VCU Lockout/Tagout
Energy Isolation Program

I. Introduction/Purpose

The purpose of the VCU Lockout/Tagout (LOTO) program is to establish rules and expected behaviors to avoid the unexpected energization, start-up, or release of stored hazardous energy that may injure people. Sources of hazardous energy may include:

a. Electrical – Electrical circuits, capacitors, batteries, emergency power
b. Thermal – Steam, hot tools or exhaust, heat exchangers
c. Mechanical – Rotating equipment, tools & equipment with moving parts, springs
d. Gravity – Objects stored at height or supported by cranes or hoists, counter weights
e. Chemical – Fuel, water treatment, cleaning, pool treatment, research or other chemical products and reagents.
f. Pressure – Compressed air or gasses, pressure vessels, liquids under pressure
g. Hydraulic – hydraulic hoses or rams on equipment
h. Radiation – ionizing, non-ionizing, x-ray, lasers

II. Applicability/Scope

a. This program applies to all VCU staff, faculty, students, visitors and contractors working at VCU facilities where the unexpected energization, start-up or release of stored energy may cause injury.
b. Personnel engaged in servicing, maintenance, repair or replacement of equipment and/or building systems shall **isolate and make inoperative the equipment or system before beginning work**. At a minimum, this program will be applied when working on all types of systems or equipment powered by one or more energy sources when:
    i. An equipment guard is removed
    ii. A safety interlock is bypassed or
    iii. Whenever a person must place any part of their body into potentially-operating equipment
c. This program does NOT apply to:
    i. Minor tool changes
    ii. Minor adjustments

iii. Other small service activities that take place during normal operations if they are:
    1. Routine
    2. Repetitive
    3. Integral to the use of the equipment. (Example: Changing a drill bit on a drill press.)

iv. Equipment that is isolated and made safe by simply unplugging an electrical cord, compressed air hose, or some other single-source energy supply when the person working on the equipment has exclusive control over the connection to the energy source.

d. *Energized Work* on equipment and systems is **not** allowed, except for specific situations that meet **all** of the following conditions:
    i. Department management demonstrates that continuity of service is essential, and
    ii. Shutdown of the system is impractical, and
    iii. Special equipment is provided along with specific standard operating procedures (SOPs) that are documented and followed that will provide effective protection for personnel.

    All three of the above criteria must be met, documented, and approved by the Program Coordinator before Energized Work is permitted. If they cannot be met, then LOTO must be practiced. Documentation of this process may use any format that covers the above criteria and must be retained by the Program Coordinator. A sample form for documenting Energized Work approval is available in Appendix C.

III. Definitions

a. Affected Person – A person who works on or near equipment upon which cleaning, repairing, servicing, setting up, or adjusting operations are performed under this LOTO Program.

b. Authorized Employee – An employee who implements a LOTO procedure on machines or equipment to de-energize and make safe that equipment prior to the start of work. The authorized employee is both
    i. Qualified, through appropriate training and experience, **and**
    ii. Authorized to perform LOTO by the Superintendent/Supervisor having operational control of the area where the work is to occur, either through Job Description, task assignment, contract, or written communication.

c. Capable of being locked out - An energy isolating device will be considered to be capable of being locked out either if it is designed with a hasp or other attachment or integral part of which, or through which a lock can be attached, or it has a locking mechanism built into it. Other energy isolating devices will also be considered to be 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.

d. De-energize/Disengage – There is a difference between turning off a machine and actually disengaging or de-energizing a piece of equipment. When a control switch is turned off, the control circuit is off. However, there is still electrical energy at the switch, and a short in the switch or someone inadvertently turning on the machine may start the machine running again. In addition, control circuits may only control power relays on main power panels. Prior to maintaining, adjusting, or repairing equipment, main power and control circuit power must be de-energized/disengaged. To de-energize/disengage equipment, the fuses/breakers must be removed or turned *off* and the electrical box containing the fuse/breaker locked shut. A knife switch disconnect locked in the 'off' position is also considered de-energized.

e. Energized - Connected to energy source or containing residual or stored energy.

f. Energy Isolating Device - A mechanical device that physically prevents the transmission or release or energy, including but not limited to the following:
    i. A manually operated electrical circuit breaker
    ii. A disconnect switch
    iii. 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
    iv. A slide gate
    v. A slip blind
    vi. A line valve
    vii. A block and
    viii. Any similar device used to block or isolate energy.
    ix. This term does not include a push button, selector switch, and other control circuit type devices.

g. Energy source - Any source of electrical, mechanical, hydraulic, pneumatic, chemical, thermal, or other hazardous energy.
h. Hot tap - A procedure used in the repair, maintenance and service activities that involves welding on a piece of equipment (pipelines, vessels or tanks) under pressure, in order to install connections or appurtenances. It is commonly used to replace or add sections of pipeline without the interruption of service for air, gas, water, steam, and petrochemical distribution systems.
i. Lockout - The act of placing a lockout device on an energy isolating device, consistent with an established procedure, ensuring that the energy isolating device and the equipment being controlled cannot be operated until the lockout device is removed.
j. Lockout Device - A device, typically a lock, that utilizes a positive means to hold an energy isolating device in the safe position and prevent the accidental or unauthorized energizing of a machine or equipment.
k. LOTO – Lockout/Tagout
l. Normal Operation - The use of a machine, equipment, or building system to perform its intended production function.
m. Owner Department – The Owner Department is a VCU School or Department that owns and/or has operational control of equipment/systems that by its nature/design must have this LOTO Program applied to the equipment for personnel to safely conduct inspection, modification, repair, adjustment, development, or maintenance work on the equipment.
n. Program Coordinator – An individual designated by the Owner Department to administer the LOTO program within their area of operational control. In the absence of a written designation, this responsibility defaults to the Superintendent, Principal Investigator, or Manager having operational control of the equipment / area.
o. Servicing and/or Maintenance - Work place activities such as constructing, installing, setting up, adjusting, inspecting, modifying, repairing, maintaining and/or servicing machines, equipment or systems, where the employee may be exposed to the unexpected energization or startup of the equipment or release of hazardous energy.

p. Setting Up - Any work performed to prepare a machine or equipment to perform its normal production operation.
q. Tagout - The act of placing a tagout device on an energy isolating device, using an established procedure, to indicate that the energy isolating device and the equipment being controlled may not be operated until the tagout device is removed.
r. Tagout Device - A prominent warning device, such as a tag and a means of attachment, which can be securely fastened to an energy isolating device, to communicate to affected persons that the energy isolating device and the equipment being controlled may not be operated until the tagout device is removed by the individual who attached it.

IV. Roles/Responsibilities

a. Owner Department:
    i. Assigns a LOTO Program Coordinator
    ii. Ensures all authorized and affected employees receive appropriate training on the specific procedures pertaining to their specific job duties.
    iii. Identifies equipment that has single or multiple sources of energy for operation that fall under the energy isolation requirements of this program.
    iv. Develops written LOTO procedures for individual *location-specific* pieces of equipment.
    v. Provides LOTO equipment.
    vi. Performs periodic audits of the program to ensure effectiveness.
    vii. Pursues the appropriate corrective action for any employee that does not comply with this program.
b. Occupational Health & Safety (OHS):
    i. Interprets and updates this written program as needed.
    ii. Performs annual inspections of the LOTO program and its implementation.
    iii. Develops and distributes LOTO awareness training to end user groups
    iv. Maintains training records.
    v. Provides safety consultation upon request.

c. Program Coordinator:
    i. Ensures the implementation of all applicable requirements of this program for people/projects within their operational control.
    ii. Ensures employees are trained on proper selection of specific LOTO devices for each type of equipment that may be serviced.
    iii. Ensures that Authorized Employees are trained on proper implementation of written LOTO standard operating procedures as applicable.
    iv. Ensures coordination and cooperation between employees and external contractors.
    v. Removes and/or approves the removal of a LOTO device if the initial authorized employee is unavailable. Removal of a LOTO device by anyone other than the initial authorized employee shall be documented using an Absentee Lock/Tag Removal Form (Appendix A) or equivalent, clearly stating the reason why the LOTO device is to be removed and why it cannot wait until later.
    vi. Approves energized work by documenting the information required in Appendix C - Energized Work Permit or equivalent that clearly states why:
        1. Continuity of service is essential, **and**
        2. Shutdown of the system is impractical, **and**
        3. Special equipment is provided along with specific standard operating procedures that are documented and followed that will provide effective protection for personnel.

d. Authorized Employees:
    i. Do **not** work on energized equipment / systems without written approval from the Program Coordinator prior to the start of work.
    ii. Place LOTO devices on equipment and/or systems in accordance with this program and written procedures.
    iii. Maintain required qualification(s) through required training and/or work experience.
    iv. Notify Affected Persons in the area when a LOTO device is deployed

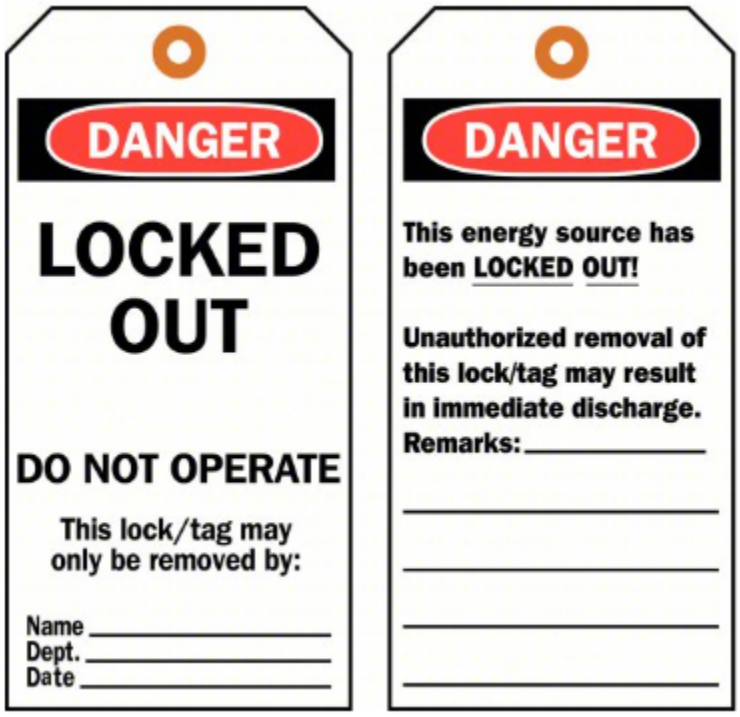
v. Develop and document LOTO procedures as requested by the Program Coordinator or Owner Department. A template procedure is available in Appendix B.

e. Affected Persons:
   i. Are made aware by the Authorized Employee conducting LOTO, through this document, and the OHS Website that:
      1. No person ever touches or tries to actuate an energy source that has been locked and/or tagged in the off position by someone other than the individual identified on the tag.
      2. Never disturb a mechanical block that has been placed to prevent equipment movement by someone other than the individual identified on the tag.

V. Devices and Hardware Requirements

a. Locks
   i. Each Authorized Employee has their own lockset and the only key to that lockset or access to a unique set that can be checked out.
   ii. These are provided to the worker by the Program Coordinator or Owner Department.
   iii. Locks are substantial, durable, and have the name of the employee (or another unique identifier) on them.

b. Tags
   i. *Tags* or *tagout devices* must be capable of enduring at least 50 pounds of pull.
   ii. One tag is placed by the Authorized Employee at each lockout location. Tags state:
      1. The reason for the lockout.
      2. The name of the person(s) who is/are working on the equipment.
      3. How the person who placed the tag may be contacted.
      4. The date and time the tag was put in place.



iii. Be capable of withstanding the environment for the maximum period of time. that exposure is expected, including but not limited to corrosive environments.

iv. Warn against hazardous conditions if the machine or equipment is energized and shall include a statement such as the following: “DO NOT OPERATE”, “DO NOT START”, “DOT NOT ENERGIZE”.

VI. General Guidelines

a. All equipment must be blocked and locked out to protect against accidental or inadvertent operation when such operation could cause injury to personnel.

b. If the equipment or system must remain energized during work,

   i. Document the decision by completing an Energized Work Permit (Appendix C) or equivalent and/or

   ii. **Contact OHS** to assist in developing adequate alternative hazard control measures, such as the use of suitable temporary barriers, special tools, and personal protective equipment.

c. Never attempt to operate any switch, valve, or other energy isolating device bearing a lock and/or tag.
d. Never remove a lock or blocking device until all personnel, tools, and obstructions have been cleared from the area, and all equipment guards have been properly reinstalled.
e. Only Authorized Employees shall perform LOTO procedures.
f. A LOTO device shall only be removed by the initial Authorized Employee.
g. Tags are not used alone. Tags or signs are used in addition to locks.
h. When more than one worker is servicing a piece of equipment or system that must be locked out, a lockout adapter hasp is used which allows all the workers to place their locks on the disconnecting means.

VII. General Sequence of LOTO Procedures

a. Identification of Hazardous Energy – Identify every source of hazardous energy being fed to, stored within, and leaving the equipment/system.
b. Notification - The Authorized Employee checks to be sure that no one is operating the machinery **before** turning off energy sources. All Affected Persons in the area, especially the machine operator and project supervisor, are informed before the energy sources are being turned off because an unexpected sudden loss of power could cause an accident. All authorized employees shall have knowledge of the type and magnitude of energy, the hazard to be controlled, and the method or means to control the energy.

c. Shutdown – if the machine, equipment or system is operating, shut it down by the established normal shutdown procedure.
d. Isolation – Isolate the equipment/system from its energy source(s).
    i. Electricity
        1. Lockout switches in the open (off) position.
        2. If a fuse was removed in order to de-energize the equipment, the fuse box must be locked.
        3. If the controls are in a metal-covered box, a common hasp can be welded or riveted to the door, along with a lock staple. Then the switch can be *opened* and the door closed and padlocked. Fuse boxes may also be locked in this way.
        4. In some equipment, an electric control circuit that will actuate the main power circuits must be locked and tagged out before safe-work can proceed.
        5. Capacitors must be safely discharged to ground with ground straps installed prior to working around, storing, or transporting them.
    ii. Pressure - Steam, air, and hydraulic piping or tanks must be bled, drained, and/or brought to atmospheric pressure and locked *open* to assure no pressure or vacuum in piping or in reservoir tanks. Physically disconnect the equipment from the supply plumbing if possible. If not possible, use double valves or blind off supply lines with appropriate flange plates or pipe caps
    iii. Gas cylinders - must be locked *closed* and if possible disconnected from distribution piping.
    iv. Mechanical - Any mechanical component that could roll, shift, or otherwise move (such as springs, counterweights, wheels, fan blades, etc.) must be chained, barred, or blocked.
    v. Dissipate – Dissipate all stored energy – Block, Blind, Bleed, or ground all stored energy within the equipment/system.
e. LOTO – Place a lock on each isolation point, valve, blind and block in the safe position as they are identified and made safe. A tag is filled out with the required information and attached to each lock.
f. Test – Prior to working on equipment/systems, verify that isolation or de-energization has been accomplished by operating the push button or other

normal operating controls to make certain the equipment will not operate. Return the operating control(s) to "neutral "or "off" position after the test.

VIII. Testing or Re-positioning of Equipment

If a LOTO device must be temporarily removed from the energy isolating device to test or position the machine, the following sequence shall be followed:

a. Clear the machine or equipment of tools and materials;
b. Notify all employees and remove them from the area;
c. Remove the minimum number of LOTO device(s) to achieve the goals of the test or repositioning;
d. Energize and proceed with testing or positioning; and
e. De-energize all systems and reapply energy control measures to continue servicing and/or maintenance.

IX. Restoring Equipment to Service

After the work is completed and the equipment is ready to be returned to normal operation, this procedure must be followed:

a. Clear the machine or equipment of tools and materials;
b. Inspect the equipment to ensure components are operationally intact, including reinstalling guards and safety devices.
c. Repair or replace defective guards before removing locks.
d. Remove each lockout device using the correct removal sequence. Each lock is removed by the qualified person that applied it, or under their direct supervision.
    i. If the qualified person is absent from the workplace, then the lock or tag can be removed by an Authorized Employee designated to perform this task provided that the Program Coordinator:
        1. Verifies that the qualified person is not present and therefore unable to remove the lock;
        2. Makes all reasonable efforts to inform the qualified person that the lockout/tagout device has been removed
        3. Ensures that the qualified person knows their lockout/tagout device has been removed before their work resumes.

4. Completes the Absentee Lock/Tag Removal Form (Appendix A) or equivalent, clearly stating the reason why the LOTO device is to be removed and why it cannot wait until later.

e. Visually check the area before restoring energy to ensure that everyone is physically clear of the equipment.

f. Notify any Affected Persons that equipment has been restored to its operational state.

X. Group LOTO

When service or maintenance is performed by more than one individual, general procedures shall be followed along with the following specific requirements:

a. One authorized employee shall be designated as responsible for the group LOTO by the Program Coordinator.

b. Hazardous energy control procedures shall be reviewed with each group member.

c. When more than one crew, craft, department, etc. is involved, assignment of overall job-associated LOTO control responsibility shall be designated to an authorized employee to coordinate affected work forces and ensure continuity of protection for the group.

d. Each authorized employee is to affix a personal LOTO device to the group lockout device, group lock box, or comparable mechanism when beginning work, and is to remove those devices when he or she stops working.

e. The equipment cannot be re-energized until all individuals in the group have removed their LOTO device.

XI. Shift or Personnel Changes

The Program Coordinator shall ensure continuity of LOTO protection, including provisions for the orderly transfer of LOTO devices:

a. Between off-going and oncoming employees. Each employee shall be responsible for removing his/her own LOTO device at the completion of his/her work task(s) or shift.

b. Maintenance / repair evolutions that have an extended duration, multiple crafts or phases.

XII. Training Requirements

a. Program Coordinators must be trained on the development of written LOTO procedures and proper application of LOTO equipment.
b. Authorized Persons must be trained on proper application of LOTO to all equipment they are expected to work on commensurate with their general knowledge and skill level.
c. Affected Employees must be trained to recognize LOTO devices and to not remove or bypass them.

XIII. Recordkeeping

a) Each department is responsible for verifying that training is current and documented. OHS will maintain basic lockout/tagout training records. Records shall be maintained on the OHS learning management system.
b) Absentee LOTO device removal forms (Appendix A) shall be maintained by the Owner Department or local Program Coordinator.
c) Specific energy control procedures shall be readily accessible in the area of the specific equipment and available to all affected employees upon request. Copies of all energy control procedures shall be kept by the Program Coordinator. The following are considered an acceptable means for making procedures accessible:
   - Electronic means;
   - Posting procedures on the equipment; or
   - Providing a binder in the mechanical room or working space.
d) Periodic inspection documentation shall include the identity of the machine or equipment on which the energy control procedure was being utilized, the date of the inspection, any deviation of inadequacy, any corrective action taken, the employees included in the inspection, and the person performing the inspection. Inspection documentation will be kept with the Program Coordinator or on the OHS learning management system.

XIV. References

a. 29 CFR 1910.147 – Control of Hazardous Energy
b. VCU Electrical Safety Program
c. UC Berkeley Lockout/Tagout Energy Isolation Program

XV. Appendices

a. Appendix A – Absentee Lock / Tag Removal Form
b. Appendix B - LOTO Equipment Specific Procedure Template
c. Appendix C - Energized Work Permit