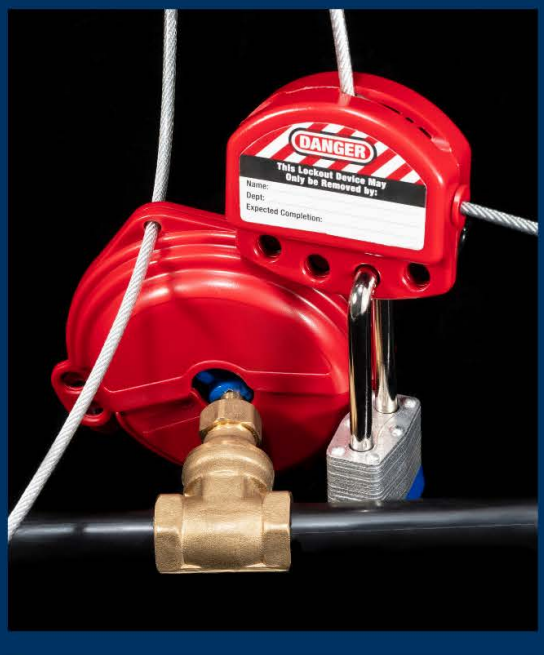
Berkeley UNIVERSITY OF CALIFORNIA EH&S OFFICE OF ENVIRONMENT, HEALTH AND SAFETY

LOCKOUT/TAGOUT ENERGY ISOLATION PROGRAM



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Quick Start

The UC Berkeley Lockout/Tagout Energy Isolation (LOTO) Program requires campus, field station personnel, and contractors to implement safe procedures when working on UCB equipment or utility systems with one or more energy sources. Because of the potential for injury from energy sources that operate equipment/utility systems, this program guides safe installation, set-up, adjustment, and maintenance work on equipment by isolating energy sources prior to commencing work. The program is required by Cal/OSHA safety regulations

This LOTO Program is applied to ALL forms of potentially hazardous energy and is applied to every individual piece of equipment that has potentially hazardous energy. The **types of energy needing to be isolated** may be part of a particular machine or utility system, including but not limited to:

- Building mechanical systems
  - HVAC components
  - Electrical Supply
- Larger experimental equipment that is hard-wired or plumbed to building utility systems
  - Scanning Electron Microscope
  - an air compressor
  - a printing press
- Shop equipment
  - CNC equipment
  - wood-working equipment
  - powered cranes and other lift equipment
- Equipment that can be *unplugged* but may have energy stored in the *unplugged* equipment
  - Springs
  - Weight
  - Capacitors

This program is applied prior to working on all types of equipment powered by one or more energy sources, whenever an equipment guard is removed, a safety interlock is bypassed, or whenever a person must place any part of their body into potentially-operating equipment.

Risk & Safety Solutions (RSS) at the University of California Office of The President (UCOP) has developed an app called ***Procedures*** for documenting equipment-specific LOTO procedures required by Cal/OSHA. The app enables campus and system-wide sharing of LOTO procedures. The data is stored on the UCOP cloud. Departments and other UC campuses can use these procedures as drafts for their own unique operations and equipment.

Purpose/Introduction

The **UC Berkeley Lockout/Tagout Energy Isolation (LOTO) Program** requires campus, field station personnel, and contractors to implement safe procedures when working on or near UC Berkeley equipment or utility systems with one or more energy sources (see: **Roles & Responsibilities**). Because of the potential for injury from energy sources that operate equipment/utility systems, this program guides safe installation, set-up, adjustment, and maintenance work on equipment by **isolating energy sources prior to commencing work**. Implementation of the program is required by Cal/OSHA safety regulations.

Applicability/Scope

This LOTO Program is applied to ALL forms of potentially hazardous energy and is applied to every individual piece of equipment that has potentially hazardous energy. The types of energy needing to be isolated include:

- Potential energy
  - mechanical springs in tension or compression
  - compressed gas cylinder
  - counterweights, etc.
  - gravity
- Kinetic energy
  - rotating flywheel
  - moving parts
  - rolling components
  - parked vehicles, etc.
- Utility energy
  - Electricity
  - compressed air
  - Steam
  - domestic water
  - hydraulics, etc

Energy Isolation may need to be performed on part of a particular machine or utility system. Such equipment may include:

- Building mechanical systems
  - HVAC components
  - Electrical Supply
- Larger experimental equipment that is hard-wired or plumbed to building utility systems
  - Scanning Electron Microscope
  - Air compressor
  - Printing press
- Shop equipment
  - CNC Equipment

- Metal and/or wood-working equipment
- Powered cranes and other lift equipment

This program is applied prior to working on all types of equipment powered by one or more energy sources, or whenever an equipment guard is removed or safety interlock is bypassed, or whenever a person must place any part of their body into potentially-operating equipment.

This program does NOT apply to:

- Minor tool changes
- Minor adjustments
- Other small service activities that take place during normal operations if they are
    - routine
    - repetitive
    - integral to the use of the equipment. (Example: Changing a drill bit on a drill press.)
- 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.

Live Work or ***Hot Work*** **(any form of potential, kinetic, or utility energy identified above)** on equipment that cannot be shut down is allowed by the program provided that:

1. Department management demonstrates that 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, e.g. Work on certain life-sustaining equipment or utility lines.

All three of the above criteria must be met before *Hot Work* is permitted by law. If they cannot be met, then LOTO must be practiced. If the above criterion can be demonstrated by management, prior to conducting *Hot Work* **contact EH&S** regarding Safety Engineering to review safe work procedures in order to assist in developing adequate safeguards and *Hot Work* processes.

Roles/Responsibilities

Faculty, Staff, and any *Affected Person*

All Faculty, Staff, and any **Affected Person** are made aware through this document and the **EH&S website** that:

- No person ever touches or tries to actuate an energy source that has been locked and/or tagged in the off position by someone else
- Never disturb a mechanical block that has been placed to prevent equipment movement by someone else

Qualified Person

Faculty and staff who work on equipment affected by this program must be **qualified** to do so by their Supervisor and follow the **Lockout/Tagout energy isolation procedures** outlined by this program. They must

be **trained** on, and remain current on its requirements and application through documented training. A ***Qualified Person*** may develop and store written equipment-specific energy isolation procedures on ***Procedures***.

A *Qualified Person* may also document procedures using the following **document template** and keep it with their other equipment records.

Capital Projects/Construction Project Manager

For new construction, building retrofits, and equipment installed by Capital Projects, the Project Manager:

- ensures the requirements of this program are integrated into project documentation
- **energy isolation surveys** of all affected building systems are completed and provided to the host department
- **signage and labels** are installed on energy disconnects in **compliance with this program**.

Owner Departments

Owner Departments are responsible for identifying equipment that has single or multiple sources of energy for operation that fall under the energy isolation requirements of this program. Academic Departments that own/operate research and other equipment in existing buildings not under the control of a *Facilities Maintenance* department must apply the LOTO Program to their equipment. Every *Owner Department* must survey and is recommended to inventory all equipment owned by the Department that requires an equipment-specific LOTO Procedure be developed. The Owner Department must survey and inventory equipment requiring an equipment-specific LOTO procedure, and track Cal/OSHA-required annual audits of those procedures using either the **attached template** or one of their own design.

Departments must provide written LOTO procedures for individual *location-specific* pieces of equipment developed for employee and contractor use.

The App, ***Procedures***, is used for documenting equipment-specific LOTO procedures required by Cal/OSHA, and allows campus and system-wide sharing for distribution. You can instead use the **attached template** to document and share your procedures if preferred.

Owner Departments must identify *Qualified individuals* to conduct energy isolation through a **documented *Qualification* process**. All **qualified persons** must have training on this LOTO Program documented. Departments may arrange with EH&S for personnel to receive **documented training** or may use another vendor for *Qualifying* personnel as long as the contents of this LOTO Program, including the use of ***Procedures***, are included in the training curriculum.

Department Safety Coordinator (DSC)/Responsible Person (RP)

The DSC/RP has **Training** and **Recordkeeping** responsibilities as outlined in those sections of this program.

Principal Investigator (PI)/Project Supervisor/Supervisor

The Principal Investigator/Project Supervisor/Supervisor must delegate a *Qualified Person* to:

- Inform all **Affected Persons** working in the area of the existence of this program and its impact on their work area,

- Ensure that their subordinates have had documented **training** concerning LOTO and the use of ***Procedures*** at a level appropriate to the anticipated level of exposure to hazardous energy sources in their research/workplace.
- Ensure that proper **labeling is applied to all disconnect locations** on specific equipment controlled by the department. Labeling activities may be conducted by the PI, Supervisor or Qualified Person, another department member under the leadership of this person, or by an outside contractor.
- Determine safe **Equipment-Specific Energy Isolation Procedures** to be worked on and record them using ***Procedures*** or on the **document template**.
- Conduct an **annual audit** of equipment-specific energy isolation procedures to ensure they are still accurate and appropriate to needed safe work practices.
- Determine who is a ***Qualified Person*** that may work on the equipment.
- Inform all *Qualified Person(s)* and/or the contractor of any:
    - known energy sources on the equipment
    - any energy isolation procedure previously developed for the equipment
    - any other known hazards associated with the equipment.
- Conduct meetings that include a review of energy isolation procedures for the equipment with all *Qualified Person(s)* prior to commencing work or at the beginning of each work shift.
- Ensure the arriving shift supervisor and shift work crew are oriented by the departing shift supervisor as to the job status prior to the arriving shift's commencement of work.
- Ensure the departing shift supervisor oversees that the arriving shift workers have put locks and tags on all energy sources before the earlier shift's locks and tags are removed when multiple shifts work on the same equipment.
- **Contact EH&S** for assistance in developing energy isolation procedures and providing training to subordinates and *Qualified Personnel* as needed.

For departments hiring contractors to conduct work at UC Berkeley, the Project Supervisor must be familiar with the **Contractor or Joint Project Roles and Responsibilities**. The Project Supervisor representing the department who owns the equipment is responsible for ensuring the contractor has a LOTO program and follows it, but is not responsible for evaluating the contractor's LOTO program. The Supervisor must make any previously developed LOTO procedure(s) for the equipment available to the contractor prior to the start of work to aid the contractor in developing equipment-specific LOTO procedures for that equipment as part of their project activities and documentation of safe-work protocols.

The Supervisor may also make this LOTO program available to the contractor for their information and use. Any equipment-specific LOTO procedures developed by the Contractor/Project Supervisor must be delivered to the Owner Department as part of the completed project documentation.

Contractors and Joint Projects

The Contractor follows their own LOTO program when working on University property or equipment. The Contractor provides evidence of their LOTO program to the University Project Supervisor/Manager upon

request. The Contractor provides their own energy isolation equipment including locks, tags, and hasps and follows Joint Project requirements.

If the Owner Department has previously developed equipment-specific LOTO procedures for equipment the Contractor is working on, the Contractor must follow the Department's procedure. For equipment that has not previously had a LOTO procedure developed, the Contractor surveys the equipment and develops and documents a written LOTO procedure for it, using ***Procedures*** or a **document template**. A copy of the Contractor's equipment-specific LOTO procedure is provided to the Project Supervisor and EH&S as part of completed-project documentation. As Contractor work progresses, the Contractor informs the Project Supervisor immediately of any newly discovered energy sources or potential hazards associated with the equipment.

Joint Project Requirements

For Joint Projects where employees of the University and Contractor(s) are working on the same equipment at the same time, the Project Supervisor, whether employed by the Contractor or University, must hold joint meetings with all personnel in attendance who will be working on the equipment to promote understanding of safe work practices, and open lines of communication between work crews.

The Office of Environment, Health, and Safety (EH&S)

The Office of Environment, Health, and Safety (EH&S) is responsible for:

- Writing and maintaining this program to meet or exceed Cal/OSHA requirements,
- Informing departments of this program's requirements,
- Providing general program awareness information across campus,
- Providing assistance for departments and personnel in the implementation of this program,
- Providing training on program implementation and requirements to all affected personnel identified by each department,
- Providing training on the use of ***Procedures***.
- Providing an easy method for creation of equipment-specific LOTO Procedures on paper,
- Recommending energy isolation equipment and processes for general and/or specific use,
- Providing assistance in the development of LOTO Procedures,
- Providing safety engineering assistance to develop alternative safe-work procedures when Hot Work must be conducted instead of LOTO
- Updating this program periodically or as regulatory change may dictate.

Definitions

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

Blind – Another form of blocking is the placement of a blind. A blind is a disk of metal placed in a pipe to ensure that no air, steam, or other substance will pass through that point if the piping system is accidentally activated/pressurized.

Blocked – Equipment is *blocked* by inserting a mechanical device to prevent inadvertent movement. The potential energy that may need to be blocked can come from:

- suspended or rolling parts subject to movement or gravity,
- energy stored in springs
- movement due to airflow, etc.

The *block* must be strong enough to support the entire load of the equipment components if the equipment moves. Blocks should have chains or some other means that can lock the block in place. Installing a wheel chock on a vehicle, a chain wrapped around a fan blade, or a steel bar inserted into the spokes of a fly-wheel are all examples of *blocks* used in LOTO.

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.

Locked out/blocked out/blinded/bled – means that any energy source is isolated in the "safe" position that prevents energy flow and/or movement. For example, electrical sources must be disengaged and shut off, pressurized fluids/gasses must be de-energized and bled to atmosphere with the bleed valves locked *open*, and/or valves or switches locked and piping blinded in an *off and safe* condition.

Owner Department – Any department that owns equipment that by its nature/design must have this LOTO Program applied to the equipment for personnel to safely conduct modification, repair, adjustment, development, or maintenance work on the equipment.

Procedures – An app that provides the means to create and reference existing LOTO procedures on mobile and desktop devices. It was created and is maintained by UCOP Risk & Safety Solution (RSS) and is available to all UC Berkeley employees.

Qualified Person – A person who performs lockouts and/or tagouts on specific machines or equipment in order to clean, repair, service, set up, and/or adjust operations on that machine or equipment. A **Qualified Person** must be approved by their Supervisor, trained on identifying and controlling hazardous energy, as well as the application of this program. They must be provided energy isolation locks and tags and be familiar with all equipment components prior to conducting work on equipment. A *Qualified Person* may develop written equipment-specific energy isolation procedures using ***Procedures*** or a **document template**.

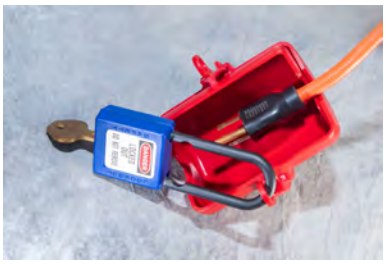
A person's *qualification* to conduct LOTO is **documented** and kept in a *Qualified Person's* permanent employee file.

Testing Equipment – Once the equipment is locked, blocked, and/or blinded, it must be tested to make sure the machinery is de-energized prior to commencing work on the equipment. **CAUTION: Return disconnects and operating controls to the off position after each test.**

Methods of Locking Out Energy

Electricity

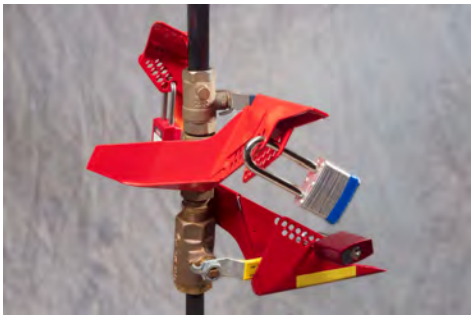
There are many different ways to lockout a piece of equipment. Commonly, the main electrical disconnect switch has one opening where a single lock can be placed.

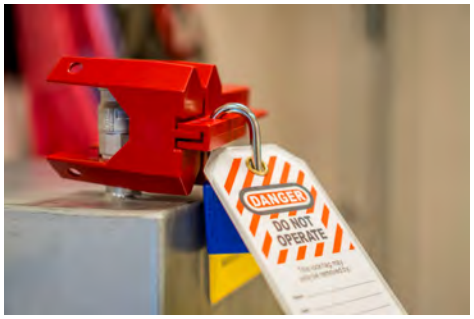


- If more than one employee works on the equipment, a multiple-lock hasp suitable for the installation of several locks must be used, enabling all workers to lockout the machine with their individual locks.
- If the switches are in a metal box, the box itself must be locked out in the closed position.
- If a fuse was removed in order to de-energize the equipment, the fuse box must be locked.
- 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 can also be locked in this way.
- In some equipment, an electric control circuit will actuate the main power circuit. In such situations, both circuits must be locked and tagged out before safe-work can proceed. Capacitors must be safely discharged to ground with ground straps installed prior to working around, storing, or transporting them. Refer to the UC Berkeley Electrical Safety Program section, **Practices for Capacitor Hazards**, for safety procedures to discharge and ground capacitors.

Compressed Air, Gasses, Hydraulic Fluids, Steam, or Pressurized Water

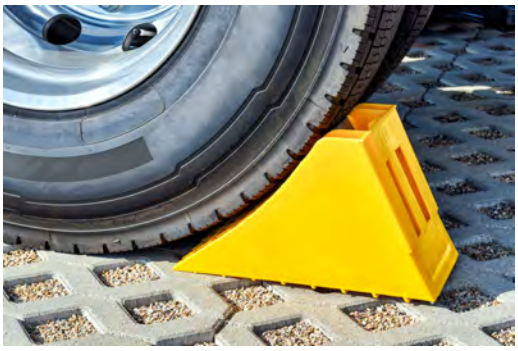
Machines activated by compressed air or steam will have valves that control movement. These valves will need to be locked out and bled to release any residual pressure into the atmosphere. Physically disconnect the equipment from the supply plumbing if possible. If not possible, use double valves or blind off supply lines with appropriate flange plates or pipe caps.

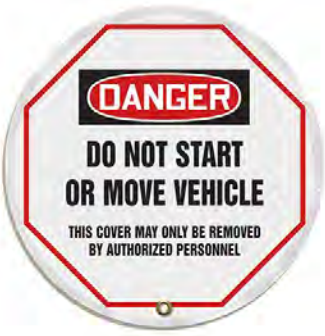




Mechanical Energy

Block equipment components so they cannot move using support rods for counterweights or elevated components, a bar through spokes of a wheel, flywheel or fan blades, a wedge-shape wheel-chock for rolling components, wrapping and locking chains around a movable equipment component, and locking it to an immovable object, etc.





Program Requirements and Procedures

Owner Department Requirements

Surveying Equipment Energy Disconnecting Means

An initial survey and annual audit of equipment specific to a department and/or work-project site is completed to identify all energy sources requiring isolation, accomplished by a physical inspection. A study of building drawings and/or equipment manuals may supplement this inspection. Note and **document** the identification and labeling details of:

- the name and type of equipment supplied
- its physical location
- energy type(s)
- magnitude

Equipment Name	Location	Energy Sources	Magnitude
Piston Air Compressor #3	Level 1, Machine Room Hildebrandt Hall	Electricity Compressed air Heat Rotating Equipment	3 Phase, 50 Amps, 480 volts 120 psi tank/piping Manifold 220 degrees F 50 lbs. flywheel and belts

New Facilities and Equipment

For new facilities or equipment being built or brought online by a Project Manager, the requirements of this program are integrated into project documentation by use of project specifications.

The Project Manager assures that energy isolation surveys are documented for each individual piece of equipment by completing either:

- a survey on ***Procedures***, or
- steps 1-4 of the **UC Berkeley - LOTO Equipment Specific Procedure**.

This completed documentation is provided to EH&S and the host Department as part of the project documentation. EH&S provides recommendations of PPE and safety equipment for the procedure directly to the host Department. Completed energy isolation surveys are provided to the host Department. The Project

Manager assures signage and labels are installed on energy disconnects in compliance with this program specification by the General Contractor.

Existing Facilities and Equipment

For previously constructed facilities/equipment, an initial LOTO equipment survey is conducted as needed as work arises for each location and piece of equipment. The LOTO survey is completed by the owner department, the owner of the equipment, Facilities Maintenance personnel, or a Contractor (whoever will be maintaining, repairing, or adjusting the equipment needing energy isolation).

This survey is documented by completing either:

- a procedure on ***Procedures***
- Steps 1-3 of the **UC Berkeley - LOTO Equipment Specific Procedure**

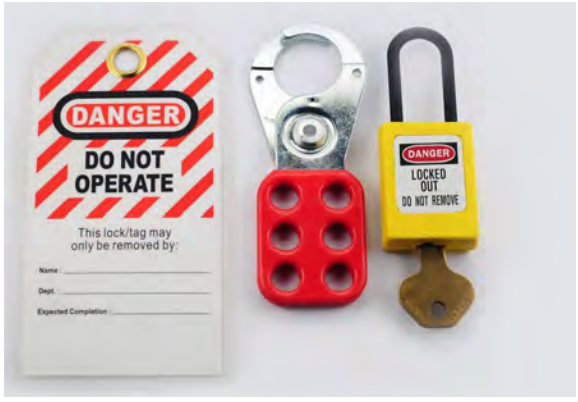
Once each survey is complete, update the **Equipment Inventory and LOTO Audit Tracking Form** listing all of the equipment requiring an EI–LOTO procedure, and an annual procedure audit is kept by the host department and made available to anyone requiring this information to conduct safe equipment-specific energy isolation work as needed for future reference/use.

Identifying & Labeling the Energy Disconnecting Means

For each piece of equipment identified, all energy sources must be determined and the corresponding disconnecting means must be appropriately marked indicating its function. Signs or stickers stating **LOCKOUT HERE** with accompanying information of the equipment being controlled at the disconnecting location must be installed to direct personnel to correct lockout devices. In complicated operations, schematics of just the disconnecting means may be developed by the Project Manager, EH&S, or the Facilities Engineering department.

Providing Locks, Blocks, & Accident Prevention Tags

LOCKS



Each worker has their own lockset and the only key to that lockset. These are provided to the worker by their Supervisor/Department. To maintain harmony with Lawrence Berkeley National Laboratory (LBNL) facility requirements, **all locks should be RED in color** to quickly identify locked/tagged energy sources. These locks are substantial, durable, and have the name of the employee (or another unique identifier) on them. In addition, locks may have a color-coded stripe to indicate different shifts, types of crafts, or lock owners. When more than one worker is servicing a piece of equipment that must be locked out, a lockout adapter hasp is used which allows all the workers to place their locks on the disconnecting means. Each worker puts one of their locks on every isolation device prior to starting work on a machine. After the work is completed, each worker removes their lock(s) and the machine is then returned to service.

BLOCKS, BLINDS AND BLEEDS

Blocks are placed under raised dies, lifts, or any equipment that might inadvertently move by sliding, falling, or rolling. Blocks, special brackets, or special stands such as those commonly used under raised vehicles, must be used. Before installing blinds or blocks, steam, air, or hydraulic lines are bled down to return the system to atmospheric pressure, then blinds/blocks are installed. Coiled springs, spring-loaded devices, or suspended loads are released so that their stored energy will not result in inadvertent movement. Bleed valves must be locked *open*.

TAGS

Tags are not used alone unless there is no method to safely isolate energy sources. Tags or signs are used in addition to locks. *Tags* or *tagout devices* must be capable of enduring at least 50 pounds of pull. One tag is placed by the Project Manager or Lead Tradesperson at each lockout location. Tags state

- the reason for the lockout
- the name of the person(s) who is/are working on the equipment
- how the person who placed the tag may be contacted
- the date and time the tag was put in place

Qualifying Personnel

A Qualified Person is an individual formally recognized and documented as:

1. Having completed required classroom, trades, or other training on LOTO
2. Having received training on the use of ***Procedures***
3. Having sufficient understanding of LOTO safe-work practices and equipment to be able to recognize and positively control any hazards that may be present, and
4. Possessing the work experience and formal training necessary to execute work according to recognized and accepted LOTO safe-work practices, and
5. Having completed orientation to a specific equipment's LOTO procedure, or
6. Having developed and reviewed a LOTO procedure for specific equipment that is subsequently reviewed and approved by another *Qualified Person* or their Supervisor.

Only persons who are *Qualified* may conduct LOTO processes. A person must be *Qualified* by their Supervisor when their duties include cleaning, repairing, servicing, setting up, and/or adjusting operations on equipment requiring Energy Isolation for safe work activities. The Supervisor determines their qualification based upon the Supervisor's knowledge of the qualified person's skills and the energy sources on the equipment.

All *Qualified Personnel* must be **trained**, be provided appropriate tools to conduct Lockout/Tagout, and follow all procedures outlined in this program. Qualified Person(s) may

- conduct LOTO to the degree of their documented qualification
- develop energy isolation procedures
- conduct **annual audits** on existing procedures

A person may be considered *Qualified* with respect to certain equipment, certain types of energy sources, and certain safe-work methods on specific equipment, but not *Qualified* for other equipment/locations within the same Department. It is the responsibility of the *Qualified Person's* Supervisor to determine the limitations of *Qualification* for each and every person working under their direction, document this on the ***Qualified Person's record*****,** and maintain a copy in the *Qualified Person's* permanent file.

Periodic Inspection/Annual Audit

Cal/OSHA requires annual audits of equipment-specific energy control procedure(s) developed by Departments to evaluate their continued effectiveness and determine the necessity for updating the written procedure(s) or safety equipment. Departments are responsible for conducting these annual audits on each LOTO procedure they have developed. EH&S will check in with department managers annually to ensure that audits are occurring. These inspections must:

1. Be performed by a Qualified Person who is not routinely using the LOTO procedure(s) being audited.
2. Identify the following:
    a. Equipment upon which the LOTO procedure was being utilized
    b. The date of the audit
    c. The Affected Persons and Qualified Persons who are impacted by the procedure being audited
    d. The person performing the audit.
3. Include random interview(s) between the auditor and Affected Persons and Qualified Persons of their responsibilities under the LOTO procedure being audited.
4. Physically audit signage, LOTO locks, tags, and other equipment.
5. Generate recommendations to the Department for procedure improvement or training as the audit may uncover.
6. Be **documented** by the Department that the audits have been performed.

LOTO Practitioner Procedures

Equipment-Specific Energy Isolation Procedures

Use ***Procedures*** or the Energy Isolation Procedure **document template**. Always follow the **Rules for Using LOTO Procedure**, and other procedures outlined in this program, unless more safe work procedures have been developed for a specific piece of equipment.

When surveying and/or training for an equipment-specific LOTO procedure:

1. All ***Affected Persons*** must understand what equipment EI-LOTO means when the equipment in their work area will be ***locked/tagged out***, and to never try to start equipment when locked/tagged out.
2. The *Supervisor* and *Qualified Person(s)* must be trained in this written procedure and fully knowledgeable of the hazardous energies related to the specific equipment.
3. *Qualified Person(s)* reassigned to different equipment must be trained on that specific equipment.

Rules for Using Energy Isolation – LOTO Procedure

Several basic safety rules are applied during every LOTO situation:

1. Only *Qualified Persons* may work on, or practice, LOTO on equipment.

2. All equipment must be blocked and locked out to protect against accidental or inadvertent operation when such operation could cause injury to personnel.
3. Never attempt to operate any switch, valve, or other energy isolating device bearing a lock.
4. Never remove a blocking device until all personnel, tools, and obstructions have been cleared from the area, and all equipment guards have been properly reinstalled.
5. If the equipment or system must remain energized during work, **contact EH&S** to assist in developing adequate alternative hazard control measures, such as the use of suitable temporary barriers, special tools, and personal protective equipment.

Standard LOTO Procedure

1. Each maintenance personnel is issued a suitable lock (or locks, for multiple energy sources). Each lock has the individual worker's name (or another unique identifier) on it. Each worker has the only key to the lock/lockset.
2. The Qualified Person checks to be sure that no one is operating the machinery **before** turning off energy sources. All 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.
3. 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.
4. Gas cylinders must be locked *closed* and if possible disconnected from distribution piping.
5. Any mechanical component that could roll, shift, or otherwise move (such as springs, counterweights, wheels, fan blades, etc.) must be chained, barred, or blocked.
6. Each person who will be working on the machinery must put a lock on each of the machine's lockout device(s). Each lock must remain on the machine until the work is completed. Only the worker who placed the lock may remove it.
7. The Supervisor or *Qualified Person* places a tag on each lockout location.
8. All energy sources which could activate the machine must be locked or blocked out following an equipment-specific LOTO Procedure, developed using ***Procedures*** or a **document template**, for that equipment.
9. All disconnects must be tested to ensure that all energy sources to the machine are off.
10. Electrical circuits must be checked by qualified persons with proper and calibrated electrical testing equipment. Stored energy in electrical capacitors must be safely discharged.
11. **CAUTION: Return disconnects and operating controls to the *off* position after each test**.
12. Attach accident prevention **tags** that give the reason for placing the lock/tag, the name of the person placing the lock/tag, how they may be contacted, and the date and time the lock/tag was placed.

Testing/Adjusting Equipment during Lockout

In many maintenance and repair operations, machinery must be tested and therefore energized before additional maintenance work can be performed. **For such situations, this procedure must be followed**:

1. Clear all personnel to safety.

2. Clear away tools and materials from equipment.
3. Remove blocks and lockout devices and re-energize systems, following the established safe procedure.
4. Proceed with tryout or test.
5. Shut off all energy sources
    a. reinstall lockouts on energy sources
    b. reinstall blocks
    c. bleed all pressure systems
    d. verify all energy sources are de-energized prior to continuing work

Equipment design and performance limitations may dictate that effective alternative worker protection be provided when the established lockout procedure is not feasible. If machinery must be capable of movement in order to perform a maintenance task, workers must use extension tools, personal protective equipment, and other means to protect themselves from moving parts and potential injury.

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:

1. Remove all non-essential items.
2. See that all equipment components are operationally intact, including reinstalling guards and safety devices.
3. Repair or replace defective guards before removing locks.
4. 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. If the qualified person is absent from the workplace then the lock or tag can be removed by a qualified person designated to perform this task provided that the immediate supervisor:
    a. Verifies that the qualified person is not present and therefore unable to remove the lock;
    b. Makes all reasonable efforts to inform the qualified person that the lockout/tagout device has been removed
    c. Ensures that the qualified person knows their lockout/tagout device has been removed before their work resumes.
5. Make a visual check before restoring energy to ensure that everyone is physically clear of the equipment.
6. Notify any ***Affected Person(s)*** that equipment has been restored to its operational state.

Joint Projects

If University personnel and contractor personnel are working on the same piece of equipment, each work team installs their own hasp and locks on each energy source. The University provides the hasps that University personnel install their locks on, and the Contractor provides the hasps and locks that their personnel install/use.

Training Requirements

All persons identified in **Roles/Responsibilities** must receive documented training on their required work practices and responsibilities in the application of this program.

Updated training for this program is required whenever:

- The program changes
- The application to specific equipment changes
- The **Owner Department** operations or equipment/energy hazards change (such that personnel must have retraining to conduct safe work)

All training is documented with, at a minimum:

- an attendance roster signed by each trained employee
- reference to the content/syllabus of the training provided

Owner Department's Training Requirements

Departments identify ***Qualified Person(s)*** requiring training, and initiate training either through their enrollment in the **UC Berkeley Learning Center** or by **contacting EH&S** and arranging for training to occur. Initial training is given within 3 months of program adoption for all current personnel, and within one month upon new hire via the Learning Center and/or Department-provided training program.

Program Administrators are trained on their **roles and responsibilities** in the management/maintenance of the requirements outlined in this program.

LOTO Practitioner Training

A ***Qualified Person*** must be trained on how to apply LOTO properly to all equipment they are expected to work on commensurate with their general knowledge and skill level. They must be trained on the use of ***Procedures*** (or the **written procedure template**), the contents of this program, and how this program is applied specifically to an Owner Department's equipment.

Recordkeeping Requirements

An Owner Department's Department Safety Coordinator (DSC), or the LOTO Program manager for the department, keeps training/qualification records of all department personnel trained on this program. Training records include the name of the person trained, the date of training, an outline of training content, and the signature of the trained individual.

Training and qualification to conduct LOTO activities are documented on the **training record of the *qualified person*** and kept in their permanent file for three years after the termination of their employment/authorization at UC Berkeley.

The DSC/Program Manager may keep an up-to-date **Equipment Inventory and LOTO Procedure Audit Tracking List** of all department-controlled equipment that falls under the requirements of this program. Inventory lists are made available for review by EH&S and regulatory agencies, and for use by Facilities Maintenance departments, other departments, and/or contractors who may need access to the list for planning and training of safe work practices.

The DSC/Program Manager provides the tools to produce written equipment-specific LOTO procedures to *Qualified Person(s)* within the Department for documenting LOTO Procedures (***Procedures*** or the **document template**), and may also provide these tools to Contractors conducting work for the Department. Hard copies of completed equipment-specific LOTO Procedures are kept on file with the equipment and by the DSC/Program Manager. The DSC/Program Manager also provides a completed LOTO Procedure for a specific piece of equipment to any UC Berkeley staff, personnel, or Contractor (conducting work on or around such equipment) upon request.

Record Retention Requirements

TRAINING RECORDS

Retain records for three years after the termination of the employee's employment/authorization.

LOTO SPECIFIC EQUIPMENT PROCEDURES

LOTO procedures developed must be kept by the Owner Department for as long as the equipment is in service. LOTO procedures are archived once the equipment has been removed from service.

EH&S REQUIREMENTS

EH&S retains indefinitely the following:

- Annual LOTO equipment-specific procedure audit records
- LOTO Program training provided by EH&S (and other entities)
- Historical documents
- Revisions LOTO Program

Records of procedures constructed using ***Procedures*** are kept by UCOP.

References

Contact EH&S

The following Title 8 Cal/OSHA codes are referenced in this program:

- §2320.4. De-Energized Equipment or Systems
- §2320.5. Energizing (or Re-Energizing) Equipment or Systems
- §2320.6. Accident Prevention Tags
- §2320.9. Backfeeding or Interconnection | Requirements for working on energized electrical systems
- §2530.43. Automatic Restarting
- §2530.86. Motor Not in Sight from Controller
- §2940. General Provisions | Requirements for working on energized electrical systems
- §3203. Injury and Illness Prevention Program
- §3314. The Control of Hazardous Energy for the Cleaning, Repairing, Servicing, Setting-Up, and Adjusting Operations of Prime Movers, Machinery, and Equipment, Including Lockout/Tagout
- §6004. Accident Prevention Tags

ATTACHMENTS

Attachment 1 | Equipment Inventory and LOTO Audit/Tracking Log

Instructions: This form may be used by Departments/DSCs to inventory all their equipment requiring an Energy Isolation – LOTO procedure. Prior to conducting Energy Isolation activities on equipment, Cal/OSHA requires that an initial survey of all energy sources providing energy to the equipment must be conducted. This must be done by physical inspection, possibly in combination with a study of drawings and equipment manuals. This survey may only be conducted by a *Qualified Person* in a department, Facilities Maintenance, EH&S, or a Contractor who will be working on the equipment, and documented using ***Procedures*** or the **UC Berkeley LOTO Equipment-Specific Procedure Template** (steps 1-3).

Procedures are developed using ***Procedures*** or by completing the **UC Berkeley LOTO Equipment-Specific Procedure Template** (Steps 4-5), and then applying the standard energy isolation process steps specific to the equipment.

To track equipment in the program, enter equipment inventory and energy supply data as demonstrated. Note the date when the procedure was created and include the initials of the *Qualified Person* who developed the procedure. Note the date when the procedure was audited by a *Qualified Person* and include the initials of the auditor.

All procedures must be audited at least annually by law.

Department List

Equipment Name	Location	Energy Sources	Magnitude	Procedure Created	Created By	Audit Date	Audit Initials
Example: Piston Air Compressor #3	Level 1, Machine Room Hildebrandt Hall	Electricity Compressed air Heat Rotating Equipment	3 Phase, 50 Amps, 480 volts 120 psi tank / piping Manifold 220 degrees F 50 lbs. flywheel and belts	4/30/21	GB	4/25/22	PK
Example: Vacuum Vane Pump #1	Level B2, Machine Room Stanley Hall	Electricity – Main Electricity – Control Vacuum Domestic Water Rotating Equipment Heat	3 Phase, 30 Amps, 480 volts 1 Phase, 15 Amps, 120 volts 24 Hg" tank / piping 80 psi. Pump-motor coupler Exhaust Pipe 190 degrees F	4/26/21	GB	4/25/22	PK

Equipment Name	Location	Energy Sources	Magnitude	Procedure Created	Created By	Audit Date	Audit Initials

Attachment 2 | UC Berkeley LOTO Equipment-Specific Procedure Template

Instructions | Completed Example

This Procedure can be found in ***Procedures*** using the name: _____

Equipment Name:	Building:	Room #:
Describe Scope of Work:		

4.	1. Energy Source	2. Magnitude/Type			3. Isolation Device/Location/Method
	☐ ELECTRICITY– Main power	Amps	Volts	# Phase	
	☐ ELECTRICITY– Control circuit(s)	Amps	Volts	# Phase	
	☐ BATTERY / SOLAR / ALT POWER	Amps	Volts	# Phase	
	☐ COMPRESSED AIR / GASSES	PSI	Gas Type		
	☐ STEAM / CONDENSATE	PSI	Source		
	☐ FLUID UNDER PRESSURE	PSI	Source		
	☐ HEAT / COLD + / - C° or + / - F°	Temp	Source		
	☐ VACUUM CHAMBER / PIPING	Hg	Source		
	☐ FUEL(S) - SOLID / LIQUID / GAS	Volume	Fuel		
	☐ ROTATING WHEEL / FAN / DRIVE	Details			
	☐ SUSPENDED WEIGHT	Details			
	☐ MECHANICAL OTHER	Details			

5. PPE to be worn during work

EYE PROTECTION
- ☐ GOGGLES
- ☐ FACE SHIELD
- ☐ WELD GEAR

BOOTS
- ☐ STEEL TOE
- ☐ RUBBER
- ☐ OTHER

GLOVES
- ☐ LEATHER
- ☐ RUBBER
- ☐ INSULATED

FALL PROTECTION
- ☐ SAFETY HARNESS
- ☐ LANYARD & LINE

RESPIRATOR
- ☐ DUST
- ☐ CHEMICAL

THERMAL PROTECTION
- ☐ HEAT
- ☐ COLD

OTHER
- ☐ APRON
- ☐ WET GEAR
- ☐ OTHER (Details):

6. Safety Equipment to be used during work

- ☐ FIRE EXTINGUISHER
- ☐ FIRE WATCHER
- ☐ LINES BLINDED & TAGGED
- ☐ VALVES - LOCKED & TAGGED
- ☐ SWITCHES - LOCKED & TAGGED
- ☐ LONG HANDLE TOOLS
- ☐ INSULATED TOOLS
- ☐ REMOVE FLAMMABLES / COMBUSTIBLES
- ☐ BLEEDERS LOCKED OPEN & TAGGED
- ☐ SHIELDS – ARC CURTAIN
- ☐ SHIELDS – HEAT BLANKET
- ☐ BLOCKS
- ☐ BARS
- ☐ BARRICADES
- ☐ CHAINS

Prepared By		**Signature**		**Date**	
Annual Review By		**Signature**		**Date**	

Follow these steps to create a written sequence for de-energizing, lockout, testing, and startup of equipment requiring energy isolation.

1. Survey and check off all energy sources
2. Note magnitude and type of each energy source
3. Note device and location of each energy disconnecting/isolation source/method
4. List sequence of energy isolation (number from 1 up to 12)
5. Check off all PPE to be used for energy isolation
6. Check off all safety equipment to be used for energy isolation

Use the completed procedure for safety meetings/training for the equipment-specific lockout process. Discuss with workers how equipment energy isolation - LOTO is applied to this specific equipment during these planned jobs/tasks. Also, Discuss communication methods on the job site.

Isolate energy sources in sequence.

Assure each worker installs their own lock on each disconnect location.

Supervisor/Authorized Person installs warning tags. Verify Energy Isolation prior to starting work. When testing/jogging equipment, always follow the equipment's prepared program procedures.

When restoring equipment to operation, reverse isolation sequence unless otherwise discussed/approved by the Project Supervisor.

Use Personal Protective Equipment and safety equipment as noted during work activities.

Contact EH&S for technical support and special concerns.

This Procedure can be found in ***Procedures*** using the name: UC Berkeley Bancroft Dual Cooling Tower

Equipment Name	Cooling Tower	Building	Bancroft Library	Room #	Roof

Describe Scope of Work:	Maintenance for cooling towers 1 and 2 including drive-belt replacement, cleaning, lubrication, testing and tightening of all electrical/mechanical/plumbing system components.

4.	1. Energy Source	2. Magnitude/Type						3. Isolation Device/Location/Method
1	☑ ELECTRICITY– Main power	Amps	20	Volts	480	# Phase	3	CT-Fan Motor 1 and CT Fan Motor 2 – Knife Switches - West Wall
2	☑ ELECTRICITY– Control circuit(s)	Amps	20	Volts	120	# Phase	1	Panel # RLA, Breaker # 6.
3	☑ BATTERY / SOLAR / ALT POWER	Amps	15	Volts	480	# Phase	3	CWP1 and CWP2 – Knife Switches – SE Wall
	☐ COMPRESSED AIR / GASSES	PSI		Gas Type				
	☐ STEAM / CONDENSATE	PSI		Source				
4	☑ FLUID UNDER PRESSURE	PSI	60	Source	Dom. H2O			1" copper ball-valve each CT – Shut off valve and open drain plug.
	☐ HEAT / COLD +/- C° or +/- F°	Temp		Source				Chem Feed Pumps - (2) ¾" globe valves in & out. Normal op's at 150PSI.
	☐ VACUUM CHAMBER / PIPING	Hg		Source				Note: Bleed Chemical Feed pumps to atmosphere before work.
	☐ FUEL(S) - SOLID / LIQUID / GAS	Volume		Fuel				
6	☑ ROTATING WHEEL / FAN / DRIVE	Details						Use a 6' chain and wrap / attach to frame member to prevent movement.
	☐ SUSPENDED WEIGHT	Details						
5	☑ MECHANICAL OTHER	Details	H2O Qual. Controller, 120 VAC, 20 Amps					Panel # RLA, Breaker # TBD.

7. PPE to be worn during work

EYE PROTECTION
- ☑ GOGGLES
- ☑ FACE SHIELD
- ☐ WELD GEAR

BOOTS
- ☐ STEEL TOE
- ☑ RUBBER
- ☐ OTHER

GLOVES
- ☑ LEATHER
- ☐ RUBBER
- ☐ INSULATED

FALL PROTECTION
- ☐ SAFETY HARNESS
- ☐ LANYARD & LINE

RESPIRATOR
- ☐ DUST
- ☐ CHEMICAL

THERMAL PROTECTION
- ☐ HEAT
- ☐ COLD

OTHER
- ☐ APRON
- ☑ WET GEAR
- ☐ OTHER (Details):

8. Safety Equipment to be used during work

- ☐ FIRE EXTINGUISHER
- ☐ FIRE WATCHER
- ☐ LINES BLINDED & TAGGED
- ☑ VALVES - LOCKED & TAGGED
- ☑ SWITCHES - LOCKED & TAGGED
- ☐ LONG HANDLE TOOLS
- ☐ INSULATED TOOLS
- ☐ REMOVE FLAMMABLES / COMBUSTIBLES
- ☐ BLEEDERS LOCKED OPEN & TAGGED
- ☐ SHIELDS – ARC CURTAIN
- ☐ SHIELDS – HEAT BLANKET
- ☐ BLOCKS
- ☑ BARS
- ☐ BARRICADES
- ☑ CHAINS

Prepared By	Gary Bayne	**Signature**	*Gary Bayne*	**Date**	4/29/21
Annual Review By	Patrick Kaulback	**Signature**	*Patrick Kaulback*	**Date**	4/25/22

Attachment 3 | LOTO – Training Record of *Qualified Person*

Personnel File For

Supervisor | Date

To be completed by the PI/Supervisor of the *Qualified Person* conducting Energy Isolation – Lockout/Tagout work

This document confirms required Qualification of the above named person to perform the following:
Check all that apply, Attach additional pages if necessary

Energy Isolation operations and work on the following equipment/locations:

- ☐ All locations and equipment under my supervision
- ☐ All locations and equipment in our Department's jurisdiction
- ☐ All locations and equipment as this person's job duties may dictate
- ☐ Specific equipment/locations as listed:

1. 2.
3. 4.

Energy Isolation work with the following energy sources:

- ☐ All Energy Sources below
- ☐ Compressed Air
- ☐ Cryogenic Fluids/Gasses
- ☐ Other Compressed Gasses (describe):
- ☐ Electricity (<50 volts)
- ☐ Electricity (50 – 600 Volts)
- ☐ Electricity (>600 volts)
- ☐ All flammable materials
  - ☐ Flammable gasses
  - ☐ Flammable fluids
  - ☐ Flammable solids
- ☐ Fluids under pressure
  - ☐ Hydraulic systems (<150 psi)
  - ☐ Hydraulic systems (>150psi)
  - ☐ Hot Fluids/Gases
  - ☐ Steam
- ☐ Mechanical Equipment – Springs/Counterweights/Fly Wheels/Fan Blades/Blocks
- ☐ Other (describe):

Designation of *Qualified Person* is based on evidence of safe performance of all duties related to Energy Isolation through:
Check all that apply

- ☐ Training on UC Berkeley LOTO program conducted (including ***Procedures*** and any skill checks or tests)
- ☐ This person has been safely performing, and has demonstrated skill in safe Energy Isolation procedures, for a minimum of 5 years
- ☐ This person has received instruction from myself or another person who is authorized in Energy Isolation, and who has observed this person's work while performing Energy Isolation operations, and confirms that the above named person has the knowledge and skills to perform Energy Isolation work safely.

PI/Supervisor Signature | Date

Qualified Person Signature | Date

As the supervisor, if this person has demonstrated they are not performing work safely, this qualification will be revoked.