This program establishes minimum standards to prevent hazardous electrical exposures to workers and ensure compliance with regulatory requirements applicable to electrical systems. Working on equipment in a de-energized state is required unless de-energizing introduces an increased hazard or is infeasible. This program is designed to help ensure that energized electrical work at Florida State University is performed safely by qualified electrical workers, who are trained and provided with the appropriate safe work procedures, protective equipment, and other controls. The program is intended to protect employees against electrical shock, burns and other potential electrical safety hazards as well as comply with regulatory requirements.

Electrical energy is one of the most potentially devastating hazards the worker will face in their respective tasks. If this hazard is not avoided or the associated risk limited with work practices or PPE, it can result in death or serious harm. Workers must be trained to understand and avoid the hazards of electrical energy as far as their respective job will put them into direct or indirect contact with this hazard.

The purpose of this electrical safety procedures document is the following:

- To establish the association of the hazard and the impact of the hazard on the human body.
- To direct activity appropriate for the electrical hazards based on voltage levels, energy levels, and circuit conditions.
- To establish workplace requirements for safe work practices for all employees who must perform work or be exposed on or around electrical conductors or circuit parts.
- To ensure safety of employees working with or around electrical hazards.
- To determine safe work practices through defined procedures with defined responsibilities.
- To identify the means by which these hazards will be labeled or otherwise identified throughout the facility.
- To provide possible mitigation strategies to lessen the electrical hazards.
- To comply with OSHA, NFPA 70E and other applicable governing bodies, codes, standards, and laws.

2.0 Electrical Safety Program Principles

The following principles will determine the procedures and policies for the Electrical Safety Program:

- De-energize when possible. The primary goal is zero voltage!
- All conductors are to be considered energized until proven to be de-energized.

- Plan every job. The approach and step-by-step procedures to complete work must be discussed by supervisors and workers before beginning the job.
- Document procedures (including but not limited to work procedures, LOTO, Electrical Safety Program, etc.) and continuous improvement of these procedures.
- Identify the hazards through engineering analysis and risk assessments.
- Periodically inspect/evaluate electrical equipment.
- Maintain electrical equipment's installation and integrity.
- Use the right tools for the job.
- Assess qualified electrical worker's abilities with defined metrics.
- Mitigate hazards when possible with engineering or administrative controls
- Anticipate problems. If it can go wrong, it might go wrong.
- Provide training to all workers effected, qualified and unqualified.
- Personal Protective Equipment is used as a last resort.

3.0 Electrical Safety Program Responsibilities

3.1 Department Head/Designee

The Department Head/Designee is responsible for the following:

- Ensure that managers are following procedural requirements as defined in this document.
- Ensure that pressure is not applied to management and workers that could force unsafe activities.
- Ensure that EHS completes annual audits.
- Provide support and funding for PPE.

3.2 Maintenance & Electrical Supervisors

Supervisors overseeing crews of electrical/controls workers are responsible for the following:

- Promote electrical safety to all employees.
- Conduct annual field audits to assure compliance with the program, LOTO and work procedures.
- Ensure employees receive training appropriate to the tasks to which they are assigned.
- Ensure employees are provided with and use PPE and tools.
- Require maintenance staff to follow safe work practices and holds staff accountable to safe work practices.
- Procure, maintain, inspect and issue required PPE, tools, equipment, meters, and ladders as required to perform electrical work safely.
- Ensure that all electrical workers have access to written electrical safety programs.
- Develop work procedures to promote consistency in electrical work tasks.

3.3 Qualified Electrical Workers

Workers directly exposed to electrical hazards (qualified) are responsible for the following:

- Follow the policies and procedures of the electrical safety program.
- Use, store, and maintain provided PPE, tools, and test instruments appropriately per applicable industry codes and standards and per manufacturer's recommendations.
- Attend all training required for the Electrical Safety Program.
- Report electrical safety hazards to a supervisor and/or EHS.
- Be responsible for understanding material presented in training and in the written electrical safety program, and ask questions concerning material that is not understood.

3.4 Environment Health & Safety Department

Environment Health & Safety is responsible for the following:

- Annually audit that each department within the campus to ensure that they are meeting the requirements of the written electrical safety program.
- Review the Electrical Safety Program and revise, as necessary.
- Maintain Electrical Safety Training records.
- Ensure that training requirements identified in this program are met.

3.5 Electrical Safety Committee

The Electrical Safety Committee is responsible for the following:

- Review and update the program as needed.
- Provide overall technical oversight and guidance.

3.6 Unqualified Electrical Workers

Maintenance workers who are restricted from doing electrical work as their respective tasks do not require such work are responsible for the following:

- Attend electrical safety training for unqualified workers.
- Report any concerns to appropriate management.
- Do not engage in work that is not approved for unqualified workers.

4.0 The Electrical Hazards

In order to avoid and/or mitigate a hazard, a worker must first understand the nature and extent of the hazard. Electrical energy presents hazards that, if not avoided, could or will result in death and/or serious injury.

Historically, we have seen in general industry that for every 300 non-electrical recordable injuries, one is a fatality. For electrical recordable injuries, for every 10 incidents, one is a fatality. This correlation directly shows that there are few 'second chances' granted by accidents involving electrical injury.

The electrical hazard can be divided into three distinct hazards: electric shock, arc flash, and arc blast.

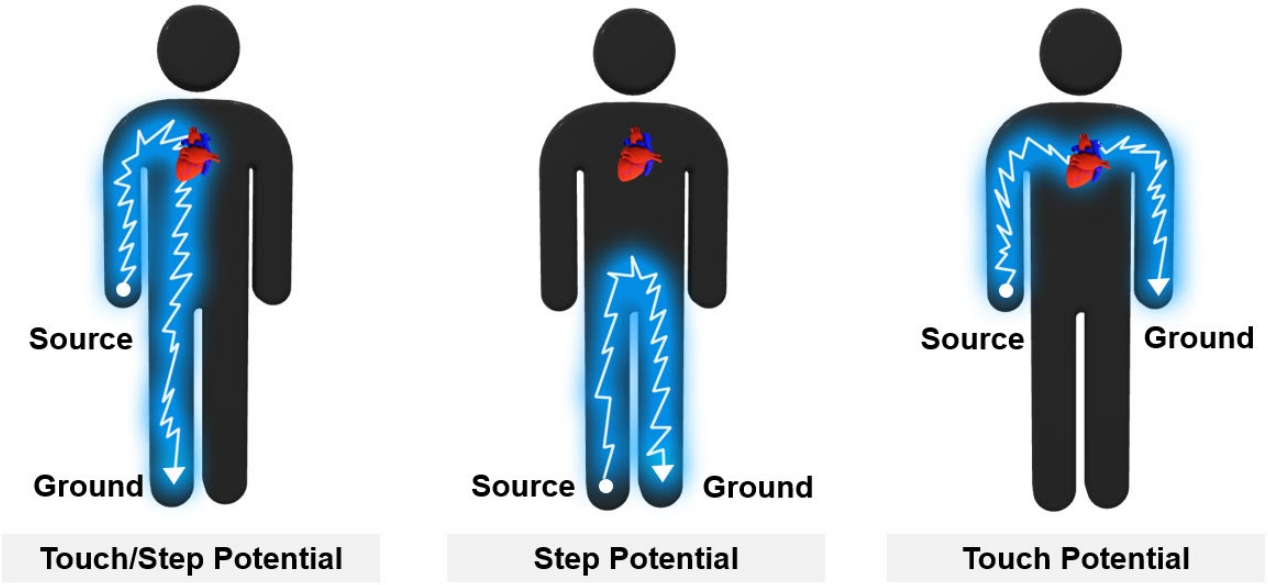
4.1 Electric Shock Hazard

The electric shock hazard is the more apparent hazard of electricity. Since the inception of electricity as a viable means of conveying power on a large scale, workers have been aware of the risk of electric shock. This is the passage of current through the human body. When enough current passes through the body, an electrocution may happen which is a fatality. **The concern of fatalities due to electrocution may occur on voltages from 50 volts and above per the NFPA 70E, NEC, and OSHA.**

The human body offers about 1000 ohms of resistance to the flow of electric current. The least damaging amount of electric current through the human body is in the 4-6 milliamp region (0.004 – 0.006 Amps). If a worker were to come into contact with a 480 Volt electrical conductor or circuit part, they could potentially conduct 480 milliamps of current according to Ohm's Law. This is enough current to cause respiratory paralysis (30-75 milliamps), cause ventricular fibrillations (100-200 milliamps), and clamp the heart to stop beating (200-500 milliamps).

Condition	Resistance (ohms)	
	Dry	Wet
Finger Touch	40,000 - 1,000,000	4,000 - 15,000
Hand Holding Wire	15,000 - 50,000	3,000 - 6,000
Finger-Thumb Grasp	10,000 - 30,000	2,000 - 5,000
Palm Touch	3,000 - 8,000	1,000 - 2,000
Human Body	200 - 1,000	

Current Through Body	Effect on Body
0.5 - 3 mA	Tingling Sensations
3 - 10 mA	Muscle Contractions and Pains
10 - 40 mA	"Let-go" Threshold
30 - 75 mA	Respiratory Paralysis
100 - 200 mA	Ventricular Fibrillations
200 - 500 mA	Heart Clamps Tight
1500 mA +	Tissue & Organs start to burn



This diagram shows the possible flow of current through the body. Obviously, any time current is flowing through the heart, the worker's life is at serious risk.

Protection from the electric shock hazard is achieved first by hazard avoidance, second by engineering mitigation and change of work practices, and lastly by dielectric mediums such as insulated gloves, insulated tools, rubber shoe soles, and other dielectric materials.

4.2 Arc Flash Hazard

When the insulating medium no longer offers sufficient resistance to the flow of electric current, an arc can occur. If enough electrical energy is present, this arc will ionize the air surrounding it causing a traumatic and explosive event called an arc flash.

This event can result in temperatures in excess of 35,000 degrees Fahrenheit, which may cause life changing human injury up to and including death and catastrophic equipment damage.

The main risk associated with arc flash is ignition of polyester or cotton clothing. When this ignition occurs, the worker may receive significant burn injuries resulting in death or months in burn units. Workers may also have vision loss or damage due to the immense light emitted in the visible, UV, and infrared spectrums.

These events may be the result of human error (i.e., dropping metal tools into the circuit or panel enclosures), equipment failure (i.e., rusted blades of a disconnect), and an innumerable assortment of other factors.

4.3 Arc Blast Hazard

Though an arc flash and an arc blast may be part of the same short circuit event, it is important to distinguish between the two hazards as the arc flash is a thermal heat event while the arc blast is a violent physical force causing solid and molten shrapnel to fly out from the source.

The arc blast is a traumatic event caused by pressure and sound waves resulting from the arcing event. These pressure waves may throw a human body, rupture eardrums, and present other potentially traumatic injury to the human body.

5.0 Training Requirements

Workers who are exposed or may be exposed to energized electrical conductors or circuit parts 50 Volts to ground or greater, shall be trained to understand the specific hazards associated with electrical energy. They shall also be trained in electrical safe work practices and procedures as defined in the Qualified Electrical Worker and Unqualified Worker sections below. Both Qualified Electrical Workers and Unqualified Workers are required to be trained. They shall be trained to identify and understand the relationship between electrical hazards and possible injury. Each worker must understand which specific activities he or she is qualified and authorized to do. The training shall establish employee proficiency in the work practices required by OSHA and NFPA's 70E for electrical work.

Workers shall be trained to understand the hazards that pertain to their respective job & title responsibilities. A worker tasked with general electrical maintenance shall have a thorough understanding of electrical safety and the principles of all written documents related to the electrical safety program that impact their assigned work tasks whether routine, repetitive, or occasional. Workers tasked with simple or singular electrical tasks only, may not need to understand and utilize all aspects of the Electrical Safety program, only those that pertain to their specific jobs.

5.1 Qualified Electrical Worker

Employees shall receive training in avoiding the electrical hazards associated with working on or near exposed energized parts prior to performing energized electrical work. Such training will be provided initially with refresher training every three years or when workplace conditions change. The following items are to be included in the training for a Qualified Electrical Workers:

- Demonstrate an acceptable working knowledge of the National Electrical Code for each level of electrical responsibilities.
- Establish an Electrically Safe Work Condition (ESWC).
- Elements of the written Electrical Safety Program based on OSHA and NFPA 70E regulations.
- Skills and techniques necessary to distinguish exposed live parts from other parts of electric equipment.
- Perform on-the-job training with a qualified electrical worker.
- Skills and techniques necessary to determine the nominal voltage of exposed live parts.

- Procedures for working in and around limited, restricted, and arc flash boundaries as defined in the written Electrical Safety Program.
- Information and application of arc flash and electric shock hazard labels.
- Selection and use of personal protective equipment, tools, insulating and shielding materials and equipment for working on or near energized parts.
- Selection of an appropriate test instrument to verify the absence of voltage, including interpreting indications provided by the device and a demonstrated understanding of all limitations of each specific voltage detector that might be used.
- Shall demonstrate knowledge in methods of release of employees from contact with exposed energized electrical conductors or circuit parts. These workers shall also be trained in recognizing signs and symptoms of electric shock, and electric burns.
- Demonstrate knowledge of acceptable work activities as required by law and all applicable University policies and procedures.

They shall have the following training:

- Basic Cardiopulmonary Resuscitation (CPR) and Automatic External Defibrillator (AED) and first aid every 2 years.
- Methods of release of workers (who are 'hung up' on energized electrical conductors or circuit parts.) annually.

5.2 Varying Levels of Qualified Electrical Workers

Qualifying electrical workers shall be performed by an authorized supervisor. A qualified electrical worker shall only be trained by a qualified person. Many workers tasked with electrical specific tasks will have varying levels of assignments with varying levels of hazards.

Management shall use the following designations for varying levels of qualified electrical workers. The tasks performed in each level can vary from facility to facility.

5.2.1 Mechanical/Controls/HVAC Technicians – Level 1

This is an electrical worker who is tasked with maintaining controls systems that will not exceed 480 volts and/or servicing HVAC units with a single electrical disconnecting means. The systems these workers may be servicing may include alarms, electrical metering, emergency lighting, HVAC, and rooftop/exhaust units.

These workers will be performing tasks such as the following:

- Basic testing & troubleshooting.
- Using a rated voltage meter for testing electrical components on their respective lines.
- Accessing electrical equipment in the same enclosures as voltages exceeding 480 volts, but not working on electrical components with a nominal voltage exceeding 480 volts.
- Performing basic testing/troubleshooting on HVAC, rooftop/exhaust units, for equipment with a single electrical disconnecting means.

5.2.1 Electricians/Skilled Trades Technicians – Level 2

This is a highly skilled electrical worker with extensive experience and knowledge of electrical power distribution systems. This worker should consistently demonstrate knowledge of safety protocols as well as the NEC and NFPA 70E.
These workers will be performing tasks such as the following:

- Electrical testing & troubleshooting.
- Using a rated voltage meter for testing electrical components.
- Accessing electrical motor control Centers, panelboards, and controls.
- Replacing fuses, circuit breakers, contactors, VFDs and other electrical components within their abilities.
- Determine if qualified to perform electrical work.
- Installing new wiring for new or repurposed equipment.
- Installing and bending conduit for new or repurposed installations.
- Accessing or servicing switchgear or switchgear.
- Accessing equipment with fuses or circuit breakers.
- Accessing and working electrical enclosures with a nominal voltage exceeding 1000 Volts.
- Making electrical terminations on electrical wire with a nominal voltage exceeding 1000 Volts.
- Using non-contact voltage testers to verify absence of voltage on electrical equipment with a nominal voltage exceeding 1000 Volts.

5.3 Unqualified Worker

Employees shall receive training in any electrical safety related work practices that are necessary for their safety in the performance of their job duties. The training must focus on hazard recognition and avoidance. Such training will be provided when the employee is initially assigned to the job and refresher training will be provided every three years or when conditions change. The following items are to be included in the training of Unqualified Workers:

- Electrical hazards including fire, electric shock, arc flash, arc blast and other injuries that are common with electrical work.
- How to recognize and avoid these hazards, including how to recognize a limited approach boundary and warning signs or labels.
- Activities that are prohibited for Unqualified Workers.
- Clarification of which tasks they are qualified for and which tasks they are not qualified for as some workers may be qualified for some tasks, but not other tasks.

5.4 Retraining

This training should occur in a classroom, on-the-job, or a combination of the two. Workers shall receive additional training (or retraining) under any of the following conditions:

- If annual performance audit or an inspection indicates that the employee is not complying with safety-related work practices.
- If 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 worker would normally use.
- If the worker must employ safety-related work practices that are not normally used during his or her regular job duties.
- Full retraining shall be performed at intervals not to exceed 3 years.

5.5 Annual Field Audits

The Department Head/Designee must determine through annual supervision that the guidelines outlined in this electrical safety program are being followed by conducting annual field audits on all electrical workers.

5.6 Documentation of Training and Experience

Directors and Managers shall maintain documentation of field audits for Qualified and Unqualified Workers and submit these records to Environmental Health and Safety. Documentation shall be stored by EHS and shall be maintained for the duration of the workers employment. Documentation is necessary to demonstrate that individuals have met the training and experience requirements for the types of work being performed. Documentation shall contain the content of the training, each employee's name, and dates of training at a minimum. Supervisors will maintain on the job retraining documentation.

Certificates of completion shall be issued and stored as workers complete training.

6.0 Annual Field Audit Requirements

Annual field audits shall be performed by a qualified supervisor on an annual basis for all qualified electrical workers. Qualified electrical workers must pass all sections of their annual field audit respective to their qualified 'level' as outlined below.

If a worker fails any portion of the annual field audit, the worker must be retrained in areas of deficiencies in knowledge. On the field audit form, areas have been designated that always require retraining and re-auditing. These areas are indicated by a blacked-out section under the 'Field Corrected' column. If a worker fails one of the 'blacked out' sections on the field audit, they must be retrained and re-audited. All other areas may be 'field corrected' by the supervisor. If workers demonstrate less than the required knowledge requirement, retraining and re-auditing must be completed.

If a worker fails the audit and must be retrained, the annual field audit retraining form must be completed, and a follow up field audit must be scheduled by the supervisor where the worker must demonstrate he has learned the required electrical safe work practices. This field audit is to be within one week of the failed audit. Additional failed field audits should be referred to EHS.

Workers performing electrical tasks will be classified according to the training they have received, knowledge and by performance on an annual field audit. All qualified electrical workers will fall into one of the following categories:

Level	Roles/Responsibilities
1	Mechanical/Controls/HVAC Technicians
2	Electricians/Skilled Trades Technicians

7.0 Approach Boundaries

An arc flash incident may send an explosive burst outward burning employees in the vicinity. Therefore, precautions shall be taken to limit the entrance into these boundaries.

Because the presence of electricity presents the arc flash and electric shock hazard, boundaries are defined for each hazard in a unique way.

7.1 Electric Shock Hazard Boundaries

Electric current may pass through the body when a worker contacts an energized electrical conductor or circuit part However, within a certain distance it can be reasonably assumed that the worker may accidentally come into contact with the electrical conductor or circuit part. Therefore, there are two distinct boundaries defined in NFPA 70E:

1. Limited Approach Boundary
2. Restricted Approach Boundary

7.1.1 Determining Electric Shock Protection Boundaries

These boundaries are determined by tables in the NFPA 70E standard.

Shock Boundaries

Nominal System Voltage	Limited Approach Boundary	Restricted Approach Boundary
50-150 Volts	42 inches	Avoid Contact
151-750 Volts	42 inches	12 inches
751 V-15 kV	60 inches	26 inches

7.1.2 Procedures for Electric Shock Protection Boundaries

The following procedures shall be adhered to when approaching these electric shock protection boundaries.

- Unqualified workers shall be outside the Limited Approach Boundary at all times unless they are accompanied by a qualified electrical worker (i.e., for purposes of examination by a supervisor).

- Unqualified workers shall never be allowed inside the Restricted approach boundary even with the proper PPE.
- Insulated tools shall be used at all times within the Restricted Approach Boundary.
- Insulated gloves shall be worn at all times within the Restricted Approach Boundary.

7.2 Arc Flash Boundary

A worker shall not be within the Arc Flash Boundary without the appropriate level of Arc Rated (AR) PPE. This level of PPE shall be determined by the AF PPE Level assigned to the equipment as indicated on the arc flash warning label or by the AF PPE Category Method. The label shall always take precedence in determining the arc flash boundary.

For each electrical installation, one AF PPE Level or AF PPE Category will be assigned (determined by whether the incident energy analysis has been performed yet), and one level of PPE will be donned appropriately whenever the arc flash boundary is crossed for each installation. A worker may not wear less PPE when within the arc flash boundary. The arc flash boundary for systems 50 volts or greater shall be the distance at which the incident energy equals 5 J/cm² (1.2 cal/cm²).

Identify the arc flash boundary from the AF label on the electrical equipment. If no label is present, the boundary shall be set per NFPA 70E Category method identified in the next section.

PPE Selection shall be in accordance with the PPE section of this document.

7.3 Barricades, Attendants, or Other Means of Preventing Access within Boundaries

The Arc Flash Boundary may be further from the electrical installation than the Limited Approach Boundary, or the Arc Flash Boundary may be closer to the electrical installation than the Limited Approach Boundary.

The boundary that is furthest from the electrical installation is the boundary where limiting means shall be applied to prevent access.

An unqualified worker may not understand the boundary system; therefore, use additional means to impede the unqualified worker from entering either the Limited Approach Boundary or the Arc Flash Boundary. The primary means of preventing access shall be a barricade system. Barricades should be

used in conjunction with safety signs to prevent or limit employee access. These barricades shall also be non-conductive in nature so that it cannot cause further risk as an electrical hazard. If the barricade system is not adequate as determined by management or a qualified electrical worker performing electrical work, then prevent access by using an attendant

When the incident energy method has not been performed on the electrical enclosure, the following method shall be used for selecting barrier distances.

AF PPE Category Method (Unlabeled) Boundaries

AF PPE Category	Arc Flash Boundary
2	5 feet
4	20 feet

8.0 Electrical PPE

Personal Protective Equipment (PPE) is not a substitute for engineering controls or work practices and is required whenever an electrical hazard exists. For many tasks, work must be performed in an energized state; therefore, PPE shall be used.

There are two basic types of electrical PPE:

1. Dielectric PPE employing an insulating material to protect the worker from the electric shock hazard.
2. Arc Rated or Arc Flash PPE to protect the worker from the arc flash hazard (thermal heat).

Often both types of electrical PPE must be used together.

8.1 Electric Shock Hazard PPE

The following PPE will be followed to limit exposure to the electric shock hazard.

- Shoes with leather uppers and rubber soles shall be used by all workers within the Limited Approach Boundary.
- Qualified electrical workers may identify the need for other types of insulated materials or equipment that may be necessary when performing various electrical tasks. Alternate insulating materials and equipment shall not be used without consent of management.

If there is a danger of hand and arm injury from electric shock employee should wear rubber insulating sleeves along with the rubber insulated gloves and leather protectors. Rubber insulated gloves shall be rated for the voltage for which the gloves will be exposed.

8.2 Arc Flash PPE (Criteria for Selection)

Arc flash PPE shall be selected either by an applied method based on the Tables in NFPA 70E or based on a label generated using the incident energy method. Refer to "17.0 Arc Flash Risk Assessment" for clarification.

The following PPE is required to limit exposure to the arc flash hazard:

- Arc Rated Clothing with a minimum cal/cm^2 rating greater than the cal/cm^2 rating as determined by the arc flash risk assessment shall be worn at all times by a worker who is within the Arc Flash Protection Boundary on all electrical installations with a rating of AF PPE Level 1, 2, 3, or 4.
- Workers within the Arc Flash Boundary of PPE Level - electrical installations shall wear cotton or other natural fibers. Please note that the only instances when PPE Level - may be worn is when an incident energy analysis has determined that the cal/cm^2 rating is less than 1.2 cal/cm^2.
- Untreated polyester or other untreated synthetic fibers shall not be worn within the Arc Flash Boundary as they will melt during an arc flash event and embed in the skin of the worker. This includes undergarments.
- Arc rated hardhat with face shield and balaclava shall be worn when within the Arc Flash Boundary on all electrical installations AF PPE Level 1 & 2.
- Arc Rated pants and shirts, or coveralls shall be worn when within the Arc Flash Boundary on all electrical installations AF PPE Level 1 & 2.
- Arc Rated beekeeper Style Hoods with bibs or suit shall be worn when within the Arc Flash Boundary on all electrical installations AF PPE Level 3 & 4.
- Leather protector gloves shall be worn within the Arc Flash Boundary at all times.
- Arc Rated apparel shall cover all ignitable clothing and allow for movement and visibility.
- AR apparel must cover potentially exposed areas as completely as possible.
- Fibers that can melt, such as acetate, nylon, polyester, polypropylene, and spandex shall not be permitted in fabric under-layers next to skin. (An incidental amount of elastic used on non-melting fabric underwear or socks shall be permitted).
- All AR fabrics must be rated according to ASTM F-1506.
- AR garments shall be the outermost layer in order to be rated to the hazard, which the worker will be exposed.
- All PPE such as high visibility vests, fall-protection equipment, etc. worn while performing electrical work shall be arc rated.

Arc Rated PPE shall adhere to the following table for minimum Arc Ratings when the incident energy analysis has been performed:

Site Specific AF PPE Level Table

AF PPE Level	Arc Rating or ATPV
-	Natural Fibers
1	Minimum 4 cal/ cm^2
2	Minimum 8 cal/ cm^2
3	Minimum 25 cal/ cm^2
4	Minimum 40 cal/ cm^2
Dangerous	NO SAFE PPE EXISTS

8.3 Hearing Protection

Hearing protection shall be worn to protect from the possibility of sound waves that may rupture eardrums when working within the arc flash boundary. To provide the most hearing protection from arc blast, employees shall wear canal insert earplugs. These shall be worn on all energized electrical work and 'change of state' electrical work. Employees shall wear hearing protection whenever working within the arc flash boundary. Hearing protection may also be required for other environmental noise conditions. Refer to the Florida State University Hearing Conservation Program for more information.

8.4 Vision Protection

Vision Protection (part of arc rated face shield) to filter out hazardous light emissions from an arc flash in the UV, infrared, and visible spectrum is required for all work classified as either AF PPE Category 1 and up as well as AF PPE Level 1 and up. The face shields shall be Arc-Rated to the ASTM F2187 Standard.

Safety glasses rated to the ANSI Z87.1 standard shall be worn underneath face shields for additional protection.

8.5 Clothing Not Permitted

The following clothing will not be permitted for work on or near energized electrical conductors or circuit parts:

- Untreated Polyester clothing shall never be worn for electrical work.
- Untreated or non-AR clothing such as coats or jackets shall not be worn over the top of AR clothing during electrical work.
- Non-AR High Visibility vests worn over AR clothing shall be removed before performing electrical work.
- Undergarments containing spandex or other melting materials shall not be worn while performing electrical work.
- Synthetic material wicking undergarments shall not be worn.

8.6 Clothing Care and Inspection

The following are requirements for care and inspection of arc rated clothing:

- AR apparel shall be visually inspected before each use. Torn or damaged garments shall not be used.
- AR apparel shall be repaired with materials that maintain the garments rating and shall be done per garment manufacturer's requirements.
- AR apparel that is contaminated shall not be used. Protective items that become contaminated with grease, oil, flammable liquids, or combustible liquids shall not be used.
- Garments shall be laundered per garment manufacturer's requirements. Use only approved detergents.
- Fabric softeners or dryer sheets shall not be used.
- The garment manufacturer's instructions for care and maintenance of AR apparel shall be followed.

8.7 Insulated Glove Requirements

The following requirements shall be required for care and inspection of insulated gloves:

- Insulated gloves shall be field tested prior to each use. This involves inflating the glove and ensuring that there are no gaps in the insulation.
- Insulated gloves shall be replaced and/or lab tested by management at intervals not to exceed 6 months.
- Insulated gloves are to be removed from service if there is any defects, gaps, or malformations.

The following table shall be used for selecting insulated gloves as determined by the nominal voltage:

Class	Voltage
00	0-500
2	501-17,000
4	17,001-36,000

9.0 Electrical Test Instruments

Instruments used for measuring, testing, tuning, verifying, or calibrating electrical conditions shall be maintained properly and rated to work on the circuit to which they are applied. The improper use of electrical test instruments may lead to serious injury and/or death.

Only qualified electrical workers shall perform tasks such as testing and troubleshooting using electrical test instruments within the limited approach boundary.

The following is required when selecting test equipment:

- All Electrical test instruments such as voltmeters must meet Underwriters Laboratories (UL), the Institute of Electrical and Electronics Engineering (IEEE), and ANSI/ISA S82.02 (Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use) consensus standard requirements should be purchased or used.
- Voltmeter shall be a minimum of a Category III for the voltage on which they will be used. This Cat III rating shall be confirmed as displayed on the outer case of the instrument.
- Test equipment shall be rated at the voltage on which they are used for testing.
- All test instruments shall be tested prior to use.
- All test instruments shall be visually inspected before use for any defect and removed from service if found defective.
- Test leads shall be examined before each use of the test equipment and removed from service if any gaps are found in the insulation.
- Test instruments for electrical equipment or circuits with a nominal voltage that exceeds 1000 Volts require non-contact voltage testers that are mounted to hot sticks. Contact meters shall not be used for voltages exceeding 1000 Volts.
- Workers must verify the absence of voltage with a contact voltmeter before establishing an Electrically Safe Work Condition (ESWC). (Except when voltage exceeds 1000 Volts, then a non-contact meter may be used.)
- Contact between the voltmeter leads and an energized conductor must not exceed the duty cycle specified on the meter's manufacturer label.
- Prior to using a voltmeter, a Qualified Electrical Worker shall receive comprehensive voltage testing training on the specific meter that the worker will be using. This training shall be documented. This training can generally be provided by the manufacturer of the voltage meter.
- Proximity detectors DO NOT comply with the performance requirements of NFPA 70E and shall not be used in place of voltmeters and therefore should not be used by qualified electrical workers for verifying absence of voltage. (This excludes voltages exceeding 1000 Volts)
- As the fusing is a crucial element on the rating of the voltmeter, all fuse replacements (when necessary) shall be replaced with the manufacturers recommended fuse.

10.0 Insulated Tools and Equipment

Insulated tools and equipment shall be used within the Restricted Approach Boundary. The following factors shall be considered for working with insulated tools and equipment:

Use of insulated tools and equipment shall only be used if an electrically safe work condition cannot be established. A live electrical work permit shall be completed before this type of work is attempted.

- Insulated tools shall be rated for the voltages on which they are used.

- Insulated tools shall be designed and constructed for the environment to which they are exposed and the manner in which they are used.
- Portable ladders used for electrical work shall have nonconductive side rails
- All insulated tools and equipment shall be rated according to ASTM F-1505.
- Electrical protective equipment shall be maintained in a safe, reliable condition.
- Insulating equipment shall be inspected before each day's use and immediately following any incident that may raise suspicion of having caused damage.

11.0 Classifications of Electrical Work

When working within the Limited Approach Boundary or arc flash boundary of electrical conductors or circuit parts, work shall be classified as either energized, de-energized, testing & troubleshooting, or change of state.

11.1 De-Energized Work

De-energized work is work performed on a circuit that has been put into an Electrically Safe Work Condition (ESWC).

All electrical conductors or circuit parts shall be considered energized until verified to be de-energized through the process of achieving an ESWC (Electrically Safe Work Condition), which is outlined in the following section.

11.1.1 Electrically Safe Work Condition (ESWC)

Work shall be classified as de-energized if the following steps are taken to establish an ESWC (Electrically Safe Work Condition):

(1) All potential sources of energy are determined from applicable one-line diagrams, panel schedules, and other equipment labeling schemes.
(2) Load current must be interrupted. Motors that are running downstream of the disconnect must be shut down.
(3) Disconnects or other switching means shall be opened.
(4) Where possible, all disconnecting means shall be verified to be opened by a visual inspection or draw out type breakers shall be removed to the fully disconnected position. Each type of manual disconnecting means shall have a predetermined method of visual verification where possible.
(5) Lockout/Tagout devices shall be installed in accordance with a documented and established policy.
(6) Before enclosure containing electrical conductors or circuit parts is removed or opened to expose energized electrical conductors or circuit parts, PPE shall be worn in accordance with the PPE Policy as outlined in section. To verify the absence of voltage the Restricted Approach Boundary will be crossed as well as the Arc Flash Protection Boundary, therefore, Arc Flash and Electric Shock PPE shall be worn.

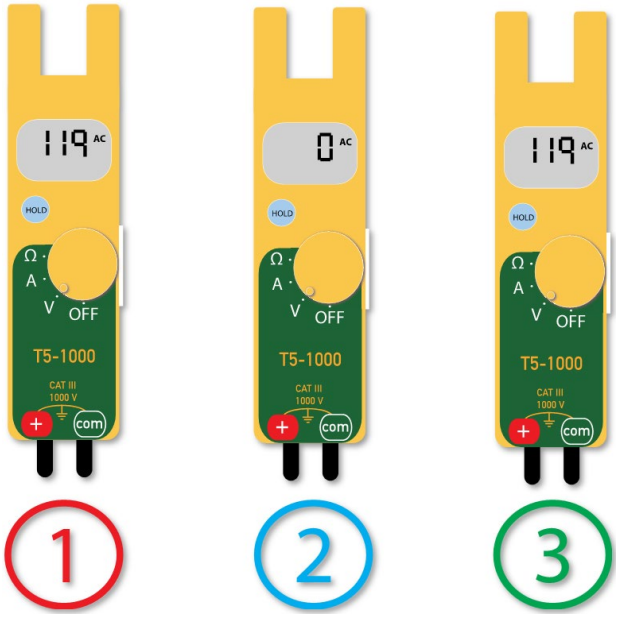
(7) A properly rated contact voltage (per ANSI S82.02) detector shall be used to verify the absence of voltage. A voltage meter shall be verified to be in working order before and after the following voltage measurement process by testing the meter on a known voltage source.

1. First, test a known voltage source. The meter should read near the nominal source voltage level as indicated in the example below.

2. Now take a voltage measurement on the circuit being tested for absence of voltage. You should read 0 volts at each point of work.

3. Now recheck the meter on the same known source to verify that the meter is still working properly.

Example: 120 V Known Source



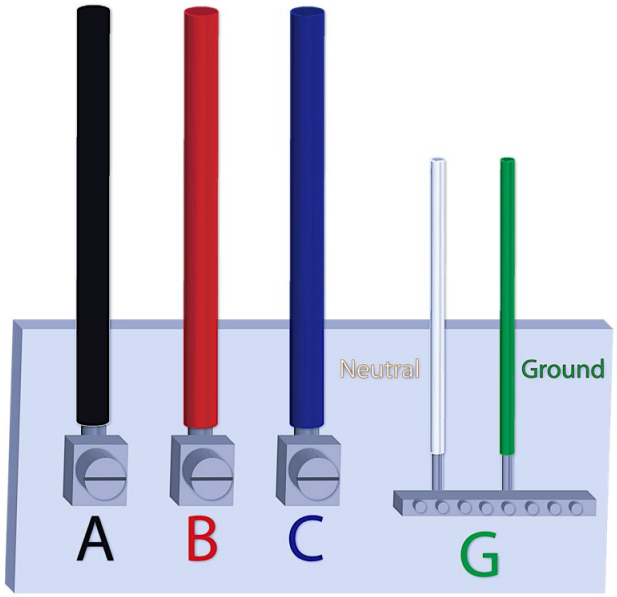
Once a meter has been verified to be working correctly, the qualified electrical worker may then verify the absence of voltage on the energized electrical conductors or circuit parts by checking each phase to phase and phase to ground at each point of work.

Three-phase power shall be delineated in individual phases as Phase A, Phase B, and Phase C. The workers shall verify that each Phase is de-energized in order to achieve an ESWC.

1. Phase A to B shall be verified to be 0 volts
2. Phase B to C shall be verified to be 0 volts
3. Phase A to C shall be verified to be 0 volts
4. Phase A to Ground shall be verified to be 0 volts
5. Phase B to Ground shall be verified to be 0 volts
6. Phase C to Ground shall be verified to be 0 volts

7. Neutral to Ground shall be verified to be 0 volts

Once all voltage measurements have been taken, the meter shall be checked again to ensure that overcurrent protection device within the meter was not damaged or opened. The meter shall once again be tested on the same known voltage source as previously tested.



(8) If equipment contains capacitors or a source of induced voltage, these sources of energy may require various grounding techniques to establish and electrically safe work condition. If concerns arise that these types of energy are present, the manufacturer's manual shall be consulted.

When the electrical component or circuit parts has a nominal voltage exceeding 1000 Volts, stored energy is more likely to present a life-threatening hazard. Grounding straps and shorting of capacitor plates may be utilized to discharge stored energy in capacitive elements. Turning of mechanical rotors may also back-feed life-threatening energy into the system so these rotors may need to be locked for certain types of loads. Interlock mechanisms may also provide secondary power from a different source so these interlocks may not be relied on as a disconnecting means unless properly locked out and tagged. Equipment manuals shall be consulted for deenergizing any loads or electrical equipment or circuit parts with a nominal voltage exceeding 1000 Volts.

11.2 Energized Work

Energized work is work that is performed on an energized circuit. This would include but is not limited to tasks such as tightening a lug, manipulating wire, cutting conductors, tapping a live bus, insertion or removal of a bucket into a MCC, terminating wire connections, inserting a fuse or circuit breaker into live bus, etc.

All work performed on electrical conductors or circuit parts that have not been put into an Electrically Safe Work Condition (ESWC) shall be classified as energized work and shall only be completed by qualified electrical workers. This energized work shall be permitted where the employer can demonstrate that de-energizing introduces additional hazards from increased risk, infeasibility, or work is being completed on equipment carrying less than 50 volts. Work performed within the Limited Approach Boundary or Arc Flash Boundary shall be considered energized even if the work does not require direct contact with energized electrical conductors or circuit parts. Appropriate PPE and tools shall be used. All energized work must be performed with an Energized Electrical Work Permit (EEWP) unless requirements are met for exceptions to the EEWP.

When management identifies a particularly hazardous, electrical work may require a buddy system on voltages less than 1000 Volts. Please note that the 2nd person utilized in the buddy system for establishing an ESWC on systems less than 1000V may be an unqualified worker who is trained on method of contact release and/or AED/CPR protocol.

11.3 Testing & Troubleshooting

Testing & troubleshooting work is work where the circuit is energized, but it is not possible to perform this work in a de-energized condition. This includes tasks such as voltage measurements, troubleshooting controls equipment, visual inspection, and thermal imaging.

For purposes of testing & troubleshooting, electrical conductors or circuit parts cannot be put into an Electrical Safe Working Condition (ESWC). This work may be performed by qualified electrical workers while the electrical conductors and circuit parts are energized without an Energized Electrical Work Permit (EEWP).

Testing and troubleshooting other than verifying absence of voltage shall not be performed on electrical components or circuit parts with a nominal voltage exceeding 1000 Volts except for verifying absence of voltage.

11.4 ‘Change of State’ Work

All work involving switching or other steps that change the state of an electrical conductor or circuit part from a de-energized to energized state or an energized to a de-energized state shall be classified as ‘Change of Electrical State’ work.

While this type of work may not expose the worker to any exposed electrical conductors or circuit parts, the possibility may exist that energy may be ‘blown out’ or released due to equipment failures or system transients. All ‘Change of Electrical State’ work shall be performed in adherence with a pre-established policy specific to that equipment.

Equipment that is not properly maintained (per applicable industry codes and standards), not properly installed (per applicable industry codes and standards), and has evidence of impending failure (such as evidence of arcing, overheating, loose or bound equipment parts, visible damage, deteriorations, or other damage) shall require PPE for ‘Change of Electrical State’ work.

12.0 Medium Voltage Work

When working on or near electrical components or circuit parts with a nominal voltage that exceeds 1000 Volts, additional electrical safe work practices shall be utilized by management and by the worker. Only Level 2 Qualified Electrical workers may work on or near electrical components or circuit parts with a nominal voltage that exceeds 1000 Volts.

12.1 Requirement for a Medium Voltage Electrical Work Permit

All work performed on or near energized electrical equipment or circuit parts with a nominal voltage exceeding 1000 Volts shall only be performed after completion of the Medium Voltage Electrical Work Permit form found within this document.

12.2 Additional Requirement for ESWC

Energized work will never be performed on electrical equipment or circuit parts with a nominal voltage exceeding 1000 Volts; however, establishing an Electrically Safe Work Condition (ESWC) on this equipment provides unique hazards. A special lockout/tagout procedure shall be written when performing work on medium voltage equipment (see FSU Hazardous Energy Control (Lockout-Tagout policy)). Proper grounding jumpers shall be used when establishing a ESWC on medium voltage equipment.

12.2.1 Non-Contact Voltage Testers

Non-contact voltage testers rated for use on nominal voltages exceeding 1000 Volts shall be utilized for verifying absence of voltage. The voltage rating of these testers must exceed the nominal voltage of the circuit being tested. These voltage testers shall be mounted on a properly rated hot stick.

12.2.2 Hot Sticks

Hot sticks must be rated for use on nominal voltages exceeding 1000 Volts. The voltage rating of these hot sticks must exceed the nominal voltage of the circuit being tested. Hot sticks must be given a visual inspection prior to use to ensure that there are no moisture or contaminants on the surface of the hot stick that could be conductive. These hot sticks shall be tested every 2 years for repair and/or cleaning.

12.2.3 Buddy System

Work performed on electrical equipment or circuit parts with a nominal voltage exceeding 1000 Volts shall not be performed alone. Two Level 2 Qualified Electrical workers must service this equipment together and verify each other's electrical safety work practices.

12.2.4 Grounding Conductors

Grounding conductors installed to discharge stored energy shall be removed prior to reenergizing electrical equipment or circuit parts with a nominal voltage exceeding 1000 Volts. Two people shall verify that grounding conductors have been removed prior to reenergizing.

For installing the grounding conductors, the grounding conductors shall be connected first to an effective ground then to Phase A, B, and C.

For removing the grounding conductors, Phase A, B, and C shall be removed prior to removing the grounding conductor from an effective ground.

Grounding conductors shall be rated to conduct the available fault current.
The grounding conductors must have adequate clamping devices to ensure that the clamps are not accidentally removed from the phase conductors or an effective ground.

Grounding may not be sufficient for removal of stored energy from some capacitive elements. Often, the plates of a capacitor must be shorted with a rated conductor. Refer to manufacturer's manuals for this information.

13.0 Energized Electrical Work Permits

Energized Electrical Work Permits (EEWP) shall be used for all Energized Work except for "Testing and Troubleshooting". The purpose of this EEWP is the following:

1) To ensure accountability & responsibility for all workers & management involved
2) To mitigate the electrical hazard when possible
3) To determine proper PPE
4) To verify procedural requirements
5) To coordinate safety efforts

14.0 Justification for Energized Work

To engage in energized work on electrical conductors or circuit parts, justification must be included on the Energized Electrical Work Permit (EEWP) and signatures of authorized management must be included.

Energized work shall only be used as a last resort. Tasks where de-energizing is considered 'inconvenient' shall not be considered as justified for performing energized work.

One or more of the following conditions must be met for valid justification for energized work for the EEWP to be considered viable:

1) De-energizing may result in risk to the lives and/or safety of students in residence halls.
2) De-energizing may result in compromises to ongoing critical research.
3) De-energizing may result in increased risk to the lives and/or safety or faculty or students in any way.
4) De-energizing may result in emergency alert system being disabled.

15.0 Electrical Lockout/Tag-out (LOTO)

Consult Florida State University's Hazardous Energy Control (Lockout-Tagout) program.

16.0 Methods of Contact Release

All qualified electrical workers shall be trained on methods of contact release if a worker is 'hung up' on a circuit.

As duration of an electric shock event can determine severity of injury and whether a worker lives or dies, workers shall be trained to instantaneously identify the following steps (please note that this is a hierarchy of steps so workers should start with step 1 if possible, and then move on down the list if not possible):

1) Open the upstream disconnecting means (shut off the power feeding the circuit)
2) Find something non-conductive to pry the worker off the circuit such as a nonconductive shepherd's hook, hot stick, or other nonconductive apparatus.
3) Use insulated gloves on hands to pull the worker off the circuit.
4) Use a wooden (not damp), rubber, or plastic apparatus to pry the worker off the circuit.

Care shall be taken that the worker does not attempt to pull the worker off the circuit using bare hands or bare arms. This could result in multiple fatalities.

17.0 Arc Flash Risk Assessment

As Florida State University is a large campus, incident energy analysis has not yet been performed on all electrical equipment. If the incident energy analysis has been performed, this equipment will have a label on it (see section 16.1-16.3). For equipment that has not been labeled, the AF PPE Categories method will be used (see section 16.4). Both methods are described below.

Please note the term PPE Level is used to determine the PPE to be worn per the incident energy analysis method only and corresponding labels. The term PPE Category is used to determine the PPE to be worn per the tables method only which is described below.

17.1 Incident Energy Analysis

If the incident energy analysis has been performed, a 'Warning' label will be applied. This label indicates that an electrical hazard exists and could result in death or serious injury. All electrical enclosures included in the incident energy analysis (208 volts and above) will be labeled with a 'Warning' label if the available incident energy is below 40 cal/cm^2 (PPE 4).

1. Incident Energy Analysis – This indicates that an engineering analysis has determined that at the working distance, the available incident energy has been calculated and indicated on the labels.
2. Arc Flash Boundary – This is the distance from a prospective arc flash source within which a person could receive a second-degree burn. Once within this boundary, all PPE as determined by the AF PPE Category shall be worn.
3. PPE Requirements – Each label should identify the correct PPE to wear based on the incident energy analysis.
4. AF PPE Level – There are 4 different levels of PPE worn for the arc flash hazard. Refer to the 'PPE Example' section for selecting PPE based on these levels.
5. Nominal Voltage – Each label shall identify the nominal voltage of the circuit.
6. Electric Shock Boundaries – Within the Limited Approach Boundary, no additional PPE is needed, but unqualified workers shall never be within this boundary. The Restricted Approach Boundary indicates the boundary for which insulated gloves shall be worn.
7. Label Location – This name designates the name of the equipment. This should correspond with one-line diagrams.AF PPE Level – There are 5 different levels of PPE worn for the arc flash hazard.

17.2 Danger Labels

A ‘Danger’ label indicates an imminently hazardous situation, which will result in death or serious injury. This signal word is to be limited to the extreme situations. All electrical enclosures will be labeled with a ‘Danger’ label if the available incident energy exceeds 40 cal/cm^2. Extreme care should be utilized when operating or working on equipment with these labels. Energized work shall be prohibited.

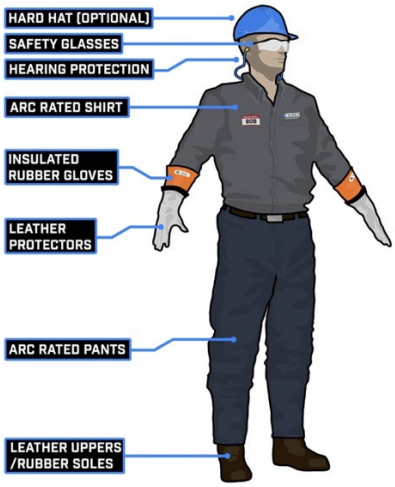
17.3 PPE Selection for Incident Energy Method

In addition to selecting PPE based off the Site Specific PPE Level listed on a warning label, risk assessments shall be performed to ensure selection of PPE takes into consideration the condition of equipment.

17.3.1 PPE Level -

When the incident energy method has been performed and warning labels indicate that the electrical enclosure is PPE Level -, the following articles of PPE will be worn for energized work, testing & troubleshooting:

(1) Safety glasses
(2) Hearing protection
(3) Leather protectors
(4) Insulated gloves (if entering into restricted approach boundary)
(5) Leather shoes with rubber soles
(6) Untreated natural fiber pants (or arc rated)
(7) Untreated natural fiber shirt (or arc rated)
(8) Hardhat



17.3.2 PPE Level 1 & 2

When the incident energy method has been performed and warning labels indicate that the electrical enclosure is PPE Level 1 or 2, the following articles of PPE will be worn for energized work, testing & troubleshooting

(1) Arc rated face shield with hard hat
(2) Arc rated balaclava
(3) Safety glasses
(4) Hearing protection
(5) Leather protectors
(6) Insulated gloves (if entering into restricted approach boundary)
(7) Leather shoes with rubber soles
(8) Arc rated pants (minimum rating of 8 cal/cm^2)
(9) Arc rated shirt (minimum rating of 8 cal/cm^2)

17.3.3 PPE Level 3 & 4

When the incident energy method has been performed and warning labels indicate that the electrical enclosure is PPE Level 3 or 4, the following articles of PPE will be worn for energized work, testing & troubleshooting:

(1) Arc rated bee-keeper style hood (minimum rating of 40 cal/cm^2)
(2) Safety glasses
(3) Hearing protection
(4) Leather protectors
(5) Insulated gloves (if entering into restricted approach boundary)
(6) Leather shoes with rubber soles
(7) Arc rated pants (minimum rating of 40 cal/cm^2)
(8) Arc rated jacket (minimum rating of 40 cal/cm^2)

17.4 PPE Selection for Categories Method (No Label)

The following method may be utilized by qualified electrical workers in the time prior to completion of the arc flash analysis and corresponding labeling for selecting PPE. (Please note that this PPE selection methodology does not meet all requirements of the 2018 NFPA 70E. This methodology is intended to ensure that workers risk is limited for the potential of receiving catastrophic burn injuries or death resulting from arc flashes in the interim period prior to completion of the incident energy analysis.)

Please note the term PPE Category is used to determine the PPE to be worn per the tables method only. The term PPE Level is used to determine the PPE to be worn per the incident energy analysis method only and corresponding labels.

In addition to utilizing the PPE Category method (when there is no warning label to indicate PPE Level), risk assessments shall be performed to ensure selection of PPE takes into consideration the condition of equipment.

17.4.1 PPE Category 2

For accessing electrical equipment such as panelboards and disconnects (like those pictured below) rated from 150 Volts-750 Volts and not exceeding 400 amp ratings, AF PPE Category 2 shall be worn.

When the AF PPE Category Method indicate that the electrical enclosure is PPE Category 2, the following articles of PPE will be worn for energized work, testing & troubleshooting:

(1) Arc rated face shield with hard hat
(2) Arc rated balaclava
(3) Safety glasses
(4) Hearing protection
(5) Leather protectors
(6) Insulated gloves (if entering into restricted approach boundary)
(7) Leather shoes with rubber soles
(8) Arc rated pants (minimum rating of 8 cal/cm^2)

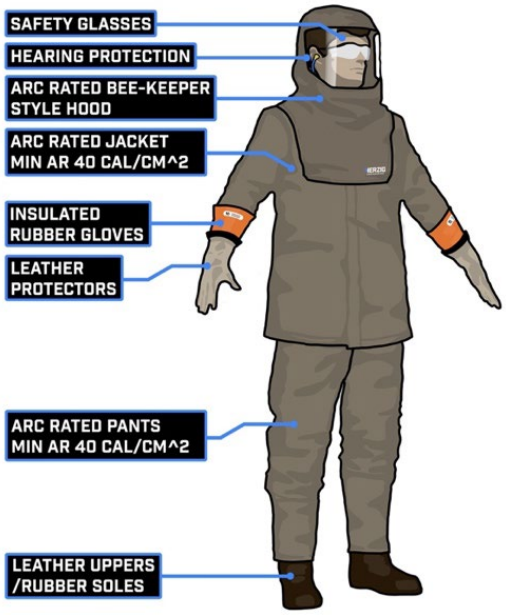
(9) Arc rated shirt (minimum rating of 8 cal/cm^2)

17.4.2 PPE Category 4

For accessing equipment such as Motor Control Centers (MCC), Switchboards or Switchgear (like those pictured below) AF PPE Category 4 shall be worn.

When the AF PPE Category Method indicates that the electrical enclosure is PPE Category 4, the following articles of PPE will be worn. This PPE may also be needed for 'change of state' electrical work:

(1) Arc rated bee-keeper style hood (minimum rating of 40 cal/cm^2)
(2) Safety glasses
(3) Hearing protection
(4) Leather protectors
(5) Insulated gloves (if entering into restricted approach boundary)
(6) Leather shoes with rubber soles
(7) Arc rated pants (minimum rating of 40 cal/cm^2)
(8) Arc rated jacket (minimum rating of 40 cal/cm^2)



For accessing any equipment with a nominal voltage of greater than or equal to 1000V, the NFPA 70E Table 130.7(C)(15)(a) indicates that AF PPE Category 4 shall be worn.

When the AF PPE Category Method indicates that the electrical enclosure is PPE Category 4, the following articles of PPE will be worn. This PPE may also be needed for 'change of state' electrical work:

(1) Arc rated bee-keeper style hood (minimum rating of 40 cal/cm^2)
(2) Safety glasses
(3) Hearing protection
(4) Leather protectors
(5) Insulated gloves (if entering into restricted approach boundary)
(6) Leather shoes with rubber soles
(7) Arc rated pants (minimum rating of 40 cal/cm^2)
(8) Arc rated jacket (minimum rating of 40 cal/cm^2)

18.0 Relationship with Contractors

18.1 Contractor's Responsibility

The contractor shall provide a copy of their written Electrical Safety Program upon request.

18.2 Host Responsibility

Contractors are expected to meet or exceed the safety requirements of OSHA and NFPA70E.

If contractors violate procedures while onsite, authorized personnel and/or management must either notify contractors of violations and remedy the violations or remove contractor personnel from the facility.

The host employer is responsible to provide a workplace free of known hazards to protect the contractor from known hazards that exist after other controls have been implemented in a workplace.

18.3 Documented Meeting

Host employer must ensure that a job briefing shall be held between authorized Host Personnel responsible for the work and the contractor designated personnel before work starts.

18.4 Work Inspection

Upon completion of work, the Host's designated personnel shall inspect contractor's work to ensure that this work meets the requirements of the contract.

19.0 General Electrical Safety Requirements

The following are general electrical safety requirements that shall be followed at all times.

19.1 Overhead Powerlines

The workplace shall be evaluated for safety before work begins when the work is near electric lines or other energized electrical conductors or circuit parts. If the possibility exists of contact with electrical conductors or circuit parts, workers must be trained to avoid the electrical hazard.

19.2 Blind Areas

Employees shall not reach blindly into areas that might contain exposed energized electrical conductors or circuit parts.

19.3 Non-Illuminated Areas

Employees shall not enter spaces containing energized electrical conductors or circuit parts unless illumination is provided that allows the work to be performed safely.

19.4 Conductive Apparel

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

19.5 Conductive Materials

Conductive materials, tools, and equipment that are in contact with any part of an employee's body shall be handled in a manner that prevents accidental contact with live parts. Such materials and equipment include, but are not limited to, long conductive objects such as ducts, pipes, tubes, conductive hose and rope, metal-lined rules and scales, steel tapes, pulling lines, metal scaffold parts, structural members, and chains.

19.6 Confined Spaces

When an employee works in a confined space or enclosed spaces (such as a manhole or vault) that contains exposed live parts, the employee shall use protective shields, barriers, or insulating materials as necessary to avoid contact with these parts. Doors, hinged panels, and the like shall be secured to prevent them from swinging into employees. All other requirements of the facility confined space entry program must be followed.

Refer to Florida State University's Confined Space Program for more information.

19.7 Wet or Damp Locations

Wet or damp locations shall be avoided when performing electrical work. If the location is wet or damp, it should be cleaned or allowed to dry if possible. Work should not be performed unless it is critical. Only use electrical equipment with GFCI's when work must be performed in wet or damp locations.

19.8 Alertness

Workers performing any electrical tasks shall be alert and cognizant of their surroundings at all times. Workers shall not be allowed to work within the Limited Approach Boundary or the Arc Flash Boundary when they are impaired due to illness, fatigue, medications, or for any other reasons.

20.0 Extension Cord Requirements

The following requirements apply to the use of cord-and-plug-connected equipment and flexible extension cords:

- Extension cords may only be used to provide temporary power, less than 90 days
- Portable cord-and-plug connected equipment and extension cords must be visually inspected before use for external defects such as loose parts, bent or missing pins, or damaged insulation. Any defective cord must be immediately removed from service.
- Extension cords shall be rated for the application on which they are used.
- Only extension cords meeting manufacturer's specifications may be used.
- Workers performing work which requires extension cords near damp or wet locations must use a GFCI.
- GFCIs must be tested before use and removed from service if found to be defective.
- Extension cords should be covered by cord protector or tape when they cross a walkway or other path of travel.
- Extension cords using grounding-type equipment must contain an equipment-grounding conductor (3 pronged). Removal of the grounding plug or prong is prohibited.
- Extension cords may not be used as a permanent source of electricity.
- Extension cords shall not be attached to the building structure or fire protection systems.

APPENDIX A - Task Procedures (Risk Assessments)

As required by the latest codes and standards, risk assessments shall be performed in this facility prior to starting work. In addition to any protective measures determined necessary by the results of the risk assessment, the following procedural requirements have been determined for all qualified electrical workers.

A.1 Opening Hinged Doors on MCC, Disconnects, and Panelboards

The following steps shall be taken prior to every time a hinged cover is opened on an electrical enclosure with energized conductors with a nominal voltage above 480 Volts (MCC bucket, Panelboard, control panel).

1) Arc flash PPE (including leather protectors) that meets the requirements of the warning label or the categories method shall be worn as intended (face shields in their correct position, shirts buttoned at sleeves and around neck, balaclavas applied, etc.).
2) Barricades (or attendant) shall be placed at a boundary that is either at the limited approach or the arc flash boundary (whichever is greater).
3) If the restricted approach boundary is to be crossed, insulated gloves with leather protectors are to be worn.
4) Area is inspected to ensure that there are no unexpected hazards such as unqualified workers in the area, standing water, or trip hazards.
5) The hinged cover shall not require excessive force to open. If excessive force is required, all conductors within the enclosure shall be de-energized prior to opening.
6) The enclosure shall not be left unattended while opened. The qualified electrical worker shall not walk further than 20 feet from the open enclosure (or line of sight).

A.2 Inserting Plugs into Welding or Temporary Receptacles

The following steps shall be taken every time a plug is inserted into a welding or temporary receptacle rated at above 480 Volts.

1) Plug shall be inspected for moisture, contaminants, or defects. If moisture, contaminants, or defects exist, it shall either be cleaned or removed from service prior to use.
2) Conductor leading from plug to device requiring power shall be inspected for any defects in insulation. If defects exist, the conductor shall be replaced before the device may be used.
3) Receptacle shall be inspected for any contaminants or defects.
4) If local disconnect exists, this disconnecting means shall be opened prior to inserting the plug into the receptacle.
5) Insulated gloves and leather protectors shall be worn if a local disconnect is not installed feeding the receptacle device.

A.3 Accessing Distribution Transformer Areas

The following procedures will be required when work is performed within 20 feet of areas containing distribution transformers with exposed energized components.

1) An arc flash suit (rated at least 40 cal/cm^2 shall be worn prior to exposing any energized conductors.
2) Only qualified electrical workers should ever enter these areas.
3) Area shall be visually surveyed prior to entering these areas to ensure that no unusual circumstances are present such as standing water or other circumstances that may increase the risk.
4) A second qualified electrical worker shall be present at all times when one or both qualified electrical workers are within 20 feet of exposed energized conductors.
5) All switching operations within these areas shall be considered high risk as exposed energized conductors are present. Arc flash PPE shall be worn for these operations.

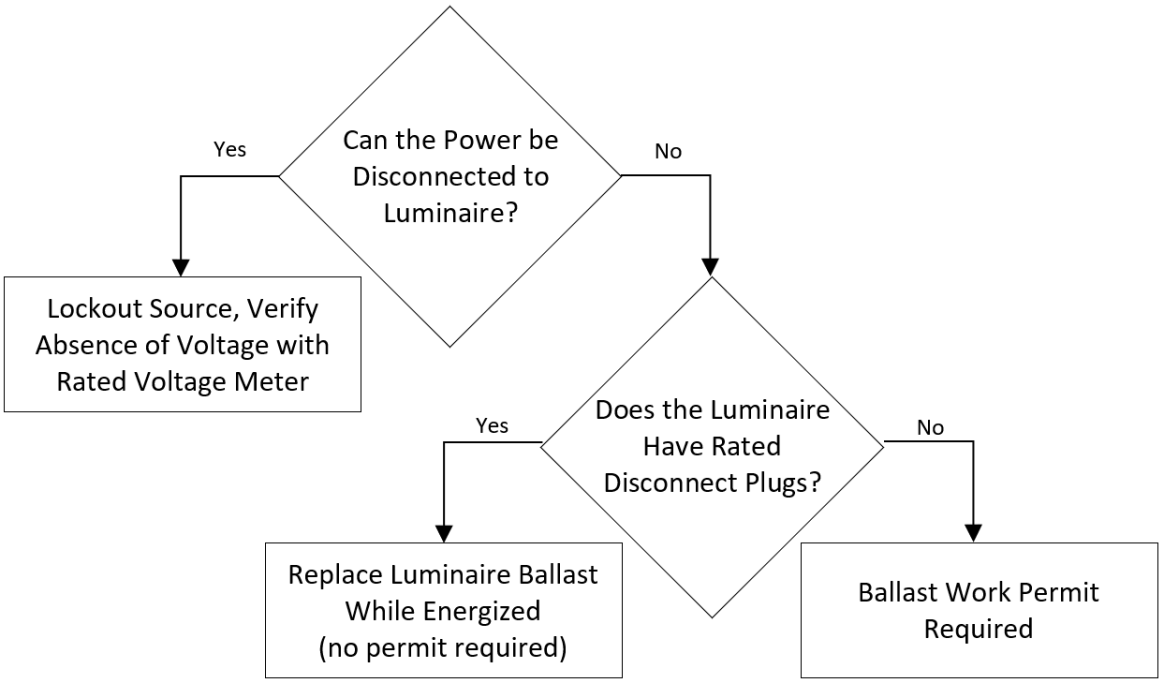
A.4 Racking In/Racking Out Breakers

The following procedures will be required when racking in or racking out a breaker:

1) Prior to racking in a breaker, a continuity test shall be performed between the lugs on the line side and load side of the device prior to reinsertion.
2) The preferred method of racking a breaker is using either the racking robot or a remote racking method.
3) If remote racking method is not available due to equipment design, the arc flash suit (rated at least 40 cal/cm^2) shall be worn for racking even if the racking allows the front paneling to remain in place.
4) For all tasks requiring racking of breakers without remote racking option or front paneling in place, the upstream disconnect shall be opened prior to racking.

A.5 Ballast Risk Assessment

Only Qualified Electrical Workers shall perform ballast replacement. The following flowchart demonstrates the thought process for changing a ballast on an overhead luminaire:



The following procedures will be required when replacing or servicing ballasts on overhead luminaire fixtures:

1) If energized components are to be exposed, upstream disconnect shall be opened and LOTO procedures followed (depending on equipment design) prior to work.
2) If ballast disconnect plugs exist (rated disconnecting plugs) no additional PPE or permits are needed for replacing ballast.
3) If upstream disconnect cannot be opened due to equipment design or due to criteria allowing for energized work, an Energized Electrical Work Permit shall be completed and submitted to management prior to work. Cotton clothing shall be worn with insulated gloves, safety glasses, leather protectors, and hearing protection. Rated insulated tools shall be used for the task. Area shall use a barricade or attendant to limit access to area.

A.6 Switching Operations

All work requiring 'Change of State' work shall require the following risk assessment procedure to be performed and implemented by the worker. If the condition of the equipment disconnect is compromised (such as visible evidence of deterioration, gaps in protective covers, or exposed conductors), an upstream disconnect shall be identified and utilized.

Task	Additional Procedures
Disconnect rated from 0 amps – 100 Amps	1) Stand to side of enclosure and look away 2) Take a deep breath inward
Disconnect rated from 101 Amps – 400 Amps	1) Stand to side of enclosure and look away 2) Take a deep breath inward 3) PPE as determined by the warning label (or the PPE Category method in NFPA 70E Table 130.7(C)(15)(a)) is required if equipment has visible evidence of deterioration, gaps in protective covers, or exposed conductors
Disconnect rated from 401-4000 Amps (480 or 240 Volt)	1) Downstream disconnects and loads shall be turned off if possible 2) Take a deep breath inward 3) 8 cal/cm^2 AR shirts and pants with leather protectors, face shield, and balaclava shall be worn 4) Hot stick shall be used (if equipment design allows) 5) Remote switching shall be used (if equipment design allows) 6) Class 00 insulated gloves shall be worn
Disconnect rated from 600 Volts -17 kV	1) Downstream disconnects and loads shall be turned off if possible 2) Take a deep breath inward 3) 40 cal/cm^2 Arc Flash Suit shall be worn 4) Hot stick shall be used (if equipment design allows) 5) Remote switching shall be used (if equipment design allows) 6) Class 2 insulated gloves shall be worn

Appendix B - Annual Field Audit Level 1

Pass	Fail	N/A	Field Corrected (Supervisor's Initials)	Opening Electrical Enclosure (Up to AF PPE Category/Level 2) (Requires 7/10)
				Can worker determine AF PPE Level based on the Arc Flash Warning Label or using the AF PPE Category Method?
				Is worker wearing hearing protection?
				Is worker wearing safety glasses?
				Is worker wearing long sleeves (uncuffed) to open enclosure?
				Is worker wearing leather protectors to open enclosure?
				Does worker have any exposed flammable material or a flammable outermost layer?
				Is clothing is free from contaminants that could negate the arc rating?
				Did worker properly barricade the work area?
				Is worker wearing arc rated face shield and hard hat?
				Is worker wearing arc rated balaclava?
Pass	**Fail**	**N/A**	**Field Corrected (Supervisor's Initials)**	**Using Electrical Test Instruments (Requires 6/9)**
				Can worker determine if meter is rated properly for application?
				Is worker using insulated gloves for voltage measurement?
				Is worker wearing leather protectors over insulated gloves for voltage measurement?
				Did worker give insulated gloves a field test prior to donning?
				Did worker inspect test leads of voltage meter prior to use?
				Did worker set the test instrument to the correct setting for a voltage measurement?
				Can the worker demonstrate a voltage measurement?
				Can the worker demonstrate a phase to ground voltage measurement?
				Can the worker demonstrate a phase to phase voltage measurement?
Pass	**Fail**	**N/A**	**Field Corrected (Supervisor's Initials)**	**Establishing an Electrically Safe Work Condition (ESWC) (Requires 10/13)**
				Can worker consult panel schedules, one line diagrams, or other labeling to locate upstream disconnecting means?
				Does worker know how to disconnect the upstream disconnecting means?
				Did worker properly interrupt load current before disconnecting the upstream disconnecting means?
				Did worker visually verify that the upstream disconnecting means is disconnected?
				Did worker properly apply LOTO devices?
				Is worker using proper PPE?
				Did worker set meter to right setting (Volts)?
				Did worker inspect test leads of voltage meter prior to use?
				Did worker properly test meter on a known voltage source?
				Did worker test phase to ground on all three phases?
				Did worker test phase to phase voltages (A to B, B to C, & A to C)?
				Did worker properly test meter on a known voltage source after testing circuit?
				Did worker properly remove LOTO device to reenergize system?

Pass	Fail	N/A	Field Corrected (Supervisor's Initials)	Determining Boundaries from Label or Using AF PPE Category Method (Requires 4/6)
				What is the Restricted Approach Boundary?
				What is the Limited Approach Boundary?
				At which boundary do insulated gloves need to be worn? (RAB)
				When do leather protectors need to be worn? (AFB)
				What is the Arc Flash Boundary?
				Can worker determine where barricades shall be placed? (Either Limited or Arc Flash depending on which is greater)
Pass	**Fail**	**N/A**	**Field Corrected (Supervisor's Initials)**	**General Electrical Knowledge (Requires 4/6)**
				Has worker removed all conductive jewelry?
				Can worker describe a safe method of release for a worker who is 'hung up' on a circuit?
				Does worker have knowledge of when insulated tools should be used?
				Do worker's shoes have leather uppers with rubber soles?
				Can worker identify personnel responsible for AED/CPR in an emergency?
				Can the worker describe when to utilize a GFCI?
Pass	**Fail**	**N/A**	**Field Corrected (Supervisor's Initials)**	**Electrical Equipment Knowledge (Requires 3/4)**
				Can the worker demonstrate an application of the Ballast Risk Assessment?
				Can the worker determine proper steps for operating a 60 amp disconnect?
				Can the worker determine proper steps for operating a 100 amp disconnect?
				Can the worker demonstrate understanding of the risk assessment flowchart (refer to the written electrical safety program)?

Note: If a worker fails one of the 'blacked out' sections on the field audit, they must be retrained and re-audited. All other areas may be 'field corrected' by the supervisor.

Maintenance Supervisor Date

Audit Administrator Date

Appendix C - Annual Field Audit Level 2

Pass	Fail	N/A	Field Corrected (Supervisor's Initials)	Opening Electrical Enclosure (Up to AF PPE Category/Level 2) (Requires 7/10)
				Can worker determine AF PPE Level based on the Arc Flash Warning Label or using the AF PPE Category Method?
				Is worker wearing hearing protection?
				Is worker wearing safety glasses?
				Is worker wearing long sleeves (uncuffed) to open enclosure?
				Is worker wearing leather protectors to open enclosure?
				Does worker have any exposed flammable material or a flammable outermost layer?
				Is clothing is free from contaminants that could negate the arc rating?
				Did worker properly barricade the work area?
				Is worker wearing arc rated face shield and hard hat?
				Is worker wearing arc rated balaclava?
Pass	**Fail**	**N/A**	**Field Corrected (Supervisor's Initials)**	**Opening Electrical Enclosure (Up to AF PPE Category/Level 4) (Requires 7/11)**
				Can worker determine AF PPE Level based on the Arc Flash Warning Label or using the AF PPE Category Method?
				Is worker wearing hearing protection?
				Is worker wearing safety glasses?
				Is worker wearing arc rated bee keeper style hood with hardhat?
				Is worker wearing arc rated long sleeves jacket or coveralls rated at 40 cal/cm^2?
				Is worker wearing arc rated pants or coveralls rated at 40 cal/cm^2?
				Is worker wearing leather protectors to open enclosure?
				Has worker removed hairnet/beard net prior to opening enclosure?
				Does worker have any exposed flammable material or a flammable outermost layer?
				Is clothing is free from contaminants that could negate the arc rating?
				Did worker properly barricade the work area?
Pass	**Fail**	**N/A**	**Field Corrected (Supervisor's Initials)**	**Using Electrical Test Instruments (Requires 8/12)**
				Can worker determine if meter is rated properly for application?
				Is worker using insulated gloves for voltage measurement?
				Is worker wearing leather protectors over insulated gloves for voltage measurement?
				Did worker give insulated gloves a field test prior to donning?
				Did worker inspect test leads of voltage meter prior to use?
				Did worker set the test instrument to the correct setting for a voltage measurement?
				Can the worker demonstrate a voltage measurement?
				Can the worker demonstrate a phase to ground voltage measurement?
				Can the worker demonstrate a phase to phase voltage measurement?
				Can worker demonstrate a resistance test?
				Can worker demonstrate a series current measurement?
				Can worker demonstrate a capacitance test?

Pass	Fail	N/A	Field Corrected (Supervisor's Initials)	Establishing an Electrically Safe Work Condition (ESWC) (Requires 11/15)
				Can worker consult panel schedules, one line diagrams, or other labeling to locate upstream disconnecting means?
				Does worker know how to disconnect the upstream disconnecting means?
				Did worker properly interrupt load current before disconnecting the upstream disconnecting means?
				Did worker visually verify that the upstream disconnecting means is disconnected?
				Did worker properly apply LOTO devices?
				Is worker using proper PPE?
				Did worker set meter to right setting (Volts)?
				Did worker inspect test leads of voltage meter prior to use?
				Did worker properly test meter on a known voltage source?
				Did worker test phase to ground on all three phases?
				Did worker test phase to phase voltages (A to B, B to C, & A to C)?
				Did worker properly test meter on a known voltage source after testing circuit?
				Did worker verify that there were no capacitive equipment that needs grounding or time to discharge energy?
				Did worker verify that there are no induced sources that would require installation of grounding jumpers?
				Did worker properly remove LOTO device to reenergize system?
Pass	**Fail**	**N/A**	**Field Corrected (Supervisor's Initials)**	**Determining Boundaries from Label or Using AF PPE Category Method (Requires 4/6)**
				What is the Restricted Approach Boundary?
				What is the Limited Approach Boundary?
				At which boundary do insulated gloves need to be worn? (RAB)
				When do leather protectors need to be worn? (AFB)
				What is the Arc Flash Boundary?
				Can worker determine where barricades shall be placed? (Either Limited or Arc Flash depending on which is greater)
Pass	**Fail**	**N/A**	**Field Corrected (Supervisor's Initials)**	**General Electrical Knowledge (Requires 5/7)**
				Has worker removed all conductive jewelry?
				Can worker describe a safe method of release for a worker who is 'hung up' on a circuit?
				Does worker have knowledge of when insulated tools should be used?
				Does worker understand that non-contact voltage testers should not be utilized for verifying the absence of voltage (except when voltage exceeds 1000 Volts)?
				Do worker's shoes have leather uppers with rubber soles?
				Can worker identify personnel responsible for AED/CPR in an emergency?
				Can the worker describe when to utilize a GFCI?

Pass	Fail	N/A	Field Corrected (Supervisor's Initials)	Electrical Equipment Knowledge (Requires 4/7)
				Can worker identify nominal voltages of all conductors within the industrial control panel (including power and control voltage)?
				Can the worker distinguish which units are switchgear and/or switchboards in the distribution system?
				Can the worker demonstrate an application of the Ballast Risk Assessment?
				Can the worker determine proper steps for operating a 60 amp disconnect?
				Can the worker determine proper steps for operating a disconnect greater than 100 amp?
				Can the worker determine proper steps for operating a disconnect in systems 600V or greater?
				Can the worker demonstrate understanding of the risk assessment flowchart (refer to the written electrical safety program)?

Note: If a worker fails one of the 'blacked out' sections on the field audit, they must be retrained and re-audited. All other areas may be 'field corrected' by the supervisor.

Maintenance Supervisor Date

Audit Administrator Date

APPENDIX D - Annual Field Audit Retraining Form

The following form must be completed by the manager auditing a worker after a worker fails any section of their annual field audit. This form must be attached to the annual field audit that has been failed by the worker as part of the documentation process.

Identify which section(s) of the annual field audit the worker failed:

_____
_____
_____
_____
_____
_____
_____

Describe the measures taken to ensure that the worker understands the sections that he failed and any retraining that took place:

_____
_____
_____
_____
_____
_____
_____

A follow-up audit will be performed on the following date:

_____

_____
_____
Auditor Signature Date

_____
_____
Worker Signature Date

APPENDIX E - Energized Electrical Work Permit

Job/Work Order Number_____

Part I: To be completed by the Requester:

(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:

_____

_____

Part II: To be completed by the qualified electrical worker doing the work:

(4) Detailed job description procedure to be used in performing the work:

_____

_____

_____

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

_____

_____

(6) Results of electric shock hazard analysis per the Warning label or NFPA 70E Table 130.4(D)(a):

(a) Limited Approach Boundary [_____]

(b) Restricted Approach Boundary [_____]

(c) Necessary electric shock personal and other protective equipment to safely perform assigned tasks:

_____

(7) Results of the arc flash hazard analysis per the Warning label or NFPA 70E Table 130.7(C)(15)(a):

(a) Available incident energy or hazard/risk category [_____]

(b) Arc flash boundary [_____]

(c) Necessary arc flash personal and other protective equipment to safely perform the assigned task:

_____

(8) Means employed to restrict the access of unqualified worker from the work area:

_____

_____

(9) Do you agree the above-described work can be done safely? [ ] Yes [ ] No
(if no, return to requester)

Part III: Approval(s) to perform the work while Electronically Energized:

_____
Requester/Title

_____ _____
Department Head/Designee Maintenance Supervisor

_____
Qualified Employee

_____
Date

APPENDIX F - Boundaries (Limited Approach/Restricted Approach/Arc Flash)

The following tables and information come from Article 130 of the NFPA 70E and are intended to be used for determining approach boundaries associated with arc flash and electric shock hazards as well as provide guidance on arc flash PPE selection. These tables are to be applied before starting work on electrical equipment that do not have warning labels from an engineering study present.

Table 130.4(E)(a) Electric Shock Protection Approach Boundaries to Exposed Energized Electrical Conductors or Circuit Parts for Alternating-Current Systems

(1)	(2)	(3)	(4)
	Limited Approach Boundary[b]		
Nominal System Voltage Range, Phase to Phase[a]	Exposed Movable Conductor[c]	Exposed Fixed Circuit Part	Restricted Approach Boundary[b,d]; Includes Inadvertent Movement Adder
Less than 50 V	Not specified	Not specified	Not specified
50 V–150 V[e]	3.1 m (10 ft 0 in.)	1.0 m (3 ft 6 in.)	Avoid contact
151 V–750 V	3.1 m (10 ft 0 in.)	1.0 m (3 ft 6 in.)	0.31 m (1 ft 0 in.)
751 V–5 kV	3.1 m (10 ft 0 in.)	1.0 m (3 ft 6 in.)	0.63 m (2 ft 1 in.)
5.1 kV–15 kV	3.1 m (10 ft 0 in.)	1.5 m (5 ft 0 in.)	0.65 m (2 ft 2 in.)
15.1 kV–36 kV	3.1 m (10 ft 0 in.)	1.8 m (6 ft 0 in.)	0.77 m (2 ft 7 in.)
36.1 kV–46 kV	3.1 m (10 ft 0 in.)	2.5 m (8 ft 0 in.)	0.84 m (2 ft 10 in.)
46.1 kV–72.5 kV	3.1 m (10 ft 0 in.)	2.5 m (8 ft 0 in.)	1.0 m (3 ft 4 in.)
72.6 kV–121 kV	3.3 m (10 ft 8 in.)	2.5 m (8 ft 0 in.)	1.2 m (3 ft 9 in.)
121.1 kV–145 kV	3.4 m (11 ft 0 in.)	3.1 m (10 ft 0 in.)	1.3 m (4 ft 4 in.)
145.1 kV–169 kV	3.6 m (11 ft 8 in.)	3.6 m (11 ft 8 in.)	1.5 m (4 ft 10 in.)
169.1 kV–242 kV	4.0 m (13 ft 0 in.)	4.0 m (13 ft 0 in.)	2.1 m (6 ft 8 in.)
242.1 kV–362 kV	4.7 m (15 ft 4 in.)	4.7 m (15 ft 4 in.)	3.5 m (11 ft 2 in.)
362.1 kV–420 kV	5.8 m (19 ft 0 in.)	5.8 m (19 ft 0 in.)	4.3 m (14 ft 0 in.)
420.1 kV–550 kV	5.8 m (19 ft 0 in.)	5.8 m (19 ft 0 in.)	5.1 m (16 ft 8 in.)
550.1 kV–800 kV	7.2 m (23 ft 9 in.)	7.2 m (23 ft 9 in.)	6.9 m (22 ft 7 in.)

Notes:
(1) For arc flash boundary, see 130.5(E).
(2) All dimensions are distance from exposed energized electrical conductors or circuit part to employee.
[a]For single-phase systems above 250 volts, select the range that is equal to the system's maximum phase-to-ground voltage multiplied by 1.732.
[b]See definition in Article 100 and text in 130.4(F)(3) and Informative Annex C for elaboration.
[c]Exposed movable conductors describes a condition in which the distance between the conductor and a person is not under the control of the person. The term is normally applied to overhead line conductors supported by poles.
[d]The restricted approach boundary in Column 4 is based on an elevation not exceeding 900 m (3000 ft). For higher elevations, adjustment of the restricted approach boundary shall be considered.
[e] This includes circuits where the exposure does not exceed 120 volts nominal.

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)
Metal enclosed interrupter switchgear, fused or unfused type construction, 1 kV through 15 kV Parameters: Maximum of 35 kA available fault current; maximum of 0.24 sec (15 cycles) fault clearing time; minimum working distance 910 mm (36 in.)	4	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)
Arc-resistant equipment up to 600-volt class Parameters: DOORS CLOSED and SECURED; with an available fault current and a fault clearing time that does not exceed the arc-resistant rating of the equipment*	N/A	N/A
Arc-resistant equipment 1 kV through 15 kV Parameters: DOORS CLOSED and SECURED; with an available fault current and a fault clearing time that does not exceed the arc-resistant rating of the equipment*	N/A	N/A

N/A: Not applicable

Note:

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

*For DOORS OPEN refer to the corresponding non-arc-resistant equipment section of this table.

Informational Note No. 1 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 and current-limiting molded case circuit breakers 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. 2 to Table 130.7(C)(15)(a): See Table 1 of IEEE 1584, Guide for Performing Arc Flash Hazard Calculations, for further information regarding list items (2) through (4) in Informational Note No. 1.

Informational Note No. 3 to Table 130.7(C)(15)(a): See IEEE C37.20.7, Guide for Testing Switchgear Rated Up to 52 kV for Internal Arcing Faults, for an example of a standard that provides information for arc-resistant equipment referred to in Table 130.7(C)(15)(a).

Informational Note No. 4 to Table 130.7(C)(15)(a): See Informative Annex O.2.4(9) for information on arc-resistant equipment.

APPENDIX G - Ballast Work Permit

Job/Work Order Number_____

Part I: To be completed by the Requester:

(1) Description of ballast replacement/work job locations:

_____

_____

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

_____

_____

Part II: To be completed by the qualified electrical worker doing the work:

(1) Detailed job description procedure to be used in performing the work:

_____

_____

_____

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

_____

_____

(3) Results of electric shock hazard analysis per NFPA 70E Table 130.4(D)(a):

(d) Limited Approach Boundary [_____]

(e) Restricted Approach Boundary [_____]

(f) Necessary electric shock personal and other protective equipment to safely perform assigned tasks:

_____

(4) Results of the arc flash hazard analysis per NFPA 70E Table 130.7(C)(15)(a):

(d) Available incident energy or hazard/risk category [_____]

(e) Arc flash boundary [_____]

(f) Necessary arc flash personal and other protective equipment to safely perform the assigned task:

_____

(5) Means employed to restrict the access of unqualified worker from the work area(s):

_____

_____

(6) Do you agree the above-described work can be done safely? [ ] Yes [ ] No (if no, return to requester)

Part III: Approval(s) to perform the Ballast Work while energized:

_____
Requester/Title

_____ _____
Department Head/Designee Maintenance Supervisor

_____
Qualified Employee

_____ Ballast Work Permit Expires in _____ [ ] Day(s) [ ] Week(s)
Date of Permit Approval

APPENDIX H - Environment Health & Safety Department Audit Checklist

Yes	No	Field Corrected (EHS Initials)	Item:
			Are annual field audits performed and documented by a supervisor for all workers?
			Do all qualified electrical workers have Cat III, 600 Volt rated meters (ANSI S82.82)?
			Do all qualified electrical workers have AF PPE Category 2 PPE (Arc rated clothing, face shields, etc.)?
			Do all workers have arc rated shirts and pants rated at a minimum of 8 cal/cm^2?
			Do all workers have arc rated face shields?
			Do all workers have balaclavas rated a minimum of 8 cal/cm^2?
			Do all workers have safety glasses?
			Do all workers have hearing protection?
			Do all workers have insulated gloves tested in the last 6 months (gloves stamped)?
			Do all workers have leather protectors to wear over insulated gloves?
			Do all workers have beekeeper style hoods rated at a minimum of 40 cal/cm^2?
			Do all workers have bibs/coveralls, and jackets rated at a minimum of 40 cal/cm^2?
			Do all workers have insulated tools (ASTM F 1505)?
			Are energized electrical work permits available upon request?
			Do all workers receive classroom retraining every 3 years?

EHS

Maintenance Supervisor

APPENDIX I - Job Briefing Summary

Project Name:_____ Job Number:_____ Date:_____
Supervisor:_____ Project Manager:_____

Check all that apply
Introduction: – The team discussed and identified:

[ ] A general overview and the goal of the work activity
[ ] All team members involved in the work activity were present and introduced
[ ] Methods of communication and contact info for all involved was distributed
[ ] All relevant work permits and documentation has been completed
[ ] Who is the on-site person in charge for
Name_____ Title_____

The Briefing Identified:

[ ] Hazards
[ ] Voltages involved
[ ] Secondary voltage sources
[ ] All unusual work conditions or factors that could affect the work
[ ] Personnel and Individual job assignments
[ ] Electric shock protection boundaries
[ ] Available incident energy
[ ] Potential for arc flash & the established arc flash boundary
[ ] All breakers, switches, interlocks, and control methods are known and identified
[ ] Safety procedures
[ ] Emergency contact information
[ ] Appropriate safety equipment on-site (First Aid kit, AED, etc…)
[ ] Required PPE, tools and equipment to control access is on-site
[ ] Reviewed all relevant drawings or other data (if available)
[ ] Task lighting, ventilation and any other work activity support equipment is on-site

Contingency Plan:

[ ] Discussed a “What if” option and all team members are aware of their role
[ ] Explained how the equipment is shut off in case of an emergency

Specific questions and answers brought up during briefing:

_____
_____
_____
_____

Sign in sheet for ALL participants of the job briefing

Employees	Vendors, Subcontractors, Suppliers, etc.
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

APPENDIX J - Medium Voltage (>1000 Volts) Electrical Work Permit

1. Voltage Level Involved: [_____]
2. Main circuit voltage (phase to phase) [_____]
3. Control voltage (max) [_____]
4. Personal Protection (per OSHA, NEC & NFPA 70E)

3.1 Approved type test equipment to be used: Yes/No

(a) Voltage sensing (non-contact) [_____]
(b) Thermography [_____]
(c) Hot Sticks [_____]
(d) Other [_____]

3.2 Type of hand electric shock protection (insulated gloves): [_____]

3.3 Arc Flash PPE: Indicate Rating of PPE (cal/cm^2)

(a) Total Body Protection [_____]
(b) Hand (Leather Protectors) [_____]
(c) Head Protection (face, neck and chin) [_____]
(d) Foot and Leg Protection [_____]
(e) Ear Protection Yes _____ No _____
(g) Other [_____]

3.4 Other protective equipment and considerations (Please describe):

(a) Guarded/Insulated Tools _____
(b) Insulate Worker From Ground _____
(c) Hard-Hat/ Safety Glasses _____
(d) Safety Grounds _____
(e) Discharge Grounds _____
(f) Fall Protection _____
(g) Non-Conductive Ladders _____
(h) Other _____

3.5 Securing work area Check if discussed prior to work:

(a) Barricades [_____]
(b) Signs [_____]
(c) Worker(s) [_____]
(d) Other [_____]

5. Description of the equipment:

(a) Location [_____]
(b) Manufacturer [_____]

(c) Model [_____]
(d) Voltage Class [_____]
(e) Year of Manufacture [_____]
(f) Serial Number [_____]
(g) Indoor or Outdoor [_____]
(h) Condition [_____]

6. Verification of Information: References Used to Prepare the Plan:

(a) Manufacturer Manuals [_____]
(d) Other documentation [_____]
(e) Are there any back feeds? Yes _____ No _____

(f) Are there any external power sources? Yes _____ No _____

7. Emergency Response Information
   (a) Nearest Telephone Location [_____]
   (b) Emergency Response Telephone Number [_____]
   (c) Fire Extinguisher Location [_____]
   (d) Is Buddy System in Place? Yes _____ No _____

8. Review and Authorization (Management):

   Name/Title_____

   Signature_____

9. Job Plan Review with Worker(s) Performing Work:

   Worker #1 Name/Title_____

   Worker #1 Signature_____

   Worker #2 Name/Title_____

   Worker #2 Signature_____

   Worker #3 Name/Title_____

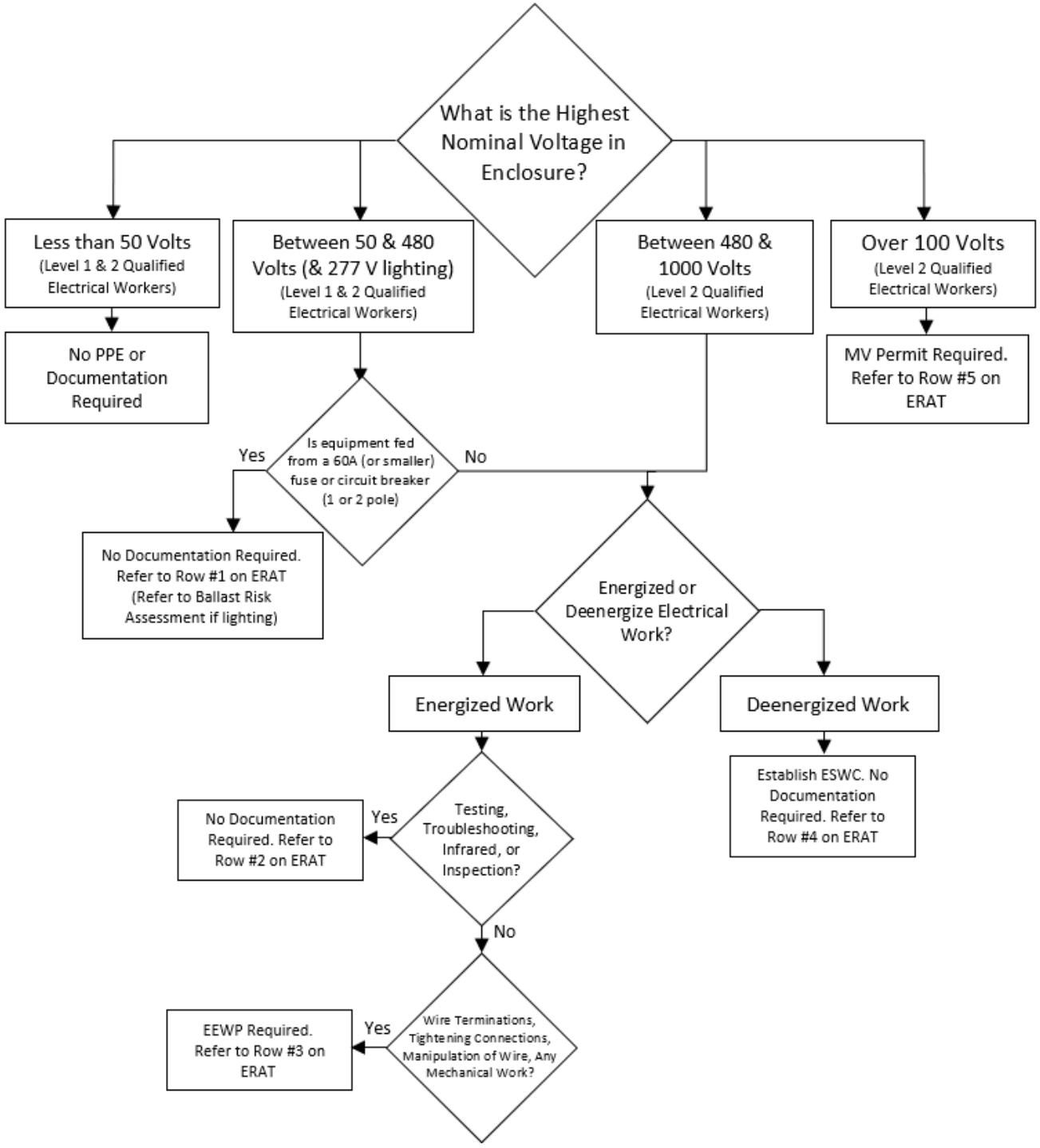
   Worker #3 Signature_____

   Supervisor Name/Title_____

   Supervisor Signature_____

APPENDIX K - Electrical Risk Assessment Flowchart

Management and qualified electrical workers shall be able to perform risk assessment to determine which tasks require certain documentation, PPE, boundaries, and insulated tools. The flowchart below outlines the thought process for performing this risk assessment.



APPENDIX L - Electrical Risk Assessment Table (ERAT)

Management and Electrical Supervisors shall be able to perform risk assessments to determine which tasks require which PPE, boundaries, and tools.

Please note that the requirements of an existing label indicating PPE and boundary requirements shall always supersede the Categories Method.

	PPE	Barricade Placement (minimum)	Insulated Tools Required?	Other Procedural Requirements	Qualified Electrical Worker Level Requirement
1	-Insulated Gloves -Leather Protectors -Cotton Clothing -Safety Glasses	5 feet	Yes, If work is done on energized conductors (i.e., terminations or cutting of wires)	If lighting circuit, refer to Ballast Risk Assessment. If circuit is to be de-energized, refer to ESWC section.	1 & 2
2	-Insulated Gloves -Leather Protectors -PPE based on Categories Method or Label -Hearing Protection	PPE Category 2: 5 Feet PPE Category 4: 20 feet	No, as no 'work' will be performed	Refer to 'Testing & Troubleshooting' Section	1 & 2
3	-Class 00 Insulated Gloves -Leather Protectors -PPE based on Categories Method or Label -Hearing Protection	PPE Category 2: 5 Feet PPE Category 4: 20 feet	Yes	Refer to 'Energized Work' Section	2
4	-Class 00 Insulated Gloves -Leather Protectors -PPE based on Categories Method or Label -Hearing Protection	PPE Level 2: 5 Feet PPE Level 4: 20 feet	No	Refer to 'ESWC' Section	1 & 2
5	-Class 2 Insulated Gloves -Leather Protectors -PPE based on Categories Method or Label -Hearing Protection	20 feet	Yes	See Medium Voltage Work Section	2

APPENDIX M - Summary of Training Requirements

The following table is a summary of training requirements for all levels of electrical workers.

Title	Electrical Safety Training (4 hour)	Unqualified Training (30 min)	AED/CPR (per Red Cross or NSC)	Methods of Contact Release (20 minute)	Management Training (2 hour)
Electrician (Qualified)	Every 3 years	-	Every 2 years	Annual	-
HVAC Technician	Every 3 years	-	Every 2 years	Annual	-
Controls Technician	Every 3 years	-	Every 2 years	Annual	-
Unqualified Worker	-	Every 3 years	-	-	-
Field Auditors (Management)	Every 3 years	Every 3 years	-	Annual	Every 3 years

APPENDIX N - Summary of Documentation Requirements

The following matrix outlines when documentation is required for the Electrical Safety Program.

Document	Requirements	Frequency
Level 1 Field Audit	To be completed by Department Head/ Designee of qualified electrical workers and retained by the department upon completion. For all Level 1 qualified electrical workers.	Annual (for every Level 1 worker)
Level 2 Field Audit	To be completed by Department Head/ Designee of qualified electrical workers and retained by the department upon completion. For all Level 2 qualified electrical workers.	Annual (for every Level 2 worker)
Annual Field Audit Retraining Form	To be filled out when a qualified electrical worker fails a section of their annual field audit	As needed
Electrical Safety (4-hour) Training Certificate	For qualified electrical workers. Records maintained by EHS.	Every 3 years
Unqualified Worker Training Certificate	For unqualified electrical workers. To be stored by EHS.	Every 3 years
Method of Contact Release Training Certificate	For qualified electrical workers. Records maintained by EHS>	Annually (for every worker)
Management Training Certificate	For manager field auditing qualified electrical workers. Records maintained by EHS>	Annually
Energized Electrical Work Permit	To be completed every time energized work is performed. Refer to 'Justification for Energized Work' section for more details.	As needed
Environmental Health and Safety Audit Checklist	EHS is to audit each department to ensure that safe work practices are being followed	Annually (for each department)
Job Briefing Summary	When the electrical work includes any of the following: 1. Multiple contractors 2. Multiple shifts 3. Unusual work 4. Accessing MCC, switchgear, or switchboards 5. High traffic areas	As needed
Medium Voltage (>1000 Volts) Electrical Work Permit	Any time electrical work is performed on electrical components with a nominal voltage exceeding 1000 Volts	As needed

APPENDIX O - Definitions

Arc Flash Hazard - A dangerous condition associated with the possible release of energy caused by an electric arc.

Arc Flash Suit - A complete arc-rated clothing and equipment system that covers the entire body, except for the hands and feet that are protected by rubber gloves with leather protectors and leather shoes.

Arc Rating - The value attributed to materials that describe 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 break open threshold (E_{BT}) (should a material system exhibit a break open response below the ATPV value). Arc rating is reported as either ATPV or E_{BT} whichever is the lower value.

Balaclava - An arc-rated hood that protects the neck and head except for the facial area of the eyes and nose.

Barrier - A physical obstruction (cones, tape, saw horse) that is intended to prevent contact with equipment or energized electrical conductors and circuit parts or to prevent unauthorized access to a work area.

Boundary, Arc Flash - An approach limit at a distance from a prospective arc source within which a person could receive a second-degree burn if an electrical arc flash were to occur.

Boundary, Limited Approach - An approach limit at a distance from an exposed energized electrical conductor or circuit part within which an electric shock hazard exists.

Boundary, Restricted Approach - An approach limit at a distance from an exposed energized electrical conductor or circuit part within which there is an increased risk of electric shock, due to electrical arc-over combined with inadvertent movement, for workers in close proximity to the energized electrical conductor or circuit part.

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.

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

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

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

Incident Energy Analysis - A component of an arc flash risk assessment used to predict the incident energy of an arc flash for a specified set of conditions.

Qualified Electrical Worker - 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 and avoid the hazards involved.

Risk - A combination of 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 - An overall process that identifies hazards, estimates the potential severity of injury or damage to health, estimates the likelihood of occurrence of injury or damage to health, and determines if protective measures are required.

Electric Shock Hazard - A dangerous condition associated with the possible release of energy caused by contact or approach to energized electrical conductors or circuit parts.

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

Step potential - A ground potential gradient difference that can cause current flow from foot to foot through the body.

Touch potential - A ground potential gradient difference that can cause current flow from hand to hand, hand to foot, or another path, other than foot to foot, through the body.

Touch/Step potential - A ground potential gradient difference that can cause current flow from hand to foot through the body.

Unqualified Worker - A person who is not a qualified worker.

Voltage, Nominal - A nominal value assigned to a circuit or system for the purpose of conveniently designating its voltage class (e.g., 120/240 volts, 480Y/277 volts, 600 volts).

APPENDIX P - References

Codes & Standards:

(a) 29 CFR 1910.331-335
(b) 29 CFR 1910.269
(c) 29 CFR 1910.147
(d) NFPA 70E 2024
(e) NFPA 70 (NEC) 2023
(f) ASTM F 1505
(g) ASTM F 1506
(h) ANSI S82.02
(i) ANSI Z535.4
(j) ANSI Z10
(k) IEEE 3007.3 2012
(l) NEMA SG-1000 2008
(m) NESC 2012
(n) ASTM F855
(o) ASTM F2522

Other Resources:

"Safety Basics Book." (2001): 9-11. Cooper Bussman, 2001. Web. 27 Apr. 2016.

Campbell, Richard B., and David A. Dini. "Occupational Injuries From Electrical Shock and Arc Flash Events." Fire Protection Research Foundation (2015): 1-96. Print.

Wyzga, RE, Lindroos, W.," Health Implications of Global Electrification", Annals of the New York Academy of Sciences, 1999, vol 888, pp1-7.

"Work Related Electrical Injuries: Study Sparks New Insights", Liberty Mutual Research Institute for Safety, vol 13, No. 3, Winter 2010

Lee, Ralph H. "The Other Electrical Hazard: Electric Arc Blast Burns". N.p.: Institute of Electrical and Electronics Engineers, 1982. Print.

Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use. Research Triangle Park, NC: Instrument Society of America, 1996. Print.

APPENDIX Q - Exclusions

Herzig Engineering technical documents are developed through industry experience based on the latest codes & standards for electrical safety including OSHA, NFPA 70E, NEC, IEEE 1584, and others. Herzig Engineering does not independently test, evaluate, or verify the accuracy of information or the soundness of any judgment contained in Herzig Engineering documents.

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Please refer to the notes of the Arc Flash PPE Category method in NFPA 70E 2024 Table 130.7(C)(15)(a) for all applicable limitations to field application of this method. Workers may not be wearing sufficient PPE if the criteria of these notes are not calculated and verified. As Herzig Engineering has not performed engineering calculations on the electrical equipment, Herzig Engineering cannot verify that the available fault current and clearing time of overcurrent protective devices as required in this method will be met. Because of this, Herzig Engineering disclaims any liability for any personal injury, property, or other damages of any nature whatsoever, whether special, indirect, consequential or compensatory, directly or indirectly resulting from the publication, use of, or reliance on this application of Table 130.7(C)(15)(a).