A. INTRODUCTION

The OSHA electrical standards were originally based on the National Fire Protection Association's standard NFPA 70E, Electrical Safety Requirements for Employee Workplaces, and the NFPA 70 Committee-derived Part I of their document from the 1978 edition of the National Electrical Code (NEC). The standards referenced from the NEC were those considered to most directly apply to employee safety and least likely to change with each new edition of the NEC. OSHA's electrical regulations contain few direct references to the NEC. However, the NEC contains specific information as to how the required performance can be obtained.

B. POLICY

2. It is the policy of Alvernia University that any individual performing work involving electrical equipment will do so in accordance with the procedures outlined in this document.
3. The procedures described in the Alvernia University The Control of Hazardous Energy (Lockout / Tagout) Plan will be followed in conjunction with the procedures of this section.
4. Alvernia University will provide personal protective equipment, operating equipment, and supervision necessary for protection of the individual health and safety.
5. Servicing or maintenance of electrical equipment should be performed only on de-energized equipment unless specific situations require that the equipment be energized. See Section F for these situations.
6. Electronic devices such as cell phones, walkie talkies, etc. shall not be permitted when working on exposed energized equipment or within approach boundaries to exposed energized equipment.

C. PURPOSE

The purpose of this program is to prevent injuries and accidents and protect Alvernia University employees from electrical hazards.

This program has been established in order to:

- Ensure the safety of employees who may work on or near electrical equipment.
- Ensure that employees understand and comply with safety standards related to electrical work.
- Ensure that employees and their agents follow uniform practices during the progress of electrical work.
- Comply with OSHA Standards to:
  o Provide and demonstrate a safety program with defined responsibilities.
  o Determine the degree of arc flash hazard by Qualified personnel.
  o Affix warning labels on equipment.
  o Provide personal protective equipment (PPE) for workers.
  o Provide documented training to workers on Lockout/Tagout procedures and the hazards of arc flash.
  o Provide appropriate tools for safe work.
D. DEFINITIONS

“Arc Flash” – A short circuit through the air when insulation or isolation between electrical conductors is breached or can no longer withstand the applied voltage. In an arc flash incident, an enormous amount of concentrated radiant energy explodes outwards from the electrical equipment creating pressure waves that can damage a person's hearing, a high-intensity flash that can damage their eyesight and a superheated ball of gas that can severely burn a worker's body and melt metal. The pressure wave can send loose material like pieces of damaged equipment, tools and other objects flying through the air. The best way to prevent arc flash from occurring is to de-energize the system before beginning any work and always verify that the energy is controlled.

Arc flash typically occurs while electrical equipment is being disconnected, inspected or serviced, and can be caused by a variety of factors such as:

- Accidental contact with live parts
- Close proximity of a conductive object, like a metal tool, with a high-amp current source
- Sparks generated from racking in breakers, replacing fuses, or even from dropped tools
- Over voltage conditions
- Insulation failure or corrosion buildup on electrical terminals
- Presence of fumes or chemical vapors that reduce the breakdown voltage of air

“Electrical Arc Flash Hazard Analysis” - An electrical arc flash hazard analysis is done to protect personnel from the risk of arc flash burn injuries. It determines the flash protection boundary to keep personnel away from the arc hazard risk and the level of fire retardant clothing needed to minimize the extent of burn injuries for personnel required to work within the flash protection boundary.

“Energized Electrical Work Permit” – The energized electrical work permit is a written description of the electrical work to be done, signatures of qualified personnel who are designated by the department to take responsibility for the work, the results of the electrical hazard analysis, and documentation of all safety equipment and practices that will be used. Methods to restrict unauthorized personnel from the work area and the job debriefing are also included in the permit.

“Electrical Equipment” - Generally, electrical equipment can be disconnected from its power source with a cord and plug at a receptacle or at a disconnect box. Equipment hardwired, such as but not limited to a breaker panel, is considered part of the facility electrical system and requires shutdown by qualified personnel.

“Electrical Shock Hazard Analysis” – A shock hazard assessment must be performed to determine the voltage that affected employees can be exposed to, what the boundary requirements are to prevent an electrical shock and the appropriate electrical personal protective equipment to minimize the potential for electrical shock for affected employees. Unauthorized personnel must stay 10 feet away from any unprotected electrical equipment.
“Energized Work” - Working on or near exposed electric conductors or circuit parts that are or can become energized because electrical power to the working equipment or system has not been shut down. An Energized Work Permit is required for work on energized equipment. An Energized Work Permit is not required for troubleshooting, thermography, testing or visual inspection of energized equipment.

“Facility Electrical System” - The facilities’ electrical service such as breaker panels, switchgears and transformers and electrical distribution including lighting and branch wiring.

“Flash Protection Boundary for Arc Flash” - A clearance distance away from exposed energized parts that limits the extent of burn injuries for unprotected personnel to second degree burns in the event of an electrical arc flash. As per NFPA 70E and the NEC, the flash protection boundaries define the safe working distances in which any qualified trades person can approach energized components with a certain level of personal protective equipment. An approach limit is a distance from exposed live parts within which a person could receive a second-degree burn if an electric arc flash were to occur. There are three such boundaries:

1. Prohibited Approach Boundary
2. Restricted Approach Boundary
3. Limited Approach Boundary

A general rule would be to maintain a four (4) foot boundary as the clearance distance away from exposed energized parts.

“Job Debriefing” - A review by the supervisor of hazards related to the specific electrical work to be done which includes the electrical protective equipment to use, the safe electrical work procedures to follow, and the energy source controls.

“Justification - The process to justify exceptions to shutting down electrical energy sources prior to doing the work. The department designee(s) must document the justification to do the work with equipment or systems still energized. Energized work on facility electrical systems including equipment permanently connected (hard-wired) to the facilities’ electrical systems will require an Energized Electrical Work Permit.

“Low Voltage” - is defined as work performed directly on or in proximity of systems of 600 volts, nominal, or less.

“Non injurious clothing” – Clothing made from the following types of fabrics: polyester, acetate, nylon rayon, spandex and polypropylene (either alone or in blends) can exacerbate burn injuries in the event of an electrical arc fire because they will melt into the skin. These are prohibited unless specifically treated to be flame retardant.

“Non-qualified Personnel” - Non-qualified personnel do not have full knowledge of the operation of electrical equipment or system and all of the inherent electrical hazards. They may be required to provide assistance to the qualified electrician who is responsible to provide safety oversight. Even though non-qualified personnel do not work directly on electrical equipment, they can still be potentially exposed to the risks of electrical hazards and must be protected based on the results of the electrical hazard analysis. A person can be considered qualified with respect to certain equipment and methods but unqualified for others.
“Prohibited Approach Boundary for Shock Hazard” – The prohibited boundary is determined by the voltage of the electrical equipment. Work performed within the prohibited boundary should be avoided because the risks are the same as working directly with exposed electrical parts. Any work to be done in this high risk area must proceed with qualified personnel and an Energized Electrical Work Permit. Reference: NFPA 70E Table 130.2(C) Approach Boundaries for Live parts for Shock Protection.

“Qualified Personnel” - Qualified personnel must be knowledgeable of the electrical equipment or systems that they work on, the inherent electrical hazards and how to avoid them. OSHA and NFPA 70E training in electrical safety work practices and the protective measures necessary to avoid shock and burn injury hazards is required for personnel assigned to facility maintenance and service responsibilities related to electrical equipment and facility electrical systems. Qualified Persons shall, at a minimum, be trained in and familiar with:

- The skills and techniques necessary to distinguish exposed live parts from other parts of electric equipment.
- The skills and techniques necessary to determine the nominal voltage of exposed live parts.
- The clearance distances specified on page 8 Table 1 of this Plan and the corresponding voltage to which the qualified person will be exposed.

A person can be considered qualified with respect to certain equipment and methods but unqualified for others.

“Restricted Approach Boundary for Shock Hazard” – The restricted boundary is determined by the voltage of the electrical equipment. Any work to be done within this area must proceed with qualified personnel and an Energized Electrical Work Permit. (Reference: NFPA 70E Table 130.2(C) Approach Boundaries for Live parts for Shock Protection).

“Shutdown” - The action of cutting off electrical power to electrical facility systems or equipment and securing the electrical energy from accidental startup until the work has been completed.

E. RESPONSIBILITIES

1. The Environmental Health & Safety Manager will:
   a. Assist with the development, review and maintenance of the Alvernia University Electrical Safety Plan.
   b. Ensure that all affected (both “Qualified” and “Non-Qualified”) employees are aware of the Plan.
   c. Periodically assess compliance with the requirements of the OSHA Standard.
   d. Notify the Maintenance Supervisor of any changes affecting the Alvernia University Electrical Safety plan.
   e. Ensure that electrical safety training is provided as required.

2. Supervisors
   a. Ensure that Alvernia University employees under their direct supervision understand and adhere to adopted procedures during electrical work operations.
b. Assure that necessary education and training will take place prior to the employee being assigned to work on electrical equipment.

c. Provide necessary personal protective equipment and resources.

d. Identify locations and potential hazards of all electrical sources.

e. Make routine surveys of electrical procedures to ensure that safe practices are being followed.

3. Qualified Employees

a. Will attend all required electrical safety training programs prior to working on or near high voltage circuits.

b. Implement the safety-related work practices required.

c. Use the required personal protective equipment for both shock and arc flash.

d. Inform supervisors of any situations which may jeopardize the employees’ safety.

e. Inform supervisor of any personal protective equipment that is needed.

f. Will employ the procedures specified in Alvernia University The Control of Hazardous Energy (Lockout / Tagout) Plan

4. Non-Qualified Employees

a. Will attend all required electrical safety awareness training programs.

b. Will not attempt to maintain or repair any energized circuit.

c. Will not enter any marked areas specifically marked as a Flash Protection Boundary for Arc Flash, Prohibited Approach Boundary for Shock Hazard, or Restricted Approach Boundary for Shock Hazard.

F. SAFE WORK PRACTICES

1. Energized Electrical Equipment

De-energization of electrical equipment provides the highest level of safety when servicing or maintaining electrical equipment. Working on live electrical parts should be avoided whenever possible, and should only be performed in the following two scenarios:

- De-energizing the equipment creates additional hazards, such as shutdown of hazardous ventilation systems or life safety systems; and
- Equipment must be energized to allow for testing that can only be performed live.

Only employees that are Qualified persons are allowed to work on live electrical parts that are 50 V or higher. Qualified persons must perform live electrical work in compliance with the most current National Fire Protection Association 70E Standard for Electrical Safety in the Workplace (NFPA 70E).

The following work practices must be followed when working on live electrical parts:

- Personal protective equipment (PPE) must be used when required.
- Conductive apparel (watches, bracelets, rings, key chains, necklaces, zippers, cloth with conductive thread, etc.) must not be worn;
- Non-conductive hand tools must be used and must be rated for the voltage at which live electrical work is being performed;
- Barricades and signage must be posted a safe distance away from the work area and unqualified persons must not be allowed in the work area;
- Conductive materials and tools must be kept a safe distance away from live electrical parts; and
• Electrical equipment must be restored to safe conditions and all safeguards must be replaced when work is complete.

When electrical equipment is not required to be live during servicing or maintenance work, equipment should be de-energized in accordance with the Alvernia Lockout/Tagout policy.

2. Ladders
   Ladders made from conductive materials such as aluminum or steel pose an electrocution hazard when working around overhead power lines or energized circuits. Follow all applicable safety requirements when using ladders around live overhead power lines or when performing live electrical work.

3. Confined Spaces
   Confined spaces with live, exposed electrical parts are considered permit-required confined spaces. Work inside these spaces must be conducted in accordance with the Alvernia University Permit-Required Confined Space policy.

4. Electrical Portable Power Tools
   Electrical portable power tools must be used in accordance with all applicable safety policies and regulations. Inspect the power tool for defects before use.

5. Personal Protective Equipment
   Personal protective equipment (PPE) for electrical hazards shall be used and maintained in accordance with the Alvernia University Personal Protective Equipment (PPE) policy.

6. Extension Cords and Power Strips
   a. Employees must be aware of the dangers of misusing extension cords and power strips, which include electrocutions and fire hazards.
   b. Extension cords and power strips must be inspected for damage to the outer insulation prior to use. Damage to the outer layer of insulation itself may be repaired with electrical tape. If damage extends beyond the outer layer of cord (i.e. if the conductor is exposed), then the extension cord must discarded.
   c. Extension cords and power strips must be plugged into a wall outlet and may not be plugged into another extension cord or power strip.
   d. Extension cords and powers strips that have a ground pin may only be plugged into grounded outlets. Devices that have a ground pin may only be plugged into extension cords and power strips that accept ground pins. Do not remove the ground pin from the plug of the device or the extension cord or power strip;
   e. Extension cords may never be used in place of permanent wiring and may only be used for a temporary period of up to 90 days.
   f. Unless they are specifically designed to do so, extension cords must not be used to suspend portable lighting. Extension cords must be heavy duty and rated for the power tool with which it is being used. Only extension cords rated for outdoor use may be used outdoors.
   g. The following work practices shall be followed when using extension cords:
      • Never use an extension cord to lift or lower power tools;
- Avoid running cords over sharp corners and projections;
- Do not run cords through windows or doors unless they are protected from damage and then only used on a temporary basis;
- Do not run cords above ceilings and inside or through walls, ceilings, or floors;
- Do not fasten cords with staples or otherwise hang them in such a fashion as to damage the outer jacket or insulation;
- Do not use extension cords to suspend portable lighting, unless they are specifically designed to do so;
- Do not lift or lower equipment with extension cords; and
- Cover cords with a cable bridge or tape when they extend into a walkway or other path of travel to avoid tripping hazards.

h. Power strips must be UL approved and are to be used within the manufacturer’s guidelines. Industrial equipment, appliances (ie. refrigerators, microwaves, etc.), power tools, and other high-current devices may not be plugged into power strips unless they are UL-approved for industrial use (the manufacturer’s guidelines will specify the rating of the power strip).

i. All cords should be GFCI-protected.

7. **Ground Fault Circuit Interrupters**
   a. Ground fault circuit interrupters (GFCI) protect users of electrically-powered tools and equipment from electrical shocks, especially when working in wet environments. The following are situations when a GFCI is required for electrically-powered equipment and tools:
      - Being used at locations where employees are likely to contact water or conductive liquids such as: outdoors, bathrooms, kitchens, or any other area with potential exposure to water;
      - Being used at construction or renovation sites; or
      - Being used for portable lighting in wet or other conductive locations (such as inside boilers or tanks).
   b. The GFCI can be located on the extension cord, outlet, or the circuit breaker. In new construction, a GFCI is required in outlets that are installed around sinks or any other areas where water may present. GFCIs must be UL-approved and used within the manufacturer’s guidelines.

8. **Electrical Installations**
   Electrical building systems and equipment must be free from recognized hazards that are likely to cause injuries or electrical fires. Equipment must be suitable for the installation and use, and must be installed and used in accordance with any instructions included in the listing or labeling and maintained in compliance with all National Electrical Code (NEC), City of Reading (Pennsylvania), and Occupational Safety and Health Administration (OSHA) requirements that are current at the time of installation. Suitable equipment means that the equipment is approved by a nationally recognized testing laboratory, such as Factory Mutual (FM) or Underwriters Laboratory (UL).
New electrical wiring and modifications, extensions, or replacements of existing wiring must conform to the requirements of the NEC, City of Reading, and OSHA. The following are additional requirements for electrical wiring:

- Conductors entering boxes, cabinets or fittings must be protected from abrasion, and openings through which conductors enter must be effectively closed;
- Unused openings in cabinets, boxes, and fixtures must be effectively closed;
- GFCI outlets must be installed where water hazards are present; such as around sinks, water treatment areas, etc.;
- All new electrical outlets must be 3-pronged; and
- Electrical wiring, components, and fixtures must be of the proper rating for the location of its installation (see Section G “Hazardous Material Areas”).

9. Guarding

Electrical systems must be guarded to prevent inadvertent contact with live conductors. The following are requirements for guarding live electrical parts:

- Live parts to electrical equipment operating at 50 volts or more above ground must be guarded against accidental contact;
- Proper guarding can be achieved by use of an approved cabinet or other approved enclosure or by location in a room or vault that is accessible to qualified persons only; and
- If electrical equipment is located in an area where it is potentially exposed to physical damage, the enclosure or guard must be of sufficient strength to prevent such damage.

10. Electrical Equipment

Electrical equipment must be provided with sufficient access and working space to permit ready and safe operation and maintenance of these equipment. Working clearances of 36 inches shall be provided in front of all electrical equipment such as electrical panels and disconnect boxes. Except as permitted by OSHA or the NEC, the working space in front of live parts operating at 600 volts or less that requires servicing, inspection or maintenance while energized may not be less than indicated in Table 1.
In Alvernia University buildings, keep a minimum 36” clearance on all sides of electrical panels.

New installations of electrical panels, disconnect boxes, or any other electrical equipment that requires servicing, inspection, or maintenance while energized shall have an arc flash and approach analysis conducted in accordance with the requirements of the NFPA 70E standard. The following are additional requirements for electrical panels and disconnect boxes:

- Disconnect boxes must be clearly labeled with the voltage and the equipment that it is powering, unless the disconnect is located and arranged such that its purpose is evident;
• There must be a clear path from the disconnect box to the equipment that it powers;
• Electrical panels must be able to open at least 90 degrees; and
• Panel doors to panels and disconnect boxes must always remain closed when they are not being serviced.

11. Electrical Rooms and Closets
The following are requirements for electrical rooms and closets:
• Storage of any materials is prohibited in rooms designated for electrical equipment;
• Only qualified persons are allowed to enter High Voltage (greater than 600 volts) rooms;
• High voltage rooms must be locked at all times; and
• Entrances to rooms and other guarded locations that contain exposed live electrical parts operating at 50 volts or more above ground must be affixed with permanent signs that state “DANGER – HIGH VOLTAGE – KEEP OUT”.

12. Electrical Panels, Circuit Breakers and Switches
The following are requirements for electrical panels, switches, and circuit breakers:
• Only authorized and Qualified persons are allowed to open and close electrical panels and/or open and close switches.
• Tripped circuit breakers may only be reset by an authorized and Qualified person who has the skills and knowledge to troubleshoot, understand the cause, and safely re-energize the circuit. Report all tripped circuit breakers to Facilities and Campus Operations (Tel: 610-796-8200 ext.0).
• Students are prohibited from accessing electrical panels, opening or closing switches, and/or resetting tripped circuit breakers.

G. PERSONAL PROTECTIVE EQUIPMENT
For those employees working in areas where there are potential electrical hazards, they must be provided with (and must use) electrical protective equipment that is appropriate for the specific parts of the body to be protected and for the work to be performed.

Head
Employees must wear nonconductive head protection wherever there is a danger of head injury from electric shock or burns due to contact with exposed energized parts. Head protection may include a Z89.1-2003 approved Class E (electrical) hard hat. The hard hat should also be Type II (offering protection to both sides and top of head).

Eyes and Face
Employees shall wear protective equipment for the eyes or face wherever there is danger of injury to the eyes or face from electric arcs or flashes or from flying objects resulting from electrical explosion. Eye and face protection may include safety glasses and/or a face shield with approved hard hat and chin cup and/or a balaclava hood.

Body
Employees working in areas where there are potential electrical hazards must be provided with, and must use, electrical protective equipment that is appropriate for the
specific parts of the body to be protected and for the work to be performed. This would include flame resistant (FR) clothing. FR clothing can take the form of pants, shirts, coveralls, jackets, parkas and full flash suits. Obviously, fit, comfort and flexibility are important but the greatest indicator of adequate FR clothing for a given task is based on the “arc thermal performance value” (ATPV). The ATPV is incident energy on a material that results in sufficient heat transfer through the fabric or material to cause the onset of a second degree burn. Manufacturers of FR clothing will provide an ATPV rating on their clothing and the ATPV on the clothing must match the potential exposures in the workplace.

Hands
Since employees working on energized electrical parts are using their hands, obviously that part of the body (hands and arms) are most susceptible to electric shock and must be protected. Insulating gloves provide an excellent means of protecting the workers from accidental electrical contact. To be effective the insulating gloves must have high insulative qualities, while also being comfortable, durable and flexible.

Rubber insulating gloves are categorized into six classifications, each based on the approved voltage levels the gloves can provide protection for. It’s easy to determine the classification based on a color-coded tag found on the glove.

<table>
<thead>
<tr>
<th>Voltage Classifications for Rubber Gloves</th>
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<tbody>
<tr>
<td>Tag Color</td>
</tr>
<tr>
<td>-------------</td>
</tr>
<tr>
<td>Beige</td>
</tr>
<tr>
<td>Red</td>
</tr>
<tr>
<td>White</td>
</tr>
<tr>
<td>Yellow</td>
</tr>
<tr>
<td>Green</td>
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<tr>
<td>Orange</td>
</tr>
</tbody>
</table>

Rubber insulating gloves must be tested per OSHA and ASTM requirements before first use and then every 6 months after.

Leather protector gloves should always be worn over rubber insulating gloves to provide the needed mechanical protection against cuts, abrasion and punctures. Do not use leather protectors alone for protection against electric shock. Serious injury or death could result. Always use proper rubber insulating gloves.

Glove liners provide a more comfortable fit and reduce friction between the hand and the insulating glove. For additional comfort and ease of putting on and off, glove dust is
recommended. Glove dust is a cooling, frictionless powder that absorbs moisture and perspiration when wearing rubber gloves.

Insulating equipment must be inspected for damage before each day’s use and anytime damage is suspected. Typical damage to insulating equipment might include the following:

- Embedded foreign objects (metal slivers, splinters)
- Holes, punctures, tears or cuts
- Ozone damage (fine cracks)
- Swelling, softening, stickiness or hardening
- Damage from chemicals

The recommended PPE that should be worn when resetting circuit breakers is: safety glasses and leather gloves.

H. HAZARDOUS LOCATIONS

Hazardous locations are areas where fire or explosion hazards may exist due to the presence of flammable gases or vapors, flammable liquids, combustible dusts, or ignitable fibers or flyings. Electrical equipment, tools, and systems can become a source of ignition in these areas. Electrical system components and electrical tools must be designed and constructed to be suitable for installation and use in hazardous locations. Electrical equipment must be designated as Class I, II, or III for the following areas:

- Class I for areas in which flammable vapors, liquids, or gases may be present;
- Class II for areas in which combustible dust may be present; and
- Class III for areas in which ignitable fibers may be present.

I. EMPLOYEE TRAINING

The level of electrical safety training provided is dependent on whether the employee is classified as a “qualified person” or “unqualified person”.

1. There are no training requirements for University employees whose normal job duties would not expose them to live electrical circuits operating at 50 volts or more above ground.

2. General Electrical Safety Awareness training is required for Non-qualified persons whose normal job duties would not expose them to live electrical parts operating at 50 volts or more, but perform duties that include the following:
   - Using electrically-powered hand tools, machines or equipment;
   - Performing maintenance, service, or repair functions on electrically-powered machines or equipment.
   The objective of General Safety Awareness is to train Non-qualified persons on electrical safety-related practices necessary to perform their work.

3. Qualified persons shall be trained in accordance with the training requirements in the most current NFPA 70E standard. It is the supervisors’ responsibility to determine what level of training is required for their employees. Employees must complete
training prior to the assignment of duties that are covered by this policy. Retraining will be required whenever an employee shows a lack of the necessary knowledge or skills to safely work on or around electrical systems.

4. A person can be considered qualified with respect to certain equipment and methods but unqualified for others. These employees will be trained per OSHA and NFPA 70E requirements in at least the following subjects: Defining Electric Hazards (Shock, Arc Flash, Arc Blast), Effects of Electric Currents on the Human Body, and Circuit Breakers and Switches. Additional training will be provided as required.

J. REFERENCES
5. The National Electric Code (NEC)
6. Alvernia University The Control of Hazardous Energy (Lockout/Tagout) Plan
7. Alvernia University Permit-Required Confined Spaces Plan
8. Alvernia University Personal Protective Equipment (PPE) Plan