Regis

Electrical Safety and Control of Hazardous Energy (Lockout/Tagout) Program

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Weston, Massachusetts

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Regis

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APPENDICES

1. INTRODUCTION

Regis College's Electrical Safety program has been established to ensure the safety of employees who may work on or near electrical equipment 600 volts or less. This manual is designed to incorporate the applicable provisions of the Occupational Safety and Health Administration (OSHA) Electrical standards (29 CFR § 1910 Subpart S) and the National Fire Protection Association (NFPA) Standard for Electrical Safety in the Workplace (70E). The provisions of 29 CFR §§ 1910.331 through 1910.335 cover electrical safety-related work practices for both qualified persons (those who have training in avoiding the electrical hazards of working on or near exposed energized parts) and unqualified persons (those with little or no such training). Regis College is committed to providing a safe and healthful work environment for employees whose work involves the servicing or maintenance of machines and equipment in which the unexpected energization or start-up of the machines or equipment, or release of stored energy, could harm employees. It is Regis College policy that employees only perform work on de-energized electrical equipment. Therefore, this manual also includes the Control of Hazardous Energy (Lockout/Tagout) Program to comply with 29 CFR § 1910.147. The full text of this OSHA standard is available online at the following address: https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.147.

This document contains the electrical safety procedures for Regis College employees who perform servicing or maintenance on machines or equipment. It is expected that the provisions and procedures of this program will serve as the minimum standards for the servicing or maintenance of machines or equipment by Facilities Maintenance personnel or contracted employees at Regis College.

1.1 SCOPE AND APPLICATION

The purpose of this program is to prevent occurrences of electric shock that could lead to injury of employees and electrical fires that could cause property damage. Electrical safe work practices, electrical risk assessment, electrical exposure based training, and other applicable materials are incorporated into this program to assist Regis College employees, supervisors, and managers in meeting requirements. It is also the intent of this program to assure compliance with NFPA 70E, Article 110.1, Electrical Safety Program.

The lockout/tagout program applies to employees servicing or maintaining machines or equipment in which the unexpected start-up, re-energization, or release of stored energy could cause injury to an employee. The application includes any hazardous energy sources, such as mechanical, hydraulic, pneumatic, chemical, thermal, electrical, or any other energy that could cause harm if not de-energized or otherwise secured during maintenance or servicing. This lockout/tagout program does not apply to the following:

- Work on cord and plug equipment where pulling the plug eliminates all sources of energy and the employee performing the servicing or maintenance has total control of the plug; and
- Hot tap operations involving transmission and distribution systems for gas, steam, water, or products when they are performed on pressurized pipelines provided Regis College demonstrates that continuity of service is essential, shut-down of the system is impractical, and documented procedures are followed and special equipment is used that will provide proven effective protection of employees.

1.2 DEFINITIONS

Affected Employee – An affected employee is an employee who performs the duties of his or her job in an area where the energy control procedure is implemented and servicing or maintenance of machines or equipment is performed. An authorized employee and affected employee may be one and the same when the affected employee's duties also involve performing maintenance or service on a machine or equipment that must be locked or tagged out. An affected employee does not perform servicing or maintenance on machines or equipment and is not responsible

for implementing the energy control procedure. An affected employee becomes "authorized" whenever he or she performs servicing or maintenance functions on machines or equipment that must be locked or tagged out.

Authorized Employee – An authorized employee is an employee who locks out and/or tags out a machine or equipment to perform servicing or maintenance to that machine or equipment and has been trained and authorized to perform the steps of lockout/tagout.

Arc-Flash – When an electric current passes through the air between two conductors, the temperature can reach 35,000 F. Exposure to these extreme temperatures can result in life-threatening burns by direct heat exposure and by igniting clothing. The majority of hospital admissions due to electrical accidents are from arc-flash burns, not electrical shocks. Arc-flashes can and do kill at distances in excess of 10 feet.

Arc-Blast – The tremendous temperatures of the arc cause an explosive expansion of both metal and the surrounding air in the arc path. For example, copper expands by a factor of 67,000 times when changed from a solid into a vapor. The dangers of this explosion are of high blast pressure wave, high decibel levels of sound and high velocity shrapnel. Finally, the material and molten metal is expelled away from the arc at speeds exceeding 700 miles per hour. Arc blasts often cause severe injuries and death.

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

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 to be worked on or near has been disconnected from energized parts, locked/tagged in accordance with established standards, tested to ensure the absence of voltage, and grounded if determined necessary.

Electrical Shock – Accidental contact with exposed electrical parts operating at a voltage greater than 50 volts to ground, and having a current greater than 5 milliamperes, can cause serious injury or death. Fatal ventricular fibrillation of the heart can be triggered by a current flow of as little as several milliamperes. Severe injuries, such as deep internal burns, can occur even if the current does not pass through vital organs or nerves.

Energized – Energized means connected to an energy source or containing residual or stored energy.

Energy-Isolating Device – An energy-isolating device is a mechanical device that physically prevents the transmission or release of energy, including but not limited to: a manually operated electrical circuit breaker; a disconnect switch; a manually operated switch by which the conductors of a circuit can be disconnected from all ungrounded supply conductors, and in addition, no pole can be operated independently; a line valve; a block; and any similar device used to block or isolate energy. Push buttons, selector switches, and other control circuit type devices are not energy-isolating devices.

Energy Source – An electrical source is any source of electrical, mechanical, pneumatic, chemical, thermal, or other energy.

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

Flash Hazard Analysis – A study investigating a worker's potential exposure to arc-flash energy, conducted for the purpose of injury prevention and determination of safe work practices and the appropriate levels of personal protective equipment (PPE).

Flash Protection Boundary – An approach limit at a distance from exposed live parts within which a person could receive a second degree burn if an electrical arc-flash were to occur. This limit is the distance from the arcing source where incident energy is 1.2 cal/cm^2.

Incident Energy – The amount of energy impressed on a surface, a certain distance from the source, generated during an electric arc event. One of the units used to measure incident energy is calories per centimeter squared (cal/cm^2).

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

Lockout Device – A lockout device is a device that utilizes a positive means such as a lock, either key or combination type, to hold an energy-isolating device in a safe position and prevent the energizing of a machine or equipment. Included are blank flanges and bolted slip blinds. A tagout device is to be used with each lockout device.

Qualified Electrical Worker – A qualified person is one who has received training in and demonstrated skills and knowledge in the construction and operation of equipment or a specific work method and is trained to recognize and avoid the electrical hazards that might be present with respect to that equipment or work method. Qualified electrical workers shall be familiar with the proper use of the special precautionary techniques, PPE, including arc-flash suit, insulating and shielding materials, and insulated tools and test equipment. Only a Qualified Electrical Worker is allowed to work on energized circuits within the Limited Approach and Arc Flash Boundaries.

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

Switching Devices – Devices designed to close and/or open one or more electric circuits. Included in this category are circuit breakers, cutouts, disconnecting (or isolating) switches, disconnecting means, interrupter switches, and oil (filled) cutouts.

Tagout Device – A tagout device is a prominent warning device, such as a tag and a means of attachment, which can be securely fastened to an energy-isolating device to indicate the energy-isolating device and the equipment being controlled may not be operated until the tagout device is removed. Tagout devices are to be used with each lockout device.

Voltage-Rated (V-Rated) – Rated and tested for the maximum line-to-line voltage upon which work will be done

Voltage (of a Circuit) – The greatest root-mean-square (effective) difference of potential between any two conductors of the circuit concerned.

Voltage, Nominal – An approximate value assigned to a circuit or system for the purpose of conveniently designating its voltage class, e.g., 120/240, 480/277, and 600.

2. RESPONSIBILITIES

It is the responsibility of all employees to conform with this program when applicable. Failure to conform with this program will result in immediate disciplinary action.

2.1 ENVIRONMENTAL, HEALTH, AND SAFETY

Environmental Health and Safety Compliance is responsible for overall coordination of EHS programs at Regis College.

- Implementing this Electrical Safety and lockout/tagout Program, including the review, maintenance, and update of this document;
- Ensuring training is provided to employees who may work on or near electrical equipment and/or perform lockout/tagout activities on machines or equipment and maintaining documentation of the training sessions;
- Ensuring the annual review of energy control procedures used by authorized employees is conducted to assure written protocols are followed;
- Providing and maintaining all necessary personal protective equipment (PPE), locks, and tags as required by this lockout/tagout Program and 29 CFR § 1910.147;
- Coordinating the annual review of energy control procedures used by authorized employees to assure written protocols are followed; and
- Requesting and obtaining a copy of the contractor's lockout/tagout procedures.

2.2 AUTHORIZED EMPLOYEES

Authorized employees identified in Appendix A are responsible for the following:

- Following the procedures and work practices outlined in this document;
- Reporting any changes or deviations from the energy control procedures to the EHS Manager;
- Not attempting to remove another employee's lock unless the circumstances in Section 6.2 are strictly followed; and
- Actively participating in assigned training sessions and adhering to the information provided in training sessions.

2.3 AFFECTED EMPLOYEES

Affected employees are responsible for the following:

- Following the procedures and work practices outlined in this document;
- Participating in assigned training sessions and adhering to the information provided in training sessions; and
- Not attempting to restart or energize a machine or piece of equipment that has been locked and/or tagged out.

2.4 CONTRACTORS

Contractors performing lockout/tagout activities at Regis College are responsible for the following:

- Providing a copy of the contractor's lockout/tagout procedures; and
- Reviewing this lockout/tagout procedure and notifying the EHS Manager if unable to comply with any part of this procedure.

3. ELECTRICAL SAFETY REQUIREMENTS

3.1 ELECTRICAL SAFETY PRINCIPLES

This section identifies the principles upon which our electrical safety program is based. When planning and performing work on electrical systems and equipment, keep these principles in mind.

- Minimize Hazards. De-energize equipment unless it introduces a greater hazard. Insulate or isolate exposed live parts to avoid contact. Use appropriate PPE and electrically safe tools.
- Plan every job. The approach and step-by-step procedures to complete the work at hand must be discussed and agreed upon between all involved employees before beginning. Write down first-time procedures. Discuss hazards and procedures in a job briefing with other workers before starting any job.
- Identify the hazards. Conduct a job hazard analysis. Identify steps that could create electric shock or arc-flash hazards.
- Minimize the hazards. De-energize any equipment, and insulate, or isolate exposed live parts so contact cannot be made. If this is impossible, obtain and wear proper PPE and tools.
- Anticipate unexpected events. If it can go wrong, it might. Make sure the proper PPE and tools are immediately available for the worst case scenario.
- Obtain training. Make sure all involved employees are a qualified electrical worker with appropriate training for the job.
- Protect the employee from shock, burn, and blast, and other hazards that are due to the working environment. Use the proper personal protective equipment for the job. This may include safety glasses or goggles, head protection, voltage-rated gloves, flame-resistant clothing, etc.
- Use the right tools for the job. Use the appropriate tools for the job at hand, keep them accessible and in good working condition. Using a screwdriver for a job that requires a fuse puller is an invitation to an accident.
- Assess people's abilities. Any person assigned to tasks associated with electrical energy must be qualified and trained for the job at hand. He or she must be able to identify electrical hazards, avoid exposure to those hazards, and understand the potential results of all actions taken.

3.2 GENERAL ELECTRICAL SAFETY REQUIREMENTS

The general electrical safety requirements and considerations outlined in this section apply to both qualified and unqualified persons.

3.2.1 General Equipment

- Portable cord and plug connected equipment must be visually inspected before use for damage or defects (e.g., loose parts, deformed and missing pins, damage to outer jacket or insulation, pinched or crushed outer jacket).
- Damage and defects must be reported immediately. The equipment must be unplugged, labeled as "out of service" and removed from use until replaced or properly repaired by a qualified person.

- GFCIs will be used for all portable power tools, outdoor work, work on or near conductive surfaces, for resistive heating elements such as heater tapes, wet locations, rooftops, within 6 feet of any wet sink, bathrooms, kitchens and other areas that could present an electrical shock hazard should the worker come in contact with the energized conductor of a tool or instrument.
- GFCIs must be provided where an employee is using tools or equipment related to maintenance and construction activity supplied by greater than 125V, 15-, 20-, or 30- ampere circuits.
- GFCI protection devices must be tested per manufacturer's instructions.

3.2.2 Portable Power Tools

Safe work practices for the use and maintenance of portable power tools include the following:

- Inspect tools visually before each use. Look for external defects (deformed or missing pins, insulation damage, etc.) and indications of internal defects. Label those tools found to be damaged or defective as "out of service" and do not use until properly repaired.
- Use guards on power tools where they are provided for use. Do not change or adjust accessories or guards on an electrical power tool until the source of energy is disconnected.
- Ensure that power tools (except battery powered or double-insulated) are grounded by a grounding conductor contained within the same cable or cord as the circuit conductor.
- For work in wet or damp locations, use double-insulated tools whenever possible. Also ensure that electrical portable power tools are connected to ground-fault circuit interrupters (GFCIs).
- Use eye protection with side shields when using portable power tools.

3.2.3 Extension Cords

Extension cords are only permissible for portable equipment use or for the temporary electrical supply of permanent equipment. A rule of thumb is no more than two weeks usage of an extension cord for permanent equipment. The following safe work practices apply to the use of extension cords:

- Inspect extension cords before each use for loose parts, deformed/missing pins, and damaged outer jacket or insulation. Dispose of damaged cords, or label and remove from service until repaired.
- Use only UL or equivalently listed extension cords and components.
- Ensure that the extension cord is of sufficient current-carrying capacity to power the device. Use of an undersized cord results in an overheated cord and insufficient voltage delivered to the device, thus causing device or cord failure and a fire hazard. Undersized cords also constitute a serious shock hazard as it may not allow the breaker feeding it to trip.
- Always use three-conductor (grounded) extension cords. Do NOT cut off the ground of an extension cord or compromise the ground protection in any way.
- Do NOT use frayed or damaged extension cords.
- Do NOT alter attachment plugs and receptacles, or splice extension cords.
- Do NOT fasten extension cords with staples or any other object that could damage the outer jacket or insulation.
- Do NOT use extension cords under carpets or inside walls, floor or ceilings. Exception: extension cords may be used until the end of a shift when run through doors, windows, or floors if there is no other outlet available and if they are protected from damage. Caution must still be exercised to avoid creating a tripping hazard.

- Do NOT daisy chain extension cords (i.e., plug one extension cord into another extension cord.)
- Extension cords cannot be used as a replacement for permanent premises wiring.

3.2.4 Relocatable Power Taps

A relocatable power tap (also referred to as a **power strip**) is a variation of an extension cord, where the cord terminates in a row or grouping of receptacles. Power strips are commonly used in offices to provide multiple receptacles to office equipment. In general, all rules pertaining to extension cords also apply to power strips. Additional considerations are:

- Power strips are not rated for heaters, refrigerators, toaster ovens, or other high power devices. Use only for office equipment such as computers, printers, etc.
- Do not permanently mount power strips to any facility surface. Power strips are classified as temporary devices. It is acceptable to hang them from screws or hooks if they are manufactured with slots or keyholes.

3.2.5 Clearance Around Electrical Equipment

Clearance space around electrical equipment ensures safe working space for personnel who inspect, adjust, maintain, or modify electrical equipment. Clearance distance is based upon equipment voltage. Clearance space must **not** be used for storage or occupied by bookcases, desks, workbenches, or anything that would obstruct access. Equipment 600V and less: Refer to the table below.

Nominal voltage to ground	Minimum Clearance Distance for Condition[2] (in ft)		
	(a)	(b)	(c)
0-150……	[1]3	[1]3	3
151-600……	[1]3	3 ½	4

[1] Minimum clear distances may be 2 feet 6 inches for installations built prior to April 16, 1981.
[2] Conditions (a), (b), and (c) are as follows: (a) EXPOSED LIVE PARTS on one side and no live or GROUNDED parts on the other side of the working space, or EXPOSED LIVE PARTS on both sides effectively GUARDED by suitable wood or other material. INSULATED wire or INSULATED busbars operating at not over 300 volts are not considered LIVE PARTS. (b) EXPOSED LIVE PARTS on one side and GROUNDED parts on the other side. (c) EXPOSED LIVE PARTS on both sides of the workspace [not GUARDED as provided in condition (a)] with the operator between.

3.2.6 Overhead Utilities

When working in an elevated position near overhead lines, the location shall be such that the employee and the longest conductive object he or she may contact cannot come closer to any unguarded, energized overhead line than the following distances:

- For voltages 50kV or less: 10 feet
- For voltages greater than 50 kV: 10 feet plus 4 inches for every 10 kV over 50 kV (See table below.)

Line Voltage	Required Minimum Safe Working Clearance Distances
0-50kV	10’ (3.05m)
51-100kV	12’ (3.66m)
101-200 kV	15’ (4.57m)
201-300kV	20’ (6.1m)
301-500 kV	25’ (7.62m)
501-750kV	35’ (10.67m)
751-1000kV	45’ (13.72m)

3.2.7 Labels, Marking and Identification

- Electrical equipment may not be used unless the following markings are placed on the equipment:
  - **a)** Manufacturer's name, trademark, or other descriptive marking by which the organization responsible for the product may be identified.
  - **b)** Voltage, current, wattage, or other ratings as necessary.
- Each disconnecting means for motors and appliances shall be legibly marked to indicate its purpose, unless located and arranged so the purpose is evident.
- Each service, feeder, and branch circuit, at its disconnecting means or overcurrent device, shall be legibly marked to indicate its purpose, unless located and arranged so the purpose is evident.
- Switchboards, panel boards, industrial control panels, meter socket enclosures, and motor control centers that are likely to require examination, adjustment, servicing, or maintenance while energized must be marked to warn workers of potential electric arc flash hazards. The following information must be included:
  - **a)** Nominal system voltage
  - **b)** Arc flash boundary
  - **c)** At least one of the following:
    - Available incident energy and the corresponding working distance, or the arc flash PPE category, *but not both*
    - Minimum arc rating of clothing
    - Site-specific level of PPE
- Entrances to rooms containing exposed live parts or exposed conductors operating at over 600 volts shall be kept locked and shall be marked with a warning sign "Danger – High Voltage – Keep Out".

✓ *Exception*: Labels applied prior to September 30, 2011 are acceptable if they contain the available incident energy or required level of PPE.
✓ Labels must be updated when the arc flash risk assessment identifies a change that renders the label in accurate.
✓ The documentation, installation, and maintenance of the label is the responsibility of the owner of the electrical equipment.

3.3 HAZARD IDENTIFICATION AND RISK ASSESSMENT

It is Regis College policy to deenergize live parts, whenever possible, before an employee works on or near them. This is the preferred method for protecting workers from electrical hazards. Deenergizing an electrical conductor or circuit part and putting it in an electrically safe work condition (i.e., lockout/tagout) is in itself a potentially hazardous task, and one which requires the worker to be qualified for that task under this program. Employees are permitted to work on or near exposed live parts only if they are qualified and it can be demonstrated that deenergization introduces increased or additional hazards or is infeasible due to equipment design or operational limitations.

Prior to working on or near live parts or where an electrical hazard exists, a risk assessment of that task must be performed. The objective of the assessment is to evaluate and control hazards. This is accomplished by going through each discrete step necessary to execute the intended job and then considering the safety hazards associated with each step.

3.3.1 Shock Risk Assessment

Observing a safe approach distance from exposed energized parts is an effective means of maintaining electrical safety. As the distance between an individual and live parts increases, the potential for an electrical injury decreases. Safe approach distances will be determined for all tasks in which approaching personnel are exposed to live parts. Safe approach distances to fixed live parts can be determined by referring to the table below, "Approach Boundaries to Live Parts for Shock Protection". This table can be used to identify the Limited and Restricted Approach Boundaries associated with various system voltages.

Approach Boundaries to Live Parts for Shock Protection
NFPA Table 130.4(D)
(all dimensions are distance from live part to employee)

System Type	Nominal System Voltage (phase to phase)[a]	Limited Approach Boundary		Restricted Approach Boundary (includes inadvertent movement Adder)
		Exposed movable conductor[b]	Exposed fixed circuit part	
Alternating-Current	Less than 50V	Not Specified	Not specified	Not Specified
	50 V to 150 V[c]	3.0 m (10 ft, 0 in.)	1.0 m (3 ft, 6 in)	Avoid Contact
	151 V to 750 V	3.0 m (10 ft, 0 in.)	1.0 m (3 ft, 6 in)	0.3 m (1 foot)
	751 V to 15 kV	3.0 m (10 ft, 0 in.)	1.5 m (5 ft, 0 in)	0.7 m (2 ft, 2 in)
	Over 15kV	See NFPA 70E Table130.4(D)(a)		
Direct-Current	< 100 V	Not Specified	Not specified	Not Specified
	100 V to 300 V	3.0 m (10 ft, 0 in.)	1.0 m (3 ft, 6 in)	Avoid Contact
	301 V to 1 kV	3.0 m (10 ft, 0 in.)	1.0 m (3 ft, 6 in)	0.3 m (1 foot)
	1.1 kV to 5 kV	3.0 m (10 ft, 0 in.)	1.5 m (5 ft, 0 in)	0.5 m (1 ft, 5 in)
	5 kV to 15 kV	3.0 m (10 ft, 0 in.)	1.5 m (5 ft, 0 in)	0.7 m (2 ft, 2 in)
	Over 15kV	See NFPA 70E Table130.4(D)(b)		

[a] For single-phase systems above 250V, select the range that is equal to the system's maximum phase-to-ground voltage multiplied by 1.732.
[b] This term describes a condition in which the distance between the conductor and the person is not under the control of the person. The term is normally applied to overhead line conductors supported by poles.
[c] This includes circuits where the exposure does not exceed 120V.

Limited Approach Boundary. An approach limit at a distance from an exposed live part within which a shock hazard exists. Unqualified persons may only cross the Limited Approach Boundary when they are under the direct supervision of a qualified person.

Restricted Approach Boundary. An approach limit at a distance from an exposed live part within which there is an increased likelihood of electric shock, due to electrical arc over combined with inadvertent movement, for personnel working in close proximity to the live part. Under no circumstance shall an unqualified person be permitted to cross the Restricted Approach Boundary. Qualified persons may not cross or take any conductive object closer than the Restricted Approach Boundary unless one of the following conditions applies:

- The qualified person is insulated or guarded from the live parts (insulating gloves or insulating gloves and sleeves are considered insulation only with regard to the energized parts upon which work is being performed) and no uninsulated part of the qualified person's body crosses the Prohibited Approach Boundary.

- The live parts are insulated from the qualified person and from any other conductive object at a different potential.

3.3.2 Arc Flash Risk Assessment

An arc flash risk assessment is required to determine if an arc flash hazard exists. If an arc flash hazard exists, the risk assessment must determine:

- Appropriate safety-related work practices;
- The arc flash boundary; and
- The PPE to be used within the arc flash boundary.

The arc flash risk assessment must take into consideration the design of the overcurrent protective device and its opening time, including its condition of maintenance. Results of the assessment must be documented, must be updated whenever a major modification or renovation takes place, and must be reviewed at least every 5 years.

Arc Flash Boundary. The distance from an arc source at which a person could receive a second degree burn if an electrical arc flash were to occur [e.g., where the incident energy equals 5 J/cm^2 (1.2 cal/cm^2)]. This boundary must be determined for each facility's electrical equipment. PPE will be provided to and used by all employees working within the arc Flash Boundary. The boundary can be determined using the information found in the table below, as long as the parameters in the tables are met:

- Maximum short circuit current available;
- Maximum fault clearing time; and
- Working distance

A limited scope engineering evaluation must take place in order to determine if these parameters can be met. If the above parameters cannot be met, the arc Flash Boundary and the appropriate protective clothing required must be calculated through engineering analysis.

Arc Flash Hazard PPE Categories

System Type	Equipment	Arc Flash PPE Category	Arc Flash Boundary
Alternating-Current[a] *[from NFPA 70E Table 130.7(C)(15)(A)(b)]*	Panelboards or other equipment Rated 240 V and Below Maximum of 25 kA short circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 18 inches.	1	19 in
	Panelboards or Switchboards Rated > 240 V up to 600 V Maximum of 25 kA short circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 18 inches.	2	3 ft
	600 V Class Motor Control Centers (MCCs) Maximum of 65 kA short circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 18 inches.	2	5 ft
	600 V Class Motor Control Centers (MCCs) Maximum of 42 kA short circuit current available; maximum of 0.33 sec (20 cycles) fault clearing time; working distance 18 inches.	4	14 ft

System Type	Equipment	Arc Flash PPE Category	Arc Flash Boundary
Alternating-Current[a] *[from NFPA 70E Table 130.7(C)(15)(A)(b)]*	600 V Class Motor Control Centers (MCCs) Maximum of 35 kA short circuit current available; maximum of up to 0.5 sec (30 cycles) fault clearing time; working distance 18 inches.	4	20 ft
	Other 600 V Class (277 v through 600 V, nominal) equipment Maximum of 65 kA short circuit current available; maximum of 0.03 sec (2 cycles) fault clearing time; working distance 18 inches.	2	5 ft
	NEMA E2 (fused contactor) motor starters, 2.3 kV through 7.2 kV Maximum of 35 kA short circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 36 inches.	4	40 ft
	Metal Clad Switchgear, 1 kV Through 15 kV Maximum of 35 kA short circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 36 inches.	4	40 ft
	Arc-Resistant Switchgear Type 1 or 2 (for clearing times of <0.5 sec (30 cycles) with a perspective fault current not to exceed the arc resistant rating of the equipment), and metal-enclosed interrupter switchgear, fused or unfused of arc-resistant-type construction, tested in accordance with IEEE C37.20.7, 1 kV through 15 kV Maximum of 35 kA short circuit current available; maximum of up to 0.24 sec (15 cycles) fault clearing time; working distance 36 inches.	N/A (doors closed)	N/A (doors closed)
		4 (doors open)	40 ft
	Other Equipment 1 kV through 15kV Maximum of 35 kA short circuit current available; maximum of up to 0.24 sec (15 cycle) fault clearing time; working distance 36 inches.	4	40 ft
Direct Current[b] *[from NFPA 70E Table 130.7(C)(15)(B)]*	**Storage batteries, dc switchboards, and other dc supply sources** 100V > Voltage < 250V *Parameters*: Voltage: 250V: maximum arc duration and working distance: 2 sec @ 18 inches		
	Short-circuit current < 4 kA	1	3 ft
	Short-circuit current 4 kA to 7 kA	2	4 ft
	Short-circuit current 7 kA to 15 kA	3	6 ft
	Storage batteries, dc switchboards, and other dc supply sources 250V ≤ Voltage ≤ 600 V *Parameters*: Voltage: 600V; maximum arc duration and working distance: 2 sec @ 18 inches)		
	Short-circuit current 1.5 kA	1	3 ft
	Short-circuit current 1.5 kA to 3 kA	2	4 ft
	Short-circuit current 3 kA to 7 kA	3	6 ft
	Short-circuit current 7 kA to 10 kA	4	8 ft

[a] For equipment rated 600 volts and below, and protected by upstream current-limiting fuses or current-limiting 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.

[b] Apparel that can be expected to be exposed to electrolyte must meet both of the following conditions:

(1) Be evaluated for electrolyte protection in accordance with ASTM F1296, *Standard Guide for Evaluating Chemical Protective Clothing*

(2) Be arc-rated in accordance with ASTM F1891, *Standard Specification for Arc Rated and Flame Resistant Rainwear*, or equivalent.

Minimum working distance is the distance of the employee's face and chest areas from a prospective arc source for the specific task to be performed.

3.5 PERSONAL PROTECTIVE EQUIPMENT

PPE shall be worn whenever qualified workers are inside the Arc Flash Boundary of energized equipment or Restricted Approach Boundary of exposed energized parts (using the greater of the two distances). Electrical protective equipment must meet the criteria established by the American Society of Testing and Materials (ASTM) and by the America National Standards Institute (ANSI). Equipment shall include rated arc flash apparel, eye protection, head protection, hand protection, hearing protection, insulated footwear, and face shields where necessary. PPE must be maintained in a safe, reliable condition and be inspected by the qualified wearer for damage before each day's use and immediately following any incident that can reasonably be suspected of having caused damage. Protective equipment that becomes damaged contaminated with grease, oil flammable liquids, or combustible liquids shall not be used.

The required PPE can be determined from the incident energy value listed on the equipment's arc flash label. If an arc flash analysis has not been done, then the Arc Flash Hazard Identification tables in NFPA 70E can be used to determine the PPE category. Once the PPE Category is determined, the required protective clothing and personal protective equipment can be identified using the matrix in Appendix B.

Arc Flash Hazard Identification
from NFPA 70E Table 130.7(C)(15)(A)(a)

Task	Equipment Condition*	Arc Flash PPE Required
Reading a panel meter while operating a meter switch	Any	No
Normal operation of a circuit breaker (CB), switch, contactor, or starter	All of the following: 1. The equipment is properly installed. 2. The equipment is properly maintained. 3. All equipment doors are closed and secured. 4. All equipment covers are in place and secured. 5. There is no evidence of impending failure.	No
	One or more of the following: 1. The equipment is not properly installed. 2. The equipment is not properly maintained. 3. Equipment doors are open or not secured. 4. Equipment covers are off or not secured. 5. There is evidence of impending failure.	Yes
For ac systems: Work on energized electrical conductors and circuit parts, including voltage testing	Any	Yes
For dc systems: Work on energized electrical conductors and circuit parts of series-connected battery cells, including voltage testing	Any	Yes

Task	Equipment Condition*	Arc Flash PPE Required
Voltage testing on individual battery cells or individual multi-cell units	All of the following: 1. The equipment is properly installed. 2. The equipment is properly maintained. 3. Covers for all other equipment are in place and secured. 4. There is no evidence of impending failure.	No
	One or more of the following: 1. The equipment is not properly installed. 2. The equipment is not properly maintained. 3. Equipment doors are open or not secured. 4. Equipment covers are off or not secured. 5. There is evidence of impending failure.	Yes
Removal or installation of CBs or switches	Any	Yes
Removal or installation of covers for equipment such as wireways, junction boxes, and cable trays that does not expose bare energized electrical conductors and circuit parts	All of the following: 1. The equipment is properly installed. 2. The equipment is properly maintained. 3. There is no evidence of impending failure.	No
	One or more of the following: 1. The equipment is not properly installed. 2. The equipment is not properly maintained. 3. There is evidence of impending failure.	Yes
Removal of bolted covers (to expose bare energized electrical conductors and circuit parts). For dc systems, this includes bolted covers, such as battery terminal covers	Any	Yes
Removal of battery intercell connector covers	All of the following: 1. The equipment is properly installed. 2. The equipment is properly maintained. 3. Covers for all other equipment are in place and secured. 4. There is no evidence of impending failure.	No
	One or more of the following: 1. The equipment is not properly installed. 2. The equipment is not properly maintained. 3. Equipment doors are open or not secured. 4. Equipment covers are off or not secured. 5. There is evidence of impending failure.	Yes
Opening hinged door(s) or cover(s) [to expose bare energized electrical conductors and circuit parts]	Any	Yes

Task	Equipment Condition*	Arc Flash PPE Required
Perform infrared thermography and other noncontact inspections outside the restricted approach boundary. This activity does not include opening of doors or covers.	Any	No
Application of temporary protective grounding equipment after voltage test	Any	Yes
Work on control circuits with exposed energized electrical conductors and circuit parts. 120V or below without any other exposed energized equipment over 120V including opening of hinged covers to gain access	Any	No
Work on control circuits with exposed energized electrical conductors and circuit parts, greater than 120V	Any	Yes
Insertion or removal of individual starter buckets from motor control center (MCC) * Only permitted by Licensed Electrician.	Any	Yes
Insertion or removal (racking) of CBs or starters from cubicles, doors open or closed * Only permitted by Licensed Electrician	Any	Yes
Insertion or removal of plug-in devices into or from busways * Only permitted by Licensed Electrician	Any	Yes
Insulated cable examination with no manipulation of cable	Any	No
Insulated cable examination with manipulation of cable	Any	Yes
Work on exposed energized electrical conductors and circuit parts of equipment directly supplied by a panelboard or motor control center	Any	Yes
Insertion and removal or revenue meters (kW-hour, at primary voltage and current) * Only permitted by Licensed Electrician	Any	Yes
For dc systems: insertion and removal of individual cells or multi-cell units of a battery system in an enclosure	Any	Yes

Task	Equipment Condition*	Arc Flash PPE Required
For dc systems: insertion and removal of individual cells or multi-cell units of a battery system in an open rack	Any	No
For dc systems: maintenance on a single cell of a battery system or multi-cell units in an open rack	Any	No
For dc systems: work on exposed energized electrical conductors and circuit parts of utilization equipment directly supplied by a dc source	Any	Yes
Arc-resistant switchgear Type 1 or 2 (for clearing times of < 0.5 sec with a prospective fault current not to exceed the arc-resistant rating of the equipment) and metal enclosed interrupter switchgear, fused or unfused of arc resistant type construction, tested in accordance with IEEE C37.20.7: • Insertion or removal (racking) of CBs from cubicles • Insertion or removal (racking) of ground and test device • Insertion or removal (racking) of voltage transformers on or off the bus * Only permitted by Licensed Electrician	All of the following: 1. The equipment is properly installed. 2. The equipment is properly maintained. 3. All equipment doors are closed and secured. 4. All equipment covers are in place and secured. 5. There is no evidence of impending failure.	No
	One or more of the following: 1. The equipment is not properly installed. 2. The equipment is not properly maintained. 3. Equipment doors are open or not secured. 4. Equipment covers are off or not secured. 5. There is evidence of impending failure.	Yes
Opening voltage transformer or control power transformer compartments	Any	Yes
Outdoor disconnect switch operation (hookstick operated) at 1 kV through 15 kV	Any	Yes
Outdoor disconnect switch operation (gang-operated, from grade) at 1 kV through 15 kV	Any	Yes

Note: Hazard identification is one component of risk assessment. Risk assessment involves a determination of the likelihood of occurrence of an incident, resulting from a hazard that could cause injury or damage to health. The assessment of the likelihood of occurrence contained in this table does not cover every possible condition or situation. Where this table indicates that arc flash PPE is not required, an arc flash is not likely to occur.

* As used in this table:

The phrase ***properly installed*** means that the equipment is installed in accordance with applicable industry codes and standards and the manufacturer's recommendation.

The phrase ***properly maintained*** means that the equipment has been maintained in accordance with the manufacturer's recommendations and applicable industry codes and standards.

The phrase ***evidence of impending failure*** means that there is evidence of arcing, overheating, loose or bound equipment parts, visible damage, deterioration, or other damage.

3.6 INSULATING MATERIALS AND TOOLS

Employees must use insulated tools and handling equipment rated for the voltages encountered when working inside the Limited Approach Boundary and Restricted Approach Boundary near exposed energized circuits, conductors, or parts. Insulated tools must be designed and constructed to meet the demands of use and the environment to which they are exposed. Insulating equipment made of materials other than rubber shall provide electrical and mechanical protection at least equal to that of rubber equipment. If the insulating capability of protective equipment is subject to damage during use, the insulating material must be protected by an outer covering of leather or other appropriate material.

Insulating rubber equipment such as gloves, sleeves, blankets, and matting must be stored in an area protected from light, temperature extremes, excessive humidity, ozone, and other substances and conditions that my cause damage. In addition to being tested according to the schedule supplied by the manufacturer, rubber insulated equipment must be

- Inspected for damage before each day's use;
- Air tested before each use;
- Inspected immediately following any incident that could have caused damage; and
- Dielectrically tested within 6 months of first use or 1 year of purchase if not used (rubber gloves used without the leather protectors must be removed from service until dielectrically tested).

Rubber insulated equipment found to have defects that might affect its insulating properties must be removed from service until testing indicates that it is acceptable for continued use. Do not attempt to repair defective rubber insulated equipment.

4. LOCKOUT/TAGOUT PRINCIPLES

4.1 LOCKOUT PRINCIPLES

Live work is prohibited unless the person performing the work is a recognized licensed electrician. Authorized employees are the only Regis employees permitted to perform lockout/tagout operations and are expected to follow all written lockout/tagout instructions and energy control procedures. Prior to starting work on machines or equipment that have been locked- and tagged-out, the authorized employee must verify that isolation and de-energization of the machine or equipment has been accomplished.

Following the application of the lockout devices to energy-isolating devices, all potentially hazardous stored or residual energy shall be relieved, disconnected, restrained, and otherwise rendered safe (brought to "zero" energy). If an accumulation of stored energy to a hazardous level is possible, verification of the isolation shall be continued until the servicing or maintenance is completed, or until the possibility of such accumulation no longer exists.

New equipment and equipment renovated or modified after January 2, 1990, must be capable of being locked out. Regis College requires a lock and tag to be used with every lockout/tagout operation.

4.2 TAGOUT PRINCIPLES

Tags are to be used with each lockout device to provide identifying information. Tagout may only be used when an energy-isolating device is not capable of being physically locked out and may only be implemented upon approval from the EHS Manager. Tagout devices, including their means of attachment, will be substantial enough to prevent inadvertent or accidental removal.

Each tag attached to an energy-isolating means is not to be removed without authorization of the authorized employee responsible for it, and it is never to be bypassed, ignored or otherwise defeated.

4.3 LOCKOUT AND TAGOUT DEVICES

Lockout and tagout devices used at Regis College must not be used for other purposes and will meet the following specifications:

- Each authorized employee identified in Appendix B is assigned his/her own lock.
- Locks used by authorized employees at Regis College are standardized. Locks used by Regis College employees are metal shanked, have a red body, and are individually keyed.
- If more than one authorized person will be working on a machine or piece of equipment, a multiple lockout device will be used and each authorized person will apply his/her own lock. Alternative procedures for group lockout are available in Section 6.1 of this document.
- Tags are red, white and black and state, "DANGER DO NOT OPERATE EQUIPMENT LOCKED OUT."
- Tags will be fastened with nylon tie wraps or other attachment that is not reusable, attachable by hand, self-locking and non-releasable with a minimum locking strength of not less than 50 pounds.
- Lockout and tagout devices must be capable of withstanding the environment to which they are exposed and constructed and printed so that exposure to weather conditions or damp locations will not cause the tag to deteriorate or the message on the tag to become illegible.

5. ENERGY CONTROL PROCEDURES

OSHA requires written energy control procedures detailing the procedures for energy isolation to be developed for the control of hazardous energy for each piece of equipment or machine that may be serviced or maintained by Regis College. If the energy isolation procedures are the same for various machines or equipment, or if other means of logical grouping exists, a single energy control procedure may be sufficient. If there are other conditions, such as multiple energy sources, different connecting means, or a particular sequence that must be followed to shut-down a particular machine or equipment, then a separate energy control procedure must be developed to protect Regis College employees. A list of those machines and equipment that require energy control procedures and the corresponding energy control procedures developed by Regis College are included in Appendix C. A template for the development of energy control procedures is also included in Appendix C.

5.1 APPLICATION OF CONTROL PROCEDURES

Each energy control procedure covers the following elements and must be done in the sequence described below.

1. Before attempting any type of lockout, the authorized employee must review the energy control procedure and have a full understanding of the procedure for the equipment or machine to be locked out.

2. Identify all energy sources in order to safely lockout the equipment/machine.

3. Notify all affected employees of the lockout/tagout operation to be performed. Nonessential employees may have to leave the area during maintenance or servicing operations. Make sure that all area personnel involved in the lockout/tagout process are aware of all aspects of the process and what steps need to be taken to perform the task(s) safely.

4. Turn off all operating controls before locking out the machine or equipment to prevent any accidental machine or equipment movement or release of energy before the lockout is applied. If there is more than one operating control, make sure that all of them are turned off or in the neutral position.

5. Identify all energy sources and the location of those energy sources per the energy control procedure.

6. Deactivate the energy isolating device(s) so that the machine or equipment is isolated from the energy source(s). Dissipate or restrain stored or residual energy (such as capacitors, springs, hydraulic systems, and pneumatic, gas, steam, or water pressure) by grounding, repositioning, blocking, or bleeding down.

7. Lock and tag all disconnects and or energy controls. Tags must identify why the machine or equipment is locked out, the name of the person(s) conducting the lockout, and the date the lockout was applied. There may only be one key per lock in the system and duplicate keys are not allowed for any reason. Once the lock(s) and tag(s) have been secured to the energy isolating device(s), the key(s) must be kept secure by the person authorized to perform the lockout. The key is not to be given to any other person for any reason. If there is more than one person working on the machine or equipment, each person must apply his or her own lock to the group lockout device.

8. Clear all tools and nonessential items from the work area and machine/equipment. Notify all employees in the area that you are about to try the operating controls to ensure all required energy sources have been properly isolated and locked out. Make sure all guards are returned to their operating positions.

9. Try the operating controls. Place all operating controls in the “on” position to ensure that all energy sources have been properly isolated and rendered safe.

10. Once all of the operating controls have been tested to ensure all energy sources have been properly isolated, return all operating controls to the "off" or neutral position. Failure to do this could cause an accident when the equipment is reenergized.

11. When all energy sources have been properly identified, isolated, and locked out, proceed with the required task. Review all of the steps required to perform the task safely and do not rush or take shortcuts. Do not remove your lock(s) until the task is complete. If the shift ends and continuation of the task is needed, the authorized employee will remove his or her lock only when another authorized employee is available to place his or her lock in place of the original lock. The authorized person replacing the lock must be fully aware of the condition of the machine or equipment. A written status report must be filled out and handed over during the exchange.

12. Once the servicing or maintenance is complete, check the machine or equipment and the immediate area around it to insure nonessential items have been removed and all guards are in place. If valves were opened to release residual energy, close them. Make sure that all area personnel are safely positioned or removed from the area. Verify all operating controls are in the "off" or neutral position. Once this is completed, remove your lock(s) and tag(s) and test the equipment.

5.2 SINGLE ENERGY SOURCE EXEMPTION

An energy control procedure is not required to be written if all of the following elements exist:

1. There is a single source of hazardous energy that can be easily identified and isolated, and there is no potential for stored or residual energy in the machine;

2. The isolation and locking out of that single energy source will totally de-energize and deactivate the machine;

3. A full lockout of the energy source is achieved by a single lockout device, which is under the exclusive control of the authorized employee performing the servicing;

4. The servicing, while the machine is locked out, cannot expose other employees to hazards; and

5. No accidents involving the accidental start-up of the machine or equipment have occurred.

6. SPECIAL CIRCUMSTANCES

6.1 GROUP LOCKOUT/TAGOUT

Where servicing or maintenance activities are performed by multiple authorized individuals, they must ensure that their procedures allow the same level of protection as if they alone were performing the lockout/tagout. The following methods may be used for group lockout:

1. Each authorized employee will place his/her own personal lockout/tagout device on the energy-isolating device(s).

2. When an energy-isolating device cannot accept multiple locks or tags, a multiple lockout or tagout device (hasp) may be used.

6.2 REMOVING LOCK IN THE ABSENCE OF EMPLOYEE

It is Regis College policy that the authorized employee who applied the lockout/tagout devices should be the person to remove the lock. If the authorized employee who applied the lockout or tagout device is not available to remove it, and the equipment or machine must be utilized immediately, the lockout or tagout device may be removed under the direction of the EHS Manager when the requirements listed below are met. A checklist for the removal of a lockout/tagout device in the absence of the employee who placed the lock is in Appendix D.

- Verify the authorized employee whom the device belongs to is not at the facility.
- Attempt to contact the authorized employee (e.g., cell phone, home phone, on radio, etc.).
- Notify the authorized employee that the lock was removed before he or she resumes work at Regis College.
- Use safe methods to remove the lock. In general, it is recommended that the lock be cut off, if necessary.

6.3 USE OF CONTRACTORS

Where outside contractors are used, the contractor and the EHS manager will inform each other of their respective lockout/tagout procedures. When conducting servicing or maintenance on equipment that Regis College authorized employees do not service or maintain, the contractor is responsible for developing their own energy control procedure for the safe lockout/tagout of the piece of equipment. If a Regis College authorized employee may perform servicing or maintenance on a piece of equipment that has undergone lockout/tagout by a contractor, the Regis College authorized person will also place a lock and tag on the piece of equipment or machine along with the contractor's lock and tag. Refer to Section 6.1 above for additional information about group lockout or tagout.

7. TRAINING, INSPECTION, AND RECORDKEEPING

7.1 EMPLOYEE TRAINING

Authorized and affected employees will be trained to ensure the purpose and function of this Electrical Safety and lockout/tagout Program is understood by Regis College employees and the knowledge and skills required for the safe application, use, and removal of energy controls are acquired. The Regis College training will include the following:

- Each authorized employee will be trained in the recognition of applicable hazardous energy sources, the type and magnitude of the energy at the facility, and the methods and means necessary for energy isolation and control. In addition, authorized employees will be provided with a review of the aspects of this lockout/tagout and will be informed about the use and location of equipment specific energy control procedures.

- Each affected employee will be trained in the purpose and use of the energy control procedures. In addition, affected employees will be shown a lockout/tagout lock and tag and be provided with an explanation of the significance of these devices to the authorized employee who uses it and a discussion about the danger of attempting to remove this hardware or operating equipment that has been locked out.

- All other employees whose work operations are or may be in an area where energy control procedures may be utilized, will be provided with a brief overview of the lockout/tagout Program and be instructed about the danger of attempting to remove lockout/tagout equipment or operating equipment that has been locked out.

Employee retraining will be provided for all authorized and affected employees annually and whenever there is a change in their job assignments, safety-related work practices, a change in machines, equipment, or process that presents a new hazard or when there is a change in the energy control procedures. Additional training will also be conducted whenever EHS has reason to believe there are deviations from or inadequacies in the authorized employee's knowledge or use of the energy control procedures. The retraining will establish the employee's proficiency and introduce new or revised control methods and procedures, as necessary.

All training records will be submitted to the EHS Manager for verification and retention.

7.2 ENERGY CONTROL PROCEDURE REVIEW

The energy control procedures will be reviewed at least annually by an authorized employee not involved in the lockout/tagout of a given piece of equipment to ensure the energy control procedure is being followed. The review will be conducted by the EHS Manager and it will include at least two components: 1) an inspection of each energy control procedure (or grouping of procedures where appropriate); and 2) a review of each employee's responsibilities under the energy control procedure being inspected. A form to be used documentation of the energy control procedures and employee annual review is included in Appendix D.

If any energy control procedures are used less frequently than once a year, they need be inspected only when used. The table in Appendix E can be used as a log to track lockout/tagouts at Regis College and as a way to identify when energy control procedures are inspected.

7.3 RECORDKEEPING

7.3.1 Training Records

Employee training records for each employee are maintained by the EHS Manager. The training records include the following information:

- Date of training session; and
- Name of employee.

7.3.2 Energy Control Procedure Review Form

Completed annual review of the energy control procedures will be maintained by the EHS Manager. The completed review form will be kept for a period of one year until the next periodic inspection is completed.

APPENDIX A: LIST OF AUTHORIZED EMPLOYEES

AUTHORIZED EMPLOYEES AND LOCK ASSIGNMENT

Name of Employee	Lock Number	Date Lock Assigned	Date Lock Returned

APPENDIX B: PROTECTIVE CLOTHING AND PERSONAL PROTECTIVE EQUIPMENT

Protective Clothing and Personal Protective Equipment

PPE Category	Protective Clothing	Protective Equipment
1	**Arc-Rated Clothing, Minimum Arc Rating of 4 cal/cm^2 *(See Note 3.)*** • Arc-rated long-sleeve shirt and pants or arc-rated coverall • Arc-rated face shield *(see Note 2)* or arc flash suit hood • Arc-rated jacket, parka, rainwear, or hardhat liner (AN)	• Hard hat • Safety glasses or safety goggles (SR) • Hearing protection (ear canal inserts) • Heavy duty leather gloves *(See Note 1.)* • Leather footwear (AN)
2	**Arc-Rated Clothing, Minimum Arc Rating of 8 cal/cm^2 *(See Note 3.)*** • Arc-rated long-sleeve shirt and pants or arc-rated coverall • Arc-rated flash suit hood or arc-rated face shield *(see Note 2)* and arc-rated balaclava • Arc-rated jacket, parka, rainwear, or hardhat liner (AN)	• Hard hat • Safety glasses or safety goggles (SR) • Hearing protection (ear canal inserts) • Heavy duty leather gloves *(See Note 1.)* • Leather footwear
3	**Arc-Rated Clothing Selected so that the System Arc Rating Meets the Minimum Arc Rating of 25 cal/cm^2 *(See Note 3.)*** • Arc-rated long-sleeve shirt (AR) • Arc-rated pants (AR) • Arc-rated coverall (AR) • Arc-rated arc flash suit jacket (AR) • Arc-rated arc flash suit pants (AR) • Arc-rated arc flash suit hood • Arc-rated gloves *(See Note 1.)* • Arc-rated jacket, parka, rainwear, or hardhat liner (AN)	• Hard hat • Safety glasses or safety goggles (SR) • Hearing protection (ear canal inserts) • Leather footwear

4	**Arc-Rated Clothing Selected so that the System Arc Rating Meets the Minimum Arc Rating of 40 cal/cm² *(See Note 3.)*** • Arc-rated long-sleeve shirt (AR) • Arc-rated pants (AR) • Arc-rated coverall (AR) • Arc-rated arc flash suit jacket (AR) • Arc-rated arc flash suit pants (AR) • Arc-rated arc flash suit hood • Arc-rated gloves *(See Note 1.)* • Arc-rated jacket, parka, rainwear, or hardhat liner (AN)	• Hard hat • Safety glasses or safety goggles (SR) • Hearing protection (ear canal inserts) • Leather footwear

AN: as needed (optional) **AR**: as required **SR**: selection required

1 If rubber insulating gloves with leather protectors used , additional leather or arc-rated gloves are not required. The combination of rubber insulating gloves with leather protectors satisfies the arc flash protection requirement.

2 Face shields are to have a wrap-around guarding to protect not only the face but also the forehead, ears, and neck, or, alternatively, an arc-rated arc flash suit hood is required to be worn.

3 "Arc rating" is defined in Appendix A of this chapter.

Guidance on Selection of Arc-Rated Clothing and Other PPE for Use When Incident Energy Exposure is Determined NFPA 70E Table H.3(b)

Incident Energy Exposure	Protective Clothing	Other PPE
≤ 1.2 cal/cm²	**Protective Clothing, non-melting (in accordance with ASTM F 1506) or untreated natural fiber**	
	• Long-sleeve shirt and long pants or coverall	• Face shield for projectile protection (AN) • Safety glasses or safety goggles (SR) • Hearing protection • Heavy duty leather gloves or rubber insulating gloves with leather protectors (AN)
≥ 1.2 to 12 cal/cm²	**Arc-Rated Clothing and equipment with an arc rating equal to or greater than the determined incident energy *(See Note 3.)***	
	• Arc-rated long-sleeve shirt and arc-rated pants or arc-rated coverall or arc flash suit (SR) (*See Note 3.*) • Arc-rated face shield and arc-rated balaclava or arc flash suit hood (SR) (*See Note 1.*) • Arc-rated jacket, parka, rainwear (AN)	• Hard hat • Arc-rated hard hat liner (AN) • Safety glasses or safety goggles (SR) • Hearing protection • Heavy duty leather gloves or rubber insulating gloves with leather protectors (SR) *(See Note 4.)* • Leather footwear
> 12 cal/cm²	**Arc-Rated Clothing and equipment with an arc rating equal to or greater than the determined incident energy *(See Note 3.)***	
	• Arc-rated long-sleeve shirt and arc-rated pants or arc-rated coverall and/or arc flash suit (SR) • Arc-rated arc flash suit hood • Arc-rated gloves • Arc-rated jacket, parka, rainwear (AN)	• Hard hat • Arc-rated hard hat liner (AN) • Safety glasses or safety goggles (SR) • Hearing protection • Heavy duty leather gloves or rubber insulating gloves with leather protectors (SR) *(See Note 4.)* • Leather footwear
AN: as needed (optional)(All items not designated "AN" are required.) **SR**: selection of one in group is required		

Notes:
1 Face shields with a wrap-around guarding to protect the face, chin, forehead, ears, and neck area are required by 130.7(C)(10)(c). For full head and neck protection, use a balaclava or an arc flash hood.
2 Arc ratings can be for a single layer, such as an arc-rated shirt and pants or a coverall, or for an arc flash suit; or a multi-layer system consisting of a combination of arc-rated shirt and pants, coverall, and arc flash suit.
4 Rubber insulating gloves with leather protectors provide arc flash protection in addition to shock protection. Higher class rubber insulating gloves with leather protectors, due to their increased material thickness, provide increased arc flash protection.

APPENDIX C: ENERGY CONTROL PROCEDURES

LIST OF ENERGY CONTROL PROCEDURES

Procedure Number (lockout/tagout-xxx)	Equipment, Machine, or Process	Mark appropriate column		If Tagout Only, List Additional Safety Measures
		Lockout / Tagout	Tagout Only	

ENERGY CONTROL PROCEDURE
lockout/tagout-001: identify equipment

Purpose, Scope & Authorization

This procedure establishes the minimum requirements for the control of hazardous energy sources whenever servicing or maintenance activities are performed on the equipment listed above located [identify equipment location]. This procedure must be followed to ensure the machine is stopped, isolated from hazardous energy sources, and locked or tagged out, wherever the unexpected energization, start-up, or release of energy could cause injury. Noncompliance with this procedure may result in disciplinary action, or even termination for continued serious violations. The person in charge of this procedure is [List person who will be held accountable for the safe execution of this procedure].

Energy Sources Under This Procedure

Check energy sources	Type of Energy Source	Magnitude of Energy Source (e.g., 480V, 30°F, 200 psi)	Potential Hazard to Employees
	Electrical		Severe shock, burns, electrocution
	Hydraulic		Loss of eyesight, hearing and skin laceration or penetration. Stored pressure can cause equipment to move leading to amputations, lacerations, or fractures.
	Pneumatic		
	Chemical		Explosion, pressure, extreme heat, fire, corrosive, toxic
	Thermal		Burns, freezing
	Mechanical (kinetic)		Amputations, lacerations, fractures
	Other:		

Lockout/Tagout Steps [Insert photographs if available and helpful.]

1. **Notifications.** Inform affected employees of intended lockout/tagout and the reason for the lockout/tagout. Ensure all authorized employees involved in the work understand the types and magnitudes of energy the machine or equipment utilizes, the hazards, and the proper procedures.
2. **Operating Controls.** If the machine or equipment is operating, shut it down by [Identify stopping mechanism and location. e.g., "depressing the stop button on the front center of the machine"]
3. **Energy-Isolating Devices.** Operate the [Identify device and location. e.g., Circuit breaker for Spent Wash Water Pumps located in Control Room] so the equipment is isolated from its energy source(s).
4. **Lockout/Tagout Devices.** Lock and tag the energy-isolating devices with assigned individual lock(s) and tag(s). [If the energy isolating device will not accept a lock, list additional safety measures taken to protect employees during a tagout only procedure.]

5. **Stored Energy.** Dissipate or restrain any stored energy (such as that in capacitors, springs, elevated machine members, rotating flywheels, hydraulic systems, and air, gas, steam, or water pressure, etc.) by methods such as grounding, repositioning, blocking, bleeding down, etc.
6. **Verification**. After ensuring that no personnel are exposed, and as a check on having disconnected the energy sources:
    a. Operate the [List the normal operating control, such as "push button", "selector switches", etc.] to make certain the equipment will not operate. **CAUTION**: Return operating control(s) to neutral or off position afterwards.
    b. To verify an electrically safe work condition, use a Cat III voltage meter. [If N/A, then delete this section.]
        1. The minimum PPE required to perform this verification step is [Insert PPE needed.]
        2. Note: If the job location is left unattended, then an authorized employee must retest for absence of voltage upon return.
    c. If there is a possibility of re-accumulation of stored energy to a hazardous level, continue verification steps until the maintenance or repair is completed, or until the possibility of such accumulation no longer exists.
7. **Service and Maintenance**. The equipment is now locked out and disconnected. Hazardous energies have been isolated and released. Service and maintenance activities can begin.

Restoring Equipment to Service

When servicing or maintenance is completed, follow the steps below:

1. Inspect the work area to ensure nonessential items have been removed, equipment components are operationally intact, and employees are safety positioned or removed from area.
2. Verify controls are in neutral. Remove the locks and tags from the machine or equipment and reenergize the equipment.
3. Notify affected employees that the servicing or maintenance is completed, and the equipment is ready for use.

Lockout/Tagout Interruption

Where the energy isolating device(s) is locked/tagged and there is a need for testing or positioning of the equipment, the following sequence shall apply:

1. Clear machines of tools and materials.
2. Remove employees from the hazardous areas around the machine.
3. Clear the control of locks/tags according to established procedure.
4. Energize the machine and employ effective employee protective while testing or positioning machinery; and
5. De-energize all systems and re-lock/re-tag the controls to continue work.

APPENDIX D: ENERGY CONTROL PROCEDURE ANNUAL REVIEW FORM

Regis

ENERGY CONTROL PROCEDURE ANNUAL REVIEW FORM

This review must be conducted at least annually, and the reviewer must not be participating in the lockout being reviewed. The reviewer must evaluate an actual equipment lockout in progress.

Procedure name and number: Inspection date:

Review conducted by:

Equipment location:

List authorized employees using this energy control procedure. Has the employee been trained in the procedure?

Employee name:	Employee Signature:	☐ Yes ☐ No
Employee name:	Employee Signature:	☐ Yes ☐ No
Employee name:	Employee Signature:	☐ Yes ☐ No
Employee name:	Employee Signature:	☐ Yes ☐ No

Can an authorized employee produce the written energy control procedures?	☐ Yes ☐ No
Are *affected* employees notified when the procedure is being used?	☐ Yes ☐ No
Have *affected* employees been trained to recognize when the procedure is being used and instructed not to remove lockout/tagout devices or start de-energized equipment?	☐ Yes ☐ No
Can energy-isolating devices be locked out? Note: When you replace, renovate, or modify machines and equipment, ensure that the energy-isolating devices will accept lockout devices. New equipment and equipment renovated or modified after January 2, 1990, must be capable of being locked out.	☐ Yes ☐ No
Are locks uniquely identified, uniquely keyed, and only used for lockout?	☐ Yes ☐ No
Did each *authorized* employee lock out all energy sources as identified in the energy control procedure?	☐ Yes ☐ No
Does this procedure involve group lockout/tagout?	☐ Yes ☐ No
Did the *authorized* employees verify the equipment was de-energized?	☐ Yes ☐ No
If deenergizing an electrical energy source, did the employee verify deneergization with a Cat III meter, and did the employee don the proper arc flash PPE?	☐ Yes ☐ No
Did the *authorized* employees follow the energy control procedure?	☐ Yes ☐ No

If this is a lockout procedure, can the employees describe their responsibilities during each part of the lockout process, including:

a. Verification that all types of energy have been **identified**
b. Identification of the energy control point(s)
c. The reason for any unique lockout hardware
d. The required steps after the lock is applied (e.g., block, lock blocking in place, dissipate, test or try to restart, warning of *affected* persons, etc.)
e. Proper safe steps to restore the equipment to operation

Yes ☐ No ☐
Not Applicable ☐

If this is a tagout only procedure, can the employees describe the limitations of tags including:

a. Tags are essentially warning devices affixed to energy isolating devices and do not provide the physical restraint of a lock
b. When a tag is attached to an isolating means, it is not to be removed except by the person who applied it, and it is never to be bypassed, ignored, or otherwise defeated
c. Tags must be legible and understandable by all employees
d. Tags and their means of attachment must be made of materials that will withstand the environmental conditions encountered in the workplace
e. Tags may evoke a false sense of security. They are only one part of an overall energy control program
f. Tags must be securely attached to the energy isolating devices so that they cannot be detached accidentally during use.

Yes ☐ No ☐
Not Applicable ☐

Does this lockout/tagout procedure adequately protect employees? ☐ Yes ☐ No

List and describe any deficiencies requiring corrective action.

1.

2.

3.

4.

5.

APPENDIX E: LOCKOUT/TAGOUT LOG

LOCKOUT/TAGOUT LOG

Equipment/ Procedure Number	Person(s) Performing lockout/tagout	Date lock Applied	Date Lock Removed	Annual Review Performed? (See Appendix F for review form)

APPENDIX F: CHECKLIST FOR REMOVING ANOTHER PERSON'S LOCK

CHECKLIST FOR REMOVING ANOTHER PERSON'S LOCK

It is Regis College policy that the authorized employee who applied the lockout/tagout device(s) should be the person to remove the lock. If the authorized employee who applied the lockout/tagout device is not available to remove it, and the equipment or machine must be utilized immediately, the lockout/tagout device(s) may be safely removed only when "Yes" can be answered to questions 1 through 5 below. The authorized employee must be informed his/her lockout/tagout device was removed prior to the employee resuming work at Regis College

1. Has the EHS Manager verified the authorized employee the device belongs to is not at the facility? ☐ Yes ☐ No

2. Has the EHS Manager attempted to contact the authorized employee? Describe the methods used to attempt to contact the authorized employee?_____ ☐ Yes ☐ No

3. Was the EHS Manager able to speak with the authorized employee directly? List the date and time the authorized employee was reached and/or the time a message was left for the authorized employee:
   ☐ Left Message – Date & Time_____
   ☐ Spoke to employee and notified employee the lockout/tagout device was removed – Date & Time _____ ☐ Yes ☐ No

4. Did the EHS Manager check to ensure the machine or equipment is safe to re-energize? ☐ Yes ☐ No

5. Did the EHS Manager notify affected employees in the area about the reenegerization? ☐ Yes ☐ No

The EHS Manager, or designee, must notify the authorized employee that his/her lock was removed before the employee resumes work at Regis College. List the date and time the authorized employee was notified:_____

By signing below, the EHS Manager verifies that the steps above were followed and the authorized employee was notified his/her lock was removed before he/she resumed work at Regis College.

Signature of EHS Manager:_____

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