CEDARVILLE UNIVERSITY

SUBJECT:	**Electrical Safety Policy & Procedure**
EFFECTIVE DATE:	Updated October 2022
APPLICATION:	Campus Wide/Physical Plant Operations
ORIGINATOR:	Douglas W. Chisholm Director of Campus Safety
APPROVED:	Electrical Department

POLICY:

This policy & procedure is written in compliance with the Occupational Safety & Health Administrations Standard (OSHA 29 CFR 1910.147, CFR 1910.331 through 1910.335 and NFPA 70 E), for the control of hazardous energy sources and electrical safety.

PURPOSE:

To prevent the incidence of injury due to contact with energized electrical circuits or components or the unexpected energizing or startup of machines, and equipment, or release of stored energy. Injury may result from electrocution, arc-flash or physical contact with moving or active fan blades/belts, pulleys, saw blades, augers, gears, rotors, air pressure, steam, etc.

GENERAL REQUIREMENTS:

An electrical safety program is vital in establishing an electrically safe workplace. All employees and contractors will be required to follow the policies and procedures outlined in this document and all associated governmental regulations pertaining to them.

CONTENTS:

Policy, purpose and general requirement statements, definitions.
Procedures:

DEFINITIONS:

The following terms used in this policy and procedure statement have been defined below:

- **Circuit Breaker**: a device that automatically interrupts the flow of an electrical current.
- **Breaker Box:** an insulated box on which interconnected circuits are mounted.
- **Electrical Panel:** an insulated panel on which electrical wires are mounted.
- **Ground-fault Interrupter (GFCI):** detects grounding problems and shuts electricity off.
- **High Voltage:** the term high voltage applies to electrical equipment that operates at more than 600 volts (for terminal-to-terminal operation) or more than 300 volts (for terminal to ground operation).
- **Hazardous Energy Sources:** this term applies to stored or residual energy such as that in capacitors, springs, elevated machine members, rotating flywheels, hydraulic systems, and air, gas, steam, or water pressure.
- **Lock-out:** the placement of a lock on an energy-isolating device. This act prevents workers from operating a piece of equipment until the lock is removed.
- **Tag-out:** the placement of a tag on an energy-isolating device. A tag out device is a prominent warning device of a lockout.
- **Energy-isolating Device:** a mechanical device that prevents the transmission or release of energy. Examples include manually operated circuit breakers, disconnect switches, line or block valves. Pushbuttons, selector switches, and other control circuit devices do not isolate energy. Energy-isolating devices should be lockable by means of a hasp or other type of attachment. It should not be necessary to dismantle or reassemble a device to lock it.
- **Approach boundaries:** see definitions under section 5 of this policy.
- **Arc-flash** is a short circuit that flashes from one exposed live conductor to another, or to ground. The resulting ionized air creates electrically conductive superheated plasma that can reach temperatures of 5000 F and above. The explosion takes less than one second and produces a brilliant flash. Intense heat, and a pressure blast equivalent to several sticks of dynamite.

PROCEDURES:

The procedures outlined in this section identify the specific requirements of the electrical safety program at the university.

1.0 **General Electrical Safety guidelines for the University:**

- Be familiar with the electrical hazards associated with your workplace.
- Unplug electrical equipment before repairing or servicing.
- If a prong breaks off inside an outlet, do not attempt to remove it yourself. Contact the electrical department in Physical Plant.
- Ensure that outlets are firmly mounted.
- Report all electrical problems, including tripped breakers, broken switches, and

flickering lights to the Physical Plant.

- Do not attempt repairs or alterations to any electrical system on campus. Only authorized individuals from the Physical Plant Department are permitted to perform these tasks on campus.
- All appliances used in Cedarville University buildings must be UL (underwriter's laboratory) of FM (factory manual) labeled.
- Only extension cords that are equipped with a power supply with fusable link are permitted to be used on a permanent basis. Inter-connecting the cords are not permitted at any time.
- Use of multi-plugs are not permitted at any time.
- Extension cords are only for temporary use and must be unplugged at the end of each day - they are never to be interconnected. If they are placed in walking areas, they must be covered with duct tape or electrical safety covers to prevent trips or falls.
- Do not use an appliance that sparks, smokes, or becomes excessively hot, unless the appliance is specifically designed to exhibit these characteristics.
- Portable electrical heaters are not to be used in any area on campus without the approval of the electrical department. Only those heaters placed by the university are to be used. Heaters must be placed to avoid creating a trip hazard and must be kept away from combustible materials. Heaters must be turned off at the end of each day. Ceramic heaters designed with built in safety features that will deactivate if tipped over, are the only units permitted and issued on campus.
- Keep electrical equipment away from water, unless the appliance is specifically designed for use around water, such as a wet-dry shop vacuum.
- Use GFCI power cords when working around wet areas and whenever possible in general.
- Beware of overhead power lines when working with tall equipment (cranes, backhoes, aerial lifts, ladders, etc.)
- Discard damaged cords, cords that become hot, or cords with exposed wiring. Never unplug an appliance by pulling on the cord, pull on the plug.
- Do not run electrical cords under rugs, above ceiling tiles or through walls.

2.0 **Working on De-energized Circuits (Lock-out Tag-out Procedures):**

Ideally all electrical work should be performed by deactivating the electrical current (see item 3.0 for exceptions). Work on electrical circuits and panels should be carefully scheduled in advance to allow for temporary power shutdowns. When deactivating the electrical current, it is important to follow proper lock-out/tag-out procedures as outlined in the chart provided.

2.1 **Lock-out Tag-out Chart**:

Step	Required Action
1	**Preparation and Notification**. Identify all affected employees and notify them that a lock-out and/or tag-out system is going to be utilized and the reason for it. This notification can be a verbal communication.
2	**Shutdown**. If machine or equipment is operating, or the circuit is live, shut it down using the safe and normal stopping or de-energizing procedures.

3	**Isolation**. Physically locate the energy isolating device that is needed to control the energy to the machine, equipment or circuit and operate it in such a manner as to isolate the machine or equipment from the energy source.
4	**Lock and Tag Application**. The authorized employee shall affix his or her personal lock, and properly sign and date it as their tag, applying it to the energy isolating device to hold it in a safe off position.
5	**Verification of Isolation**. Verify the mechanical integrity of the energy isolation device and verify the de-energization of the machines, equipment, or processes (zero-energy state). Perform required tests specific to the machines, equipment, or processes, such as zero-voltage verification, to ensure that isolation has been achieved and that any stored hazardous energy is relieved. A worker performing electrical verifications shall be a qualified energized electrical worker in accordance with Training Requirements. Return all operating controls to the neutral or off position. Note: When work involves contact with exposed conductors, zero voltage verification must be done using meters (fixed or portable) or other similar test equipment.
6	**Keeping a Lock and Tag in Place**. The equipment is now locked out. Every person working on the equipment shall keep his or her personal lock and tag (in some cases only one tag may be sufficient) on until he or she has finished working on or near the equipment.
7	**Perform the required work safely.**

2.2 **Return to Service Procedures:**

Upon completing the work, the authorized worker(s) shall take the following steps to restore the energy to the machine or equipment.

Step	Required Action
1	Determine that it is safe to energize the machine or equipment, and personal and tools are clear
2	Check to ensure that machine or equipment components are operationally intact, and there is no mechanical hazard.
3	Notify operators and other affected employees that the machine or equipment is ready to be energized and the lock and tag is going to be removed momentarily.
4	Remove the lock and tag from each energy isolating device. A lock or tag must not be removed by anyone other than the individual who installed it, unless by the supervisor in the other person's absence, after it can be shown that no other persons are working on the circuit, equipment, etc. and it is safe to energize the power.

2.3 **Issuance of Locks & Tags:**
Each employee working on de-energized circuits shall have their own locks and tags as supplied by the University. Each employee has the responsibility for obtaining and replacing these devices from their department as approved by their supervisor/manager.

3.0 **Working on Live Circuits (ARC-flash prevention procedures):**
Sometimes there is no choice but to work on energized or live circuit(s) since procedures like testing or troubleshooting often cannot be performed any other way. The hazards of live circuit work are so serious that the only way to ensure your safety is to follow specific safety measures and utilize certain (PPE) personal protective equipment to prevent electrocution and/or arc-flash.

3.1 **Flash Hazard Analysis** - according to NFPA 70E section 110.8(B)(1)(b), a flash hazard analysis shall be done to protect personnel from the possibility of being injured by an arc-flash. The analysis shall determine the Flash Protection Boundary and the personal protective equipment that people within the Flash Protection Boundary must use. This analysis is accomplished through a series of complicated calculations.

At the conclusion of NFPA 70-E, 2004, 130.3(B) there is a provision for a shortcut, of sorts. It states, as an alternative, the PPE requirements of 130.7(C)(9) shall be permitted to be used in lieu of the detailed flash hazard analysis approach described in 130.3(A). This alternative approach will be utilized at Cedarville University.

3.2 **PPE Matrix & Hazard Risk Categories** -the following chart is defined in NFPA 70E-130.7(C)(10) and 70E-130.7(C)(11). It describes the hazard categories on a **0-4 scale** with minimum Arc- rating, measured in Cals. These Arc-flash categories correspond with the required PPE designed to protect the worker from physical injury.

See chart!

Category	Minimum Arc Rating (cal/cm2)	Voltage Levels	Non-melting or Untreated Natural Fiber clothing	Arc Flash Fire Rated Clothing	Fire Rated Equipment
0	N/A	**50-120V**	Long-sleeve uniform shirt Long pants	N/A	Safety glasses
1	4	**121V-240V**	T-shirt or special uniform shirt Long pants	Long-sleeve shirt Long pants	Safety glasses or goggles **Arc-rated face shield with Helmet & Ear plugs** **Leather/rubber elect. Gloves** Hearing protection Leather work shoes
2	8	**241V-480V**	T-shirt or special uniform shirt Long pants	Long-sleeve shirt Long pants	Safety glasses or goggles **Arc-rated face shield with Helmet & Ear plugs** **Leather/rubber elect. gloves** Hearing Protection Leather work shoes
3	25	**481V - 600V ***	T-shirt or special uniform shirt Long pants	Long-sleeve shirt Long pants	**Flash suit jacket (multi-layer)** **Flash suit pants** **Arc-rated face shield with Helmet & Ear plugs** Hard hat Safety glasses or goggles **Flash suit hood** Hearing protection **Leather/rubber elect. gloves** Leather work shoes
4	40	**600V + ***	T-shirt or special uniform shirt Long pants	Long-sleeve Shirt Long pants	**Flash suit jacket (multi-layer)** **Flash suit pants** **Arc-rated face shield with Helmet & Ear plugs** Hard hat Safety glasses or goggles **Flash suit hood** Hearing protection **Leather/rubber elect. gloves** Leather work shoes

4.0 **Policy for working on High Voltage levels exceeding 480 V *:**
The employees of Cedarville University will not work on voltage levels exceeding 480V. All

such work will be contracted with the appropriate high voltage company**.** The university does not have PPE to work on systems in categories 3 and 4.

4.1 **Opening up Transformers for Visual Inspection:**
While opening up transformers, a Category 2 level of PPE will be worn at all times. Other than conducting a visual inspection, university employees will not work on any element of the transformer.

4.2 **Stand-by Procedures:**
When standing by transformers in the process of being trouble shot by our High Voltage contractor, employees will observe the proper boundary distances. Even while wearing level 2 protection, they are not to go beyond the "Limited Approach Boundary" category (3) for exposed Fixed Circuits.

5.0 **Approach Boundaries for Shock Protection:**
The table indicated on page 8 provides approach distances to exposed energized electrical conductors. The table identifies boundaries for limited approach, restricted approach, and prohibited approach. The table establishes satisfactory distances between a qualified or unqualified person and conductors that have not been placed in an electrically safe work condition.

5.1 **The Limited Approach Boundary:**
This provides the "limit of approach distances" for unqualified persons to a live part. In concept, unqualified people are less capable of recognizing a shock and flash hazard. Therefore, these persons should remain at a safer distance from open, energized conductors. When there is a need for an unqualified person to cross the limited approach boundary to perform a minor task, or look at equipment, a qualified person shall advise him/her of the possible hazards and ensure the unqualified person is safeguarded. Under no circumstances shall an unqualified person be permitted to cross the restricted approach boundary.

5.2 **The Restricted Approach Boundary:**
This is the closest distance for an unqualified person. Under no circumstances shall an unqualified person be permitted to cross the restricted approach boundary. To cross this boundary, a person must meet the following criteria:

- Be a qualified person
- Have an approved plan
- Use PPE approved for the conditions
- Position his or her body in a way that minimizes risk of inadvertent contact.

5.3 **The Prohibited Approach Boundary:**
Is the minimum approach distance to an exposed energized conductor or circuit part and is the closest point to prevent flash over. To cross this boundary and enter the prohibited space shall be considered the same as making contact with exposed energized conductors or circuit parts. To cross the prohibited approach boundary, the qualified person must do the following:

- Have specified training to work on energized conductors or circuit parts.
- Perform a hazard risk analysis (how many volts, etc.)

- Review plan with supervisor as to the need to work within prohibited approach boundary.

- Use PPE appropriate for working on exposed energized conductors or circuit parts and rated for the voltage and energy level involved.

1	2	3	4	5
	Limited Approach Boundary		Restricted Approach Boundary	Prohibited Approach Boundary
Nominal Voltage Range Phase to Phase	Exposed Movable Conductor *	Exposed Fixed Circuit Part *	Includes Inadvertent Movement Adder	
0 to 50 V	Not specified	Not specified	Not specified	Not specified
51 to 300 V	10 ft. 0 in.	3 ft. 6 in.	Avoid contact	Avoid Contact
301 to 750 V	10 ft. 0 in.	3 ft. 6 in.	1 ft. 0 in.	0 ft. 1 in.
751 to 15 kV	10 ft. 0 in.	5 ft. 0 in.	2 ft. 2 in.	0 ft. 7 in.
15.1 kV to 36 kV **(transformers)**	10 ft. 0 in.	6 ft. 0 in.	2 ft. 2 in.	0 ft. 10 in.

Note: * *The exposed movable conductor (column 2) is intended to mean that either the conductor might move (as in an overhead line), or the person might move (as in an articulating support platform). A fixed circuit part (column 3) refers to a task where the conductor is not expected to move, such as within a unit substation.*

6.0 **Personal Protective Equipment:**

Electricians and HVAC technicians have access to several different Arc-flash equipment bags at the universities expense. This equipment will be signed out to them for use, and it will be their responsibly to maintain it in good working condition. Any defects should be reported to their manager/supervisor for replacement. Other physical plant personal will be able to sign out equipment as needed. Standard issue includes:

- Rubber/leather gloves
- Helmet with Flash Shield & ear plugs
- Select tools
- Rubber/leather gloves
- Flash suite and hood

Employees are expected to use the equipment as issued. Failure to do so may result in disciplinary action in accordance with regular university practices. Any modification to the use of equipment must receive prior approval by the Electrical Manager and Campus Safety Director.

6.1 **Gloves:**
The electrical rated rubber gloves must be sent out and tested every 6 months to 1 year depending on the amount of use they get, as part of our glove replacement program. If found to be defective after testing, they will be replaced with new ones; otherwise, they will be returned for continued use. Any damaged gloves should be reported to management/supervision immediately and taken out of service.

6.2 **Protective clothing:**
Each individual will be issued regular fire rated uniform shirts and pants. A fire rated cotton short sleeve shirt can be used with the fire rated protective arm sleeve in lieu of a long sleeve shirt. It is the employees' responsibility to purchase their own undergarments and ensure that they are 100% cotton rated.

6.3 **Electrically Insulated Tools:**
Each electrician and HVAC technician will be issued special screw drivers, wire cutters and plyers, unless they prefer to use their own electrical rated tools.

7.0 **Labeling of Electrical Panels:**
In accordance with NEC 2002 - Article 110.16 Flash Protection, each electrical panel will include a "warning label" that is intended to reduce the occurrence of severe injury or death due to arc faults occurring that expose those working on or near energized electrical equipment. The warning label should remind a qualified worker who intends to open the equipment for analysis or work that a serious hazard exists, and that the worker should follow appropriate work practices and wear appropriate personal protective equipment (PPE) for the specific hazard (a non-qualified worker must not open or be near open energized equipment).

8.0 **Electrical Emergency Response:**
The following instructions provide guidelines for handling three types of electrical emergencies.

8.1 **Electric Shock** - when someone suffers serious electrical shock, he or she may be knocked unconscious. If the victim is still in contact with the electrical current, immediately turn off the electrical power source. If you cannot disconnect the power source - do not touch the victim and immediately call 911. **IMPORTANT**: *Do not touch a victim that is still in contact with a power source; you could electrocute yourself.*

8.2 **Electric Fire** - if an electrical fire occurs, try to disconnect the electrical power source, if possible. If the fire is small, you are not in immediate danger, obtain a near-by a BC or ABC fire extinguisher and extinguish the fire.
IMPORTANT: *Do not use water on an electrical fire.*

8.3 **Power lines** - stay away from live power lines and downed power lines. Be particularly careful if a live power line is touching a body of water. The water will conduct electricity. If a power line falls on your car while you are inside, remain in the vehicle until help arrives or it is no longer safe to remain inside. When exiting such a situation, jump from the vehicle, and shuffle away (DO NOT WALK) from the vehicle until you are safely away. Remember that the ground can be energized around the vehicle and to walk could cause your death.