This chapter was last reviewed for currency 4/22/2024.
The next thorough review is due 4/22/2027.

ENVIRONMENT, SAFETY & HEALTH DIVISION

Chapter 51: Control of Hazardous Energy

Quick Start Summary

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URL: https://www-group.slac.stanford.edu/esh/eshmanual/references/coheQuickstart.pdf

1 Who needs to know about these requirements

The requirements of the Control of Hazardous Energy (CoHE) program apply to workers performing *service and maintenance*[1] of machines, equipment, or systems where *hazardous energy* may be present (for example, electrical, thermal, mechanical, hydraulic, pneumatic, chemical, and ionizing and non-ionizing radiation), their supervisors; equipment designers, custodians, and owners; CoHE assessors; construction and service managers and points of contact; the CoHE program manager, related ESH program managers; and associate laboratory directors. The program also covers *administrative lock and tag control*, which may involve the lockout of equipment for configuration or operational purposes, but which may not be used alone to protect workers from hazardous energy.

2 Why

Exposure to hazardous energy from the unexpected energization or start-up of machines, equipment, or systems can cause serious injury or death.

3 What do I need to know

Each worker must have control over hazardous energy that could be encountered during service and maintenance of equipment. A hazard analysis is required to confirm the presence of hazardous energy. If hazardous energy is confirmed the appropriate lockout procedure must be used. *Simple lockout* may be performed under the simple lockout procedure; *complex lockout* (involving for example multiple energy sources, crews, crafts, or locations) requires either a group or *equipment-specific lockout procedure*.

Under these procedures *authorized workers* may begin work only after they have placed their *personal lock*(s) on the *energy isolating device(s)* or *group lockout device* in accordance with the applicable procedure: no worker may work under another worker's lock.

4 When

These requirements take effect 22 April 2024.

5 Where do I find more information

SLAC Environment, Safety, and Health Manual (SLAC-I-720-0A29Z-001)

- Chapter 51, "Control of Hazardous Energy"

Or contact the program manager.

1 *Service and maintenance* includes activities such as constructing, installing, setting up, adjusting, inspecting, modifying, demolishing, and maintaining and/or servicing machinery or equipment.

ENVIRONMENT, SAFETY & HEALTH DIVISION

Chapter 51

Control of Hazardous Energy

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1 Purpose

The purpose of this program is to prevent worker exposure to *hazardous energy* (such as from unexpected energization, start-up, or release of stored energy).

It covers controlling hazardous energy associated with the *service and maintenance* of machines, equipment, or systems. It also covers *administrative lock and tag control*, which may involve the lockout of equipment for configuration or operational purposes, but which may not be used alone to protect workers from hazardous energy.

It applies to workers (as *authorized*, *lead authorized*, *affected*, and zero voltage verification workers and operations group members) and supervisors; equipment designers, custodians, and owners; CoHE assessors; construction and service managers and points of contact; the CoHE program manager, related ESH program managers; and associate laboratory directors.

Note Control of hazardous energy *is commonly referred to as* CoHE*, and* lockout/tagout *is commonly referred to as* LOTO *or* lockout.

1.1 Exemptions

The following activities are exempt from CoHE requirements.

- Work on *cord-and- plug connected equipment*, in which all these conditions are met:
  - There is a single energy source.
  - All of the hazardous energy is controlled by unplugging the equipment and there is no potential for stored hazardous energy.
  - The plug remains under the exclusive control of the worker performing the servicing or maintenance.
- Minor tool changes and adjustments, and other minor servicing activities that take place during normal operations, provided that (a) they are routine, repetitive, and integral to the use of the equipment, and (b) the work is performed using alternative measures which provide effective personnel protection. (See Control of Hazardous Energy: General Requirements, for guidance on the use of alternative energy controls to provide effective personnel protection.)

  Service and maintenance that takes place during normal production operations requires control of hazardous energy in accordance with this program if

  - A worker is required to remove or bypass a guard or other safety device, or

  - A worker is required to place any part of their body into an area on a machine or piece of equipment where work is actually performed upon the material being processed (point of operation) or where an associated danger zone exists during a machine operating cycle.

- Operations on energized electrical equipment such as diagnostics and testing that can only be performed with the circuit energized. Workers performing these activities must follow all requirements of Chapter 8, "Electrical Safety", including safe work practices, personal protective equipment, safety analyses, work plans, and management approvals.

2 Roles and Responsibilities

Functional roles and general responsibilities for each listed below. More detailed responsibilities and when they apply are provided in the procedures, processes, and requirements.

The roles may be performed by one or more individuals and one individual may play more than one role, depending on the structure of the organizations involved. Responsibilities may be delegated.

2.1 Authorized Worker

- Completes and stays current in required training and authorized worker certification
- Obtains permission from the *equipment custodian* before implementing an *equipment-specific lockout procedure (ELP)*
- Performs lockout in accordance with an approved lockout procedure: *simple*, *equipment-specific lockout procedure (ELP)*, or *group lockout procedure*
- Coordinates with equipment owner/custodian to shut down machinery, equipment, or systems
- Contacts supervisor if asked to perform any lockout that is beyond current level of experience, knowledge, or training
- Conducts hazard analyses as assigned
- Never attempts to start, energize, or use machinery, equipment, or systems that have been locked and tagged out by others, nor attempts to defeat or remove another worker's LOTO lock or tag
- Notifies their supervisor or line management if he has concerns regarding the accuracy of drawings and documents used for planning lockouts
- Notifies his supervisor or line management if he has concerns regarding the maintenance status of equipment to be operated when implementing lockouts

2.2 Lead Authorized Worker

- Must be an *authorized worker*
- For a *complex lockout,* is designated by the responsible manager or supervisor in consultation with the equipment custodian
- Ensures a *written plan of execution* is developed and followed
- Coordinates implementation of an ELP or group lockout procedure
- Coordinates multiple work groups and multiple work scopes associated with the lockout

- Provides continuity of protection for all workers for the duration of the lockout
- Verifies completion of work and proper lock-off of all authorized workers
- Coordinates system restoration

2.3 Operations Group Member

- May establish energy isolation for systems under their control
- Performs the functions and responsibilities of the *lead authorized worker* if so assigned when group lockout is established by an operations group
- If involved in the execution of lockout procedures must be an *authorized worker*

2.4 Zero Voltage Verification Worker

- Must be a *qualified person*/*qualified electrical worker*
- Completes and remains current in required training
- Must be authorized by their supervisor to perform *zero voltage verification (ZVV)*
- Restricts equipment access in accordance with the arc-flash label(s) whenever there are exposed electrical parts
- Performs ZVV in accordance with requirements

2.5 Affected Worker

- Completes and remains current in required training
- Must be notified before equipment is locked out and after the lockout is removed
- Never attempts to start, energize, or use machinery, equipment, or systems that have been locked or tagged out by others, nor attempts to defeat or remove another worker's LOTO lock or tag

2.6 Supervisor

- Completes and remains current in required training
- Ensures that CoHE program requirements are implemented for work activities in their organization and facilities
- Ensures workers, including operations group members involved in the execution of lockout procedures, are knowledgeable and qualified to implement the specific lockout procedures they are assigned
- Ensures that workers who perform lockout are current in required training before they are authorized/assigned to perform lockout
- Ensures workers who perform zero voltage verification are trained and qualified
- Consults, as needed, with the equipment custodian, equipment or system owner, or field construction manager to appoint a lead authorized worker for a complex lockout

- Selects workers with appropriate knowledge, skills and training to prepare and review *group lockout energy isolation plans (EIPs)*
- Ensures that workers who are selected by an equipment custodian to write, review, inspect, or implement an *equipment-specific lockout procedure (ELP)* have appropriate knowledge, skills, and training
- Provides hardware to authorized workers for isolating, securing, or blocking machines, equipment, or systems from energy sources
- Ensures that workers performing lockouts have personal protective equipment (PPE) as required for the work to be done
- Ensures that adequate safety signs, barricades, shields, barriers, tools, meters, and work space illumination are available when workers perform lockout
- Ensures design documents used for CoHE are maintained up-to-date and provided to workers performing lockouts; if up-to-date documents are not available, must ensure that an equally effective means of locating sources of hazardous energy is employed
- Ensures that any operations locks are uniquely identified as required and that all keys remain under the control of group members
- Establishes maintenance programs that preserve or restore the condition of equipment to a state that does not present an undue hazard to workers during equipment operation
- Ensures a job safety analysis is prepared for any hot tap operations and approves

2.7 Construction Manager / Service Manager / Point of Contact

- Ensures that subcontractor-authorized worker LOTO and electrical safety training records, as applicable, have been provided by the subcontractor and accepted by SLAC
- Ensures that subcontractor affected and authorized workers understand and follow the applicable provisions of SLAC's and the subcontractors' CoHE programs
- Ensures that equipment and systems are first locked and tagged by SLAC authorized workers; subcontractor authorized workers lock over the SLAC locks
- Ensures that all lockouts are addressed in a job safety analysis (JSA) or electrical work plan (EWP) and in the daily safety tailgate briefing, and that all workers participating in the lockout participate in the briefing
- Ensures that subcontractors maintain up-to-date marked- up drawings at the job site for all construction projects, and that the marked-up drawings are available to all SLAC and subcontractor authorized workers for their use planning lockouts

2.8 Equipment Custodian

- Ensures equipment is evaluated for all hazardous energy sources
- Understands the equipment, including all of its energy sources and energy isolation points
- Ensures a compliant ELP is written and reviewed if one is required

- Ensures the ELP is maintained and available to workers
- Provides workers with complete and accurate electrical circuit diagrams, mechanical drawings, and procedures necessary to understand the equipment/system. If up-to-date documents are not available, the equipment custodian must ensure that an equally effective means of locating sources of hazardous energy is employed.
- Establishes maintenance programs that preserve or restore the condition of equipment to a state that does not present an undue hazard to workers during equipment operation
- Updates ELPs that have been inspected and returned with changes marked up by the authorized worker, and resolves any discrepancies with the worker
- Grants permission to authorized worker(s) to implement an ELP
- For a complex lockout, in consultation with the responsible manager or supervisor, designates an authorized worker with appropriate knowledge, skills, and training to act as lead authorized worker
- Provides qualified workers to shut down and lock out equipment in coordination with service workers

2.9 Equipment Owner

- Ensures that a knowledgeable, qualified person (such as the equipment custodian) has evaluated the equipment for hazardous energy types and magnitudes
- Ensures that new and extensively modified machinery, equipment, or systems are equipped with energy-isolating devices designed to accept locks
- Designates or act as the equipment custodian for any machine, piece of equipment, or system
- Provides complete and accurate design documents to workers who perform lockout/tagout tasks and to equipment custodians or other workers. If up-to-date documents are not available, the equipment owner must ensure that an equally effective means of locating sources of hazardous energy is employed.
- Establishes maintenance programs that preserve or restore the condition of equipment to a state that does not present an undue hazard to workers during equipment operation
- Coordinates with authorized workers in the preparation, lockout/tagout, and service or maintenance of equipment to ensure that all energy sources are isolated

2.10 Engineer / Designer

- Designs for effective control of hazardous energy by workers when performing activities outlined in this chapter
- Specifies or designs isolation devices that accept lockout devices into all equipment undergoing significant repair or modification or being replaced

2.11 ELP and EIP Preparer / Lead Reviewer

- Conducts hazard analyses for ELPs and EIPs
- Prepares or reviews ELPs and EIPS
- Must be a knowledgeable worker current in the required training

- For ELPs involving research and development or experimental equipment the ELP preparer and lead reviewer must be *competent persons* as defined in this chapter

2.12 CoHE Assessor

- Completes and remains current in required training
- Must be an *authorized worker*
- Must be conversant with the construction or operation of equipment or a specific work method to identify and avoid the hazards that might be present with respect to that equipment or work method
- Certifies authorized workers by witnessing the conduct of the lockout procedures assigned to the worker and determining, through observation and discussion, if the worker understands the activities and carries them out as required; refrains from certifying the worker if the worker does not or cannot demonstrate competency in implementing the assigned lockout procedures
- Is approved by the control of hazardous energy program manager

2.13 Associate Laboratory Director

- In consultation with the equipment owner, designates the equipment custodian for any machine, piece of equipment, or system for which no equipment custodian has yet been assigned
- Resolves disputes concerning designation of equipment owners and custodians (for specific equipment or systems)

2.14 Related ESH Program Manager

- Reviews and approves, as appropriate and in consultation with the CoHE program manager, alternative energy controls for their respective program. The related ESH program managers are the laser safety officer, radiation safety officer, and pressure systems program manager.

2.15 Control of Hazardous Energy (CoHE) Program Manager

- Maintains a high level of knowledge concerning control of hazardous energy and stays up to date on new requirements
- Develops requirements and procedures for the control of hazardous energy
- Assists authorized workers with implementation of the CoHE program
- Provides CoHE program oversight to ensure it is understood and effectively implemented
- Ensures comprehensive and effective lockout/tagout training is available and delivered
- Approves hot tap operations by reviewing and approving the required job safety analysis
- Reviews and, if needed, updates this chapter
- Performs an annual inspection of the CoHE program; corrects any deviations or inadequacies observed
- Performs program self-assessments

The SLAC electrical safety officer (ESO) is the CoHE program manager.

3 Procedures, Processes, and Requirements

These documents describe the detailed requirements for this program and how to implement them:

- Control of Hazardous Energy: General Requirements (SLAC-I-730-0A10S-004). Describes requirements that apply to all lockouts and specific requirements for simple versus complex lockouts; also describes administrative lock and tag
- Control of Hazardous Energy: Hazard Analysis Procedure (SLAC-I-730-0A10C-002). Describes process for determining hazardous energy sources and provides thresholds and other references
- Control of Hazardous Energy: Simple Lockout Procedure (SLAC-I-730-0A10C-003). Describes process for performing a simple lockout (a written plan of execution is required: this procedure, a custom plan, an ELP, or a group lockout procedure may be used)
- Control of Hazardous Energy: Group Lockout Procedure (SLAC-I-730-0A10C-006). Describes process for conducting a complex, group lockout
- Control of Hazardous Energy: Zero Voltage Verification Procedure (SLAC-I-730-0A10C-004). Describes process for verifying zero voltage
- Control of Hazardous Energy: Authorized Worker Certification Procedure (SLAC-I-730-0A10C-005). Describes process for certifying authorized workers to on assigned lockout procedures; also covers revalidation of equipment-specific lockout procedures (ELPs)

These documents provide useful guidance; their use is not mandatory:

- Control of Hazardous Energy: Simple Lockout Checklist (SLAC-I-730-0A10J-008). Checklist for completing a simple lockout
- Control of Hazardous Energy: Group Lockout Checklist (SLAC-I-730-0A10J-007). Checklist for completing a group lockout

These are the forms and tools for this program:

- Control of Hazardous Energy: Request for Authorized Worker Certification Form (SLAC-I-730-0A10J-010). Form for requesting certification of authorized workers
- Control of Hazardous Energy: Authorized Worker Certification Form (SLAC-I-730-0A10J-004). Form for certifying authorized workers on assigned lockout/tagout procedures (restricted access, available form the Control of Hazardous Energy Program Site [SharePoint])
- Control of Hazardous Energy: Alternative Authorization for Removing Locks and Tags Form (SLAC-I-730-0A10J-002). Form for authorizing removal of a personal red lock and tag if the person who applied it is not available and is unable to return to site

The following are recommended templates. Equivalent forms may be used:

- Simple lockout plan template and instructions. Template for creating a simple lockout plan; lists required elements (available form the Control of Hazardous Energy Program Site [SharePoint])
- Control of Hazardous Energy: Equipment-specific Lockout Procedure (ELP) Template (SLAC-I-730-0A10J-001). Template for creating an equipment-specific lockout procedure (ELP); lists required elements of an equipment-specific lockout procedure (ELP)

- Control of Hazardous Energy: Group Lockout Energy Isolation Plan Template (SLAC-I-730-0A10J-005). Template for creating group lockout energy isolation plans (EIPs); lists required elements of an energy isolation plan
- Control of Hazardous Energy: Complex Lockout Permit (SLAC-I-730-0A10J-006). Form for documenting lead authorized worker and sign on and sign off of workers for complex LOTO
- Control of Hazardous Energy: Tag Templates (SLAC-I-730-0A10J-003). Templates for creating tags

These are other program documents and resources:

- Control of Hazardous Energy Program Site (SharePoint). Contains additional information and documents for implementing CoHE requirements

4 Training

4.1 Authorized Worker

Authorized workers will receive training in how to recognize hazardous energy sources, the type and magnitude of the energy present in the workplace, and the required lockout procedures to be followed to ensure energy isolation and control. Authorized workers must complete the following:

- ESH Course 431, Human Performance Improvement (HPI) Tools for Workers (ESH Course 431)
- ESH Course 432, Hazard Recognition and Risk Tolerance Seminar (ESH Course 432)
- ESH Course 157, Control of Hazardous Energy (ESH Course 157) (initially, with retraining every 36 months by taking ESH Course 157R, Control of Hazardous Energy [CoHE] Refresher [ESH Course 157R])
- ESH Course 157PRA, Simple and Complex Lockout/Tagout for Authorized Workers Practical (ESH Course 157PRA) (recertification every 12 months)

Authorized workers who are only joining, not establishing a lockout, complete the following instead of 157PRA:

- ESH Course 157JN, Joining Established Group Lockout/Tagout for Authorized Workers Practical (ESH Course 157JN) (every 12 months)

In addition, before an authorized worker is allowed to implement an ELP, the worker must have the training, knowledge, and experience required to perform the ELP steps. Any authorized worker may implement an ELP if authorized by their supervisor and permitted by the equipment custodian. Likewise, the equipment custodian may require on-the-job training specific to that equipment. Such training must be given by the equipment custodian or other knowledgeable person.

Workers must receive additional on-the-job training whenever their job assignment changes, a change in machines, equipment, or processes creates a new hazard, lockout procedures change, or observations or inspections reveal that an employee is not following or does not fully understand lockout procedures. The CoHE assessor may require the worker to repeat ESH Course 157/157R if the worker cannot demonstrate general knowledge of CoHE.

4.2 Zero Voltage Verification Worker

Authorized workers who apply test equipment to exposed conductors to perform zero voltage verification (ZVV) must, in addition to the authorized worker courses above, complete the following:

- ESH Course 205, CPR/AED/Training for Qualified Electrical Workers (ESH Course 205) (every 24 months)
- ESH Course 205PRA, CPR/AED/ Practical Training for Qualified Electrical Workers (ESH Course 205PRA) (every 24 months)
- At least one of the following, as determined by supervisor:
  - ESH Course 251, Electrical and General Safety Awareness for R&D (ESH Course 251) (every 36 months) or
  - ESH Course 274, Electrical-Low/High Voltage Training (ESH Course 274) (every 36 months)

4.3 Affected Worker

Affected workers will be instructed in the purpose, use, and restrictions of CoHE and how to recognize that CoHE is being implemented through basic safety orientation training:

- ESH Course 219, Environmental Safety and Health Orientation (ESH Course 219)

4.4 Administrative Lock and Tag Worker

Workers who apply lock and tag only for administrative purposes or configuration control will be instructed through basic safety orientation training:

- ESH Course 219, Environmental Safety and Health Orientation (ESH Course 219)

4.5 Supervisor

First-line supervisors of authorized workers joining or administering a CoHE lockout must complete the following:

- ESH Course 431, Human Performance Improvement (HPI) Tools for Workers (ESH Course 431)
- ESH Course 432, Hazard Recognition and Risk Tolerance Seminar (ESH Course 432)

First-line supervisors are strongly recommended, but not required, to complete the following:

- ESH Course 157, Control of Hazardous Energy (ESH Course 157) (initially, with retraining every 36 months by taking ESH Course 157R, Control of Hazardous Energy [CoHE] Refresher [ESH Course 157R])

4.6 ELP and EIP Preparer / Lead Reviewer

Equipment-specific lockout procedure (ELP) and *energy isolation plan (EIP)* preparers and lead reviewers must complete the following:

- ESH Course 431, Human Performance Improvement (HPI) Tools for Workers (ESH Course 431)
- ESH Course 432, Hazard Recognition and Risk Tolerance Seminar (ESH Course 432)
- ESH Course 157, Control of Hazardous Energy (ESH Course 157) (initially, with retraining every 36 months by taking ESH Course 157R, Control of Hazardous Energy [CoHE] Refresher [ESH Course 157R])

4.7 CoHE Assessor

CoHE assessor must complete the following:

- ESH Course 431, Human Performance Improvement (HPI) Tools for Workers (ESH Course 431)
- ESH Course 432, Hazard Recognition and Risk Tolerance Seminar (ESH Course 432)
- ESH Course 157, Control of Hazardous Energy (ESH Course 157) (initially, with retraining every 36 months by taking ESH Course 157R, Control of Hazardous Energy [CoHE] Refresher [ESH Course 157R])
- ESH Course 157PRA, Simple and Complex Lockout/Tagout for Authorized Workers Practical (ESH Course 157PRA) (recertification every 12 months)

4.8 Safety Officer

The radiation safety officer, laser safety officer, pressure systems program manager, and electrical safety officer are required to familiarize themselves with lockout requirements as they relate to equipment and systems within their purview.

Safety officers are required to complete the following:

- ESH Course 157, Control of Hazardous Energy (ESH Course 157) (initially, with retraining every 36 months by taking ESH Course 157R, Control of Hazardous Energy [CoHE] Refresher [ESH Course 157R])

5 Definitions

accountability. A method to account for all persons who could be exposed to hazardous energy during a complex lockout. At SLAC accountability is achieved by use of the complex lockout permit.

administrative lock and tag. Applying a restrictive lock and tag for purposes of operational or configuration control of the equipment or system, not for the personal protection of persons performing work on the equipment or system

alternative energy control. Authorized hazardous energy controls to be used during service and maintenance activities on energized or partially energized equipment where lockout/tagout is not feasible

blanking. The absolute closure of a pipe, line, or duct by fastening across its bore a solid plate or “cap” that completely covers the bore, which extends at least to the outer edge of the flange at which it is attached; and which is capable of withstanding the maximum upstream pressure (or in the case of lasers, the maximum laser irradiance). A blank flange and bolted slip blind are considered to be lockout devices.

*blinding. (*See *blanking.)*

boundary, arc flash protection. When an arc flash hazard exists, an approach limit at a distance from a prospective arc source within which a person could receive a second degree burn if an electrical arc flash were to occur.

boundary, limited approach. An approach limit at a distance from an exposed energized electrical conductor or circuit part within which a shock hazard exists. The distance varies as a function of voltage and is typically specified on the arc flash hazard label for electrical equipment.

capable of being locked out. An energy isolating device that is designed with a hasp or other means of attachment to which, or through which, a lock can be affixed, or that has a locking mechanism built into it. Other energy isolating devices are capable of being locked if lockout can be achieved without the need to dismantle, rebuild, or replace the energy-isolating device or permanently alter its energy control capability. (See also *device, energy isolating*.)

complex lockout permit. The sign-on/sign-off form used for complex lockout. The permit provides accountability for all persons working under a complex lockout/tagout.

continuity of protection. To freeze the state of a complex lockout for the duration of all work. The lead authorized worker is the first to lock on and the last to lock off the energy isolating devices or, if used, the group lockbox or multi-lock hasp(s). Continuity of protection ensures the equipment or system remains in a safe state for all workers across shift changes and pauses in work until all work is complete.

control of hazardous energy (CoHE). Control measures used to protect workers from exposure to all forms of hazardous energy due to accidental equipment energization or start-up, or from working on or near electrical conductors or circuit parts. Using lockout/tagout to de-energize and control equipment is the primary means to achieve CoHE during service or maintenance.

CoHE assessor. A worker who certifies authorized workers on lockout/tagout procedures

deactivate, deactivation. To place facilities and equipment in a safe and stable condition that is protective of workers, the public, and the environment, and that is economical to monitor and maintain for an extended period, until the eventual decommissioning of the facilities or equipment

de-energized. Isolated from all energy sources and not containing residual stored hazardous energy

device, energy isolating (also *energy isolation device*). A mechanical device that physically prevents the transmission or release of energy, including the following:

- 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; a blank flange, 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.

device, group lockout. A group lockbox, multi-lock hasp, or similar device that accepts multiple authorized worker personal locks

device, lockout. A device that uses a positive means such as a lock to hold an energy isolating device in the safe position that prevents the energizing of machinery or equipment. A blank flange or bolted slip blind are also considered lockout devices.

device, tagout. A prominent warning device, such as a tag and a means of attachment that can be securely fastened to an energy isolating device in accordance with 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

electrically safe work condition. A state in which an electrical conductor or circuit part 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

energized. Connected to an energy source or containing residual or stored energy. De-energized equipment is considered energized until a *zero energy state* is verified.

energy source. Any source of energy, including electrical, mechanical, hydraulic, pneumatic, chemical, thermal, and radiation

equipment custodian. A person or organization responsible for servicing, maintaining, or repairing a machine, system or component (See also *owner, equipment.*)

equipment owner. A person or organization who exercises direct control over and has line responsibility for the operation of a machine, system, or component (See also *custodian, equipment.*)

group lockout energy isolation plan. A written plan used to establish group lockout/tagout energy isolation. The plan includes all steps required to lockout and de-energize equipment and systems, including release of stored energy and zero energy verification. A group lockout/tagout procedure together with the energy isolation plan and the complex lockout permit constitute the *written plan of execution* required by NFPA 70E for complex lockout/tagout.

hazardous energy. Energy that could cause injury to a worker involved in service or maintenance through the unexpected release of stored energy or the unexpected energization or startup of machinery, equipment, or a system

hot tap operations. The use of specialized drilling equipment to tap into in-service, pressurized process piping for the purpose of attaching a mechanical or welded branch fitting

individual control. Control over hazardous energy by an individual worker while performing servicing or maintenance by application of SLAC control of hazardous energy program principles; typically achieved by application of personal locks and tags

lock, administrative. A non-red lock used for operational or configuration control of equipment or systems; may not be relied on for control of hazardous energy during servicing or maintenance

lock, group lockout master. A lock applied to a group lockout/tagout lock box by the lead authorized worker. The presence of a group lockout master lock signifies that energy isolation is complete and that the system is safe for work.

lock, operations. A red lock owned by an operations department or group used exclusively for complex lockout

lock, personal. A red lock (SLAC workers) or otherwise uniquely identifiable lock (subcontractor workers) that has only one key and that key remains in the control of the worker. Personal locks may not be used for any purpose other than lockout/tagout.

lockout (also *lockout/tagout, LOTO*). 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 energized or operated until the lockout device is removed. Lockout is the primary means for controlling hazardous energy.

lockout, complex. Lockout/tagout for machinery, equipment, or system that has more than one energy source, or involves more than one department, group, or employer (for example when subcontractors are working side-by-side with SLAC employees).

lockout, group. Lockout that involves multiple authorized workers that affords each authorized worker a level of protection equivalent to that provided by the use of a personal lockout device. Each person applies a unique lock and tag to a multi-lock hasp or group lock box (or equivalent).

lockout, simple. Lockout of machinery, equipment, or system to be worked on that 1) has a single source of hazardous energy that can be readily identified, isolated, locked out, and that the single source controls all hazards with no potential for stored hazardous energy, and that 2) involves only one department, group, craft, or employer, and no shift change, and 3) contains no potential to release a hazardous material.

normal production operation. The use of machinery or equipment to perform its intended production function

out-of-service equipment. Equipment that is not in service and is no longer required for SLAC operations

person, competent. A person who meets all the requirements of an *authorized worker* as defined in this chapter and who, in addition, is responsible for all work activities or safety procedures related to custom or special equipment and has detailed knowledge regarding the exposure to electrical hazards, the appropriate control methods to reduce the risk associated with those hazards, and the implementation of those methods (see NFPA 70E, Article 350, "Safety-Related Work Requirements: Research and Development Laboratories")

person, qualified. A person who has demonstrated skills and knowledge related to the construction and operation of electrical equipment and installations and has received safety training to identify and avoid the hazards involved. Also known as a *qualified electrical worker*.

procedure, equipment-specific lockout (ELP). A written procedure for the lockout of specific machinery, equipment, or systems (or a group of machines, equipment, or systems that are alike). The ELP and *complex lockout permit* together constitute the written plan of execution required by NFPA 70E for complex lockout/tagout.

procedure, group lockout. A written procedure used for system-level lockout, usually involving multiple pieces of equipment or multiple systems, and multiple energy isolation points; may be used for simple or complex lockout. The group lockout procedure with the *energy isolation plan (EIP)* and the *complex lockout permit* together constitute the *written plan of execution* required by NFPA 70E for complex lockout.

procedure, simple lockout. A lockout procedure used when the machinery, equipment, or system to be worked on 1) has a single source of hazardous energy that can be readily identified, isolated, locked out,

and that the single source controls all hazards with no potential for stored hazardous energy, and that 2) involves only one department, group, craft, or employer, and no shift change, and 3) contains no potential to release a hazardous material; may be used for simple lockout, but not for complex lockout.

safety-related maintenance. Preserving or restoring the condition of electrical equipment and installations, or parts of either, for the safety of employees who work where exposed to electrical hazards. Electrical equipment must be maintained in accordance with manufacturers' instructions or industry consensus standards to reduce the risk of failure and the subsequent exposure of employees to electrical hazards.

service and maintenance. Includes workplace activities such as constructing, installing, setting up, adjusting, inspecting, modifying, demolishing, and maintaining and/or servicing machinery or equipment. These activities include lubrication, cleaning or un-jamming of machines or equipment and making adjustments or tool changes, where the employee may be exposed to the unexpected energization or start-up of the equipment or release of *hazardous energy*.

state, disconnected. A state in which equipment has been physically and permanently disconnected (sometimes referred to as *air-gapped*) from all potential sources of hazardous energy and has no potential to internally store hazardous energy. The disconnection of all possible sources of hazardous energy must be accomplished in a manner that cannot be readily restored. Equipment in the *disconnected state* must be tagged or labeled with durable materials to allow workers to quickly determine with certainty that no *hazardous energy* is present.

state, zero energy. The lowest achievable energy state for machinery, equipment, or systems. Achieving zero energy state is unique to each system, depending on the energy sources. Generally, the zero-energy state is achieved by

- De-energizing electrical energy sources, including discharging capacitive and inductive elements (absence of voltage and current)
- Totally blocking or releasing mechanical (kinetic or potential) energy
- Allowing surface or liquid temperatures to dissipate to prevent thermal burns
- Removing all differential pneumatic or hydraulic pressure to equal atmospheric pressure

tagout. The placement of a tagout device, normally in conjunction with a lockout device, onto an energy isolating device. This is done in accordance with 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. (See also *lockout*.)

worker, affected. An employee who operates machines or equipment on which servicing or maintenance is performed under lockout, or whose job requires him/her to work in an area in which such servicing or maintenance is performed

worker, authorized. A worker who performs service or maintenance on machinery, equipment, or a system, who is qualified through appropriate training, has demonstrated proficiency in the performance of lockout, and has been assigned by their supervisor

worker, lead authorized. An authorized worker who is qualified to implement lockouts and who carries additional responsibility for coordinating group lockout and/or shift change regardless of the employer, occupation, crew, craft, location, or duration of the lockout. The lead authorized worker is the person in charge required for the written plan of execution as defined in NFPA 70E.

worker, qualified electrical. (See also *person, qualified.*)

written plan of execution. A plan that identifies a *lead authorized worker* and provides accountability for all workers participating in the lockout; required by NFPA 70E

zero energy verification. Confirmation of a *zero energy state* by test, action, or observation

zero voltage verification (ZVV). A procedure that ensures by measurement that there are no electrically live parts, that is, parts are in a *zero energy state*

6 References

6.1 External Requirements

The following are the external requirements that apply to this program:

- Title 8, *California Code of Regulations*, "Industrial Relations", Division 1, "Department of Industrial Relations", Chapter 4, "Division of Industrial Safety", Subchapter 5, "Electrical Safety Orders"
  - Group 1, "Low-Voltage Electrical Safety Orders" (8 CCR 2299–2599)
  - Group 2, "High-Voltage Electrical Safety Orders" (8 CCR 2700–2989)
- Title 8, *California Code of Regulations*, "Industrial Relations", Division 1, "Department of Industrial Relations", Chapter 4, "Division of Industrial Safety", Subchapter 7, "General Industry Safety Orders"
  - Group 2, "Safe Practices and Personal Protection", Article 7, "Miscellaneous Safe Practices", Section 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" (8 CCR 3314)
- National Fire Protection Association (NFPA) 70E, "Standard for Electrical Safety in the Workplace" (NFPA 70E)

6.2 Related Documents

SLAC Environment, Safety, and Health Manual (SLAC-I-720-0A29Z-001)

- Chapter 8, "Electrical Safety"

Other Documents

- Department of Energy Handbook 1092, "Handbook for Electrical Safety" (DOE-HDBK-1092)
- Federal Occupational Safety and Health Administration (OSHA) Letters of Interpretation
  - February 10, 2004, "Clarification of 'authorized' and 'affected' employees and proper energy control procedures". [1910.147(b); 1910.147(c)(4); 1910.147(c)(7)(i); 1910.147(d); 1910.147(d)(4)(i); 1910.147(f)(3)(ii); 1910.147(f)(3)]
  - December 19, 2006, "'Continuous industrial processes' and the infeasibility of de-energizing equipment under 29 CFR 1910.333". [1910.333; 1910.333(a)(1)]

- American National Standards Institute (ANSI) Z244.1, "Control of Hazardous Energy Lockout/Tagout and Alternative Methods" (ANSI Z244.1)

NATIONAL ACCELERATOR LABORATORY

ENVIRONMENT, SAFETY & HEALTH DIVISION

Chapter 51: Control of Hazardous Energy

General Requirements

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1 Purpose

The purpose of these requirements is to prevent worker exposure to *hazardous energy* (such as from unexpected energization, startup, or release of stored energy) during service and maintenance of machines, equipment, or systems.

Service and maintenance include constructing, installing, setting up, adjusting, inspecting, and modifying machines, equipment, or systems. These terms are broad in scope and encompass a wide range of activities and equipment types. Service and maintenance also include lubrication, cleaning or un-jamming of machines or equipment, and making adjustments or tool changes where lockout is necessary to prevent workers from being exposed to the unexpected energization or startup of the equipment or release of hazardous energy.

These requirements also cover *administrative lock and tag,* which may involve the lockout of equipment for configuration or operational purposes, but which may not be used alone to protect workers from hazardous energy.

They apply to workers and supervisors; equipment designers, custodians, and owners; CoHE assessors; construction and service managers and points of contact; the CoHE program manager, and related ESH program managers.

Note Control of hazardous energy *is commonly referred to as* CoHE*, and* lockout/tagout *is commonly referred to as* LOTO *or* lockout.

1.1 Exemptions

The following activities are exempt from CoHE requirements.

- Work on *cord-and- plug connected equipment*, in which all these conditions are met:
  - There is a single energy source.
  - All of the hazardous energy is controlled by unplugging the equipment and there is no potential for stored hazardous energy.
  - The plug remains under the exclusive control of the worker performing the servicing or maintenance.
- Minor tool changes and adjustments, and other minor servicing activities that take place during normal operations, provided that (a) they are routine, repetitive, and integral to the use of the equipment, and (b) the work is performed using alternative measures which provide effective personnel protection.

(See Section 2.12, "Alternative Energy Controls", for guidance on the use of alternate measures to provide effective personnel protection.)

Service and maintenance that takes place during normal production operations requires control of hazardous energy in accordance with this program if

- A worker is required to remove or bypass a guard or other safety device, or
- A worker is required to place any part of his or her body into an area on a machine or piece of equipment where work is actually performed upon the material being processed (point of operation) or where an associated danger zone exists during a machine operating cycle.

- Activities on energized electrical equipment such as diagnostics and testing that can only be performed with the circuit energized. Workers performing these activities must follow all requirements of Chapter 8, "Electrical Safety", including safe work practices, personal protective equipment, safety analyses, work plans, and management approvals.

2 Requirements

2.1 Individual Control and Protection

The primary goal of the CoHE program is individual control over and protection from hazardous energy. The lockout procedures described below give each *authorized worker* personal control over the hazardous energy to which he or she otherwise would be exposed. Work on equipment may begin only after an authorized worker has placed his or her *personal lock(s)* on the *energy isolating device(s)* or group lock box. Each worker maintains control over the hazardous energy through application of his or her personal lock(s). No worker may work under another worker's lock. It is only when all authorized workers have removed their personal locks that the equipment may be re-energized.

Important No worker, either SLAC or subcontractor, will attempt to start, energize, or use machinery or equipment that is locked or tagged out of service by others with LOTO lock and tag, nor will any worker attempt to defeat or remove another worker's LOTO lock or tag. Failure to comply with these requirements will result in disciplinary action up to and including termination.

2.2 Subcontractors

The SLAC construction manager (CM), service manager (SM), or point of contact (POC) must ensure that the subcontractor's *affected* and *authorized workers* understand and follow the applicable provisions of SLAC's and the subcontractor's CoHE programs. In all instances, any equipment that requires a lockout will first be locked and tagged by a SLAC authorized worker or operations group, then, when authorized by the subcontractor supervisor, the subcontractor's authorized workers will apply their personal LOTO locks.

Note *If the SLAC authorized worker will not perform any work under the lockout and is not the* lead authorized worker*, then the SLAC worker should apply an administrative lock after the subcontractor has applied their CoHE lock and before the SLAC worker removes their CoHE lock.*

Note *Only SLAC* qualified electrical workers *are authorized to operate breakers and perform switching of electrical equipment.*

Subcontractors must maintain up-to-date marked-up drawings at the job site for all construction projects. These marked-up drawings must be made available to all SLAC and subcontractor workers for their use planning lockouts in support of construction activities.

2.3 Determination and Control of Hazardous Energy

An exposure to hazardous energy, such as from unexpected energization, startup, or release of stored energy, could cause serious injury or death. (Examples of potentially hazardous energy include electrical, thermal, mechanical, hydraulic, pneumatic, chemical, and ionizing and non-ionizing radiation.) For any work that might involve such exposure, a hazard analysis is required to confirm the presence of hazardous energy and determine the sources (see Control of Hazardous Energy: Hazard Analysis Procedure). If hazardous energy is confirmed a lockout procedure must be used.

2.3.1 Exposed De-energized Electrical Parts

De-energized electrical parts that have not been locked out and verified de-energized by test in accordance with a lockout procedure must be treated as energized. Only individuals who participate in the lockout in accordance with these procedures are protected from hazardous energy. Workers not participating in the lockout must treat de-energized electrical equipment as energized and remain outside the *limited approach boundary* and *arc flash protection boundary* of exposed electrical parts.

2.3.2 Control Circuit Devices

Control circuit devices such as push buttons, selector switches, and interlocks are not energy isolating devices and may not be used as a means for de-energizing circuits or equipment for the purpose of lockout. Interlocks for electric equipment may not be used as a substitute for lockout tag out procedures. In particular, personnel protection systems (PPS) and door switch interlocks (on panels, cabinets, or equipment) are not acceptable as a substitute for a lock and tag for service or maintenance.

2.3.3 Mechanical Movement

Workers must never use their own bodies to stop moving equipment parts (for example, rotating gears, fans, fan belts, pulleys, flywheels, and rolling or pressing components). The motion must be allowed to stop on its own. Parts that could move and cause injury must be blocked or braced.

On multiple fan systems, all fans must be locked out to prevent windmilling. If not all fans can be locked out, a piece of four-by-four wood or heavy-duty cable or chain and lock must be used to prevent movement of the locked-out fan(s).

2.3.4 Electrical Energy Isolation Devices

Wherever possible, workers must verify visually that all blades of electrical disconnecting devices are fully open and that drawout-type circuit breakers are open and withdrawn to the fully disconnected position. Rackable motor control center (MCC) buckets must be fully withdrawn with the breaker open.

2.3.5 Documentation for Lockout Planning

Drawings and documents are a primary resource for workers in planning lockouts. These drawings and documents must be maintained accurate and up to date by the employer (the SLAC departments responsible for the document content). When up-to-date drawings and documents are not available the employer is responsible for providing to workers an equally effective means of locating, isolating, and locking out all sources of potentially hazardous energy. Workers must notify their supervisor or line manager if they have concerns regarding the accuracy of drawings and documents used for planning lockouts. The supervisor or manager must address these concerns before implementation of the lockout.

See Section 2.2 for the requirement to maintain up-to-date marked up drawings at construction job sites for use by workers in planning lockouts. Workers contact the construction manager or project engineer to obtain access to the marked-up drawings.

2.3.6 Safety-related Maintenance

Safety-related maintenance is maintenance that preserves or restores the condition of electrical equipment for the safety of employees who work where exposed to electrical hazards. Electrical equipment must be maintained in accordance with manufacturers' instructions or industry-consensus standards to reduce the risk of failure and the subsequent exposure of employees to electrical hazards.

Workers and their supervisors must consider the condition of maintenance of electrical equipment before operating the equipment. Improper or inadequate maintenance can result in increased equipment failure rates, including increased opening time of overcurrent protective devices, thus increasing arc-flash incident energies. Where equipment is not properly maintained, the worker's personal protective equipment may not provide adequate protection from arc-flash hazards.

The employer (the SLAC departments responsible for equipment maintenance) is responsible for establishing maintenance programs that preserve or restore the condition of equipment to a state that does not present an undue hazard to workers during equipment operation. Workers are responsible to notify their line manager or supervisor if they have concerns regarding the maintenance status of equipment to be operated when implementing lockouts. The manager or supervisor must address these concerns before implementation of the lockout.

2.4 Lockout Types and Procedures

Lockouts are either simple or complex, and requirements vary accordingly.

2.4.1 Simple Lockout

A *simple lockout* is when the machinery, equipment, or system to be worked on meets all the following conditions:

- Has a single source of hazardous energy that can be readily identified, isolated, and locked out; and that single source controls all hazards, with no potential for stored energy
- Involves only one department, group, craft, or employer, and does not involve a shift change
- Contains no potential to release a hazardous material

2.4.1.1 Written Plan of Execution

A simple lockout requires a written *plan of execution* that identifies the lockout steps for the specific piece of equipment, or for multiple pieces or equipment where a single plan suffices.

A *simple lockout procedure* may be used (see Control of Hazardous Energy: Simple Lockout Procedure or a custom plan) or an *equipment-specific lockout procedure (ELP)* or a *group lockout procedure* if desired (for example, if more than one worker from the same crew is involved).

Note *A simple lockout procedure may be used for locking out multiple molded case breakers in a panelboard with a single cable-type lockout device.*

2.4.1.2 Training

Only authorized workers who are current in ESH Course 157PRA, Simple and Complex Lockout/Tagout for Authorized Workers Practical (ESH Course 157PRA), are permitted to execute a lockout. Workers qualified in ESH Course 157JN, Joining Established Group Lockout/Tagout for Authorized Workers Practical (ESH Course 157JN), may join but not establish a lockout.

2.4.2 Complex Lockout

A *complex lockout* is when one or more of the following conditions exist:

- Multiple energy sources
- Multiple crews
- Multiple crafts
- Multiple locations
- Multiple employers
- Multiple disconnecting means
- Particular sequences of operation are necessary to establish the locked-out condition safely
- Work involves a shift change

At SLAC, complex lockout may only be performed under an ELP (Section 2.4.3) or a group lockout procedure (Section 2.4.4). A simple lockout procedure may not be used for complex lockout.

2.4.2.1 Written Plan of Execution

Following National Fire Protection Association (NFPA) 70E, “Standard for Electrical Safety in the Workplace” (NFPA 70E), a complex lockout requires a written *plan of execution* that identifies a *lead authorized worker* and provides accountability for all workers participating in the lockout. For complex lockout under an ELP, the ELP itself with a complex lockout permit constitutes the written plan of execution; under a group lockout procedure, the procedure with an energy isolation plan (EIP) and a complex lockout permit constitutes the written plan of execution.

Complex Lockout Permit

A permit is required for all complex lockouts. The permit is used to identify the lead authorized worker and communicate the state of the lockout to all workers (see Control of Hazardous Energy: Complex Lockout Permit for a recommended template). The permit also provides accountability of all persons working under the lockout.

The identity of the lead authorized worker must be recorded on the complex lockout permit. When the lockout is complete and the equipment is safe for work the lead authorized worker signs the permit and, if a group lockbox used, applies a group lockout master lock and orange master lock tag to the group lockbox. Workers sign the complex lockout permit and affix their personal lock(s) to the energy isolating devices or, if used, the group lockbox, before beginning work.

Upon completion of work the workers sign off the permit and remove their personal lock(s) from the energy isolating devices or group lockbox. After all workers are signed off and locked off the lead authorized worker may lock off and the system may be restored.

2.4.2.2 Training

Only authorized workers who are current in ESH Course 157PRA, Simple and Complex Lockout/Tagout for Authorized Workers Practical (ESH Course 157PRA), are permitted to execute a lockout. Workers qualified in ESH Course 157JN, Joining Established Group Lockout/Tagout for Authorized Workers Practical (ESH Course 157JN), may join but not establish a lockout.

2.4.2.3 Roles and Responsibilities

Lead Authorized Worker

Complex lockouts require designation of a *lead authorized worker*. The lead authorized worker (who must be an *authorized worker*) carries responsibility for the entire group, including addressing worker concerns before work begins. The lead authorized worker must be knowledgeable in both the equipment to be locked out and the work scope to be performed.

Note *A member of the group performing the work is not always the best choice for lead authorized worker. In some cases, a member of the owning or custodial group may be the best choice, even though that group is not involved in the hands-on work. The key requirement is that the lead be knowledgeable in both the* ***work scope*** *and the* ***equipment****. Any of the following may be a good choice: work group member; custodial group member; operations group or operations group member; area manager; field construction manager; project engineer; system engineer; ACC/SPEAR3 operator; safety coordinator.*

Note *For complex lockouts involving only one worker, that worker is the de facto lead authorized worker.*

For an ELP, the *equipment custodian*, in consultation with the responsible manager or supervisor, designates the lead authorized worker. For a group lockout procedure, the responsible manager or supervisor designates the lead.

The lead authorized worker will

- Ensure a written plan of execution is developed and followed

- Be accountable for safe execution of the lockout
- Address worker concerns before commencing work
- Coordinate multiple work groups and work scopes
- Provide continuity of protection (see Section 2.4.2.5) for all workers for the duration of the lockout
- Ensure each authorized worker 1) affixes a personal lock to the group lockout device, group lockbox, or comparable mechanism before beginning work, and 2) removes those devices when finished working on the machine or equipment being serviced or maintained

Authorized Worker

Each authorized worker must review the energy isolation steps in the ELP or EIP. Worker concerns must be addressed before beginning work. Each worker has the right to walk down the energy isolation points to confirm proper energy isolation before beginning work. The worker then signs the complex lockout permit and affixes his personal lock(s) to the energy isolating devices or, if used, the group lockbox or multi-lock hasp, before beginning work. The worker should remain locked on until his work is complete.

Upon completion of work the worker signs off the permit and removes his personal lock(s) from the energy isolating devices or group lockbox. After all workers are signed off and locked off the lead authorized worker may lock off and the system may be restored.

For ELPs, any authorized worker may implement an ELP if the equipment custodian consents. The equipment custodian has the option to require that authorized workers be individually qualified and listed by name on a particular ELP if it is unusually complex.

Authorized workers must never attempt to start, energize, or use machinery, equipment, or systems that have been locked out by others, nor attempt to defeat or remove another worker's LOTO lock or tag.

Affected Worker

An *affected worker* is one who operates machines or equipment on which servicing or maintenance is performed under lockout, or whose job requires him/her to work in an area in which such servicing or maintenance is performed.

Affected workers must be notified before equipment is locked out and after the lockout is removed.

Affected workers must never attempt to start, energize, or use machinery, equipment, or systems that have been locked out by others, nor attempt to defeat or remove another worker's LOTO lock or tag.

Operations Group

Members of an operations group may establish energy isolation in accordance with an ELP or group lockout procedure for systems under their control. Energy isolation devices are locked out with operations locks. *Operations locks* are a set of red locks owned by a department or group that are used exclusively for an ELP or group lockout procedure and for no other purpose.

When an ELP or group lockout procedure is implemented by an operations group, the functions and responsibilities of the lead authorized worker may be transferred to the operations group. When this is the case the operations group places the group lockout master lock and orange master lock tag on the group lockbox (see 2.4.2.4, "Group Lockbox", and 2.10.5, "Group Lockout Master Lock"). The operations group

must designate an on-shift worker to perform lead authorized worker functions whenever work is in progress under the lockout. Authorized workers working under the lockout must be notified of this designation.

2.4.2.4 Group Lockbox

Group lockboxes may be used for either simple or complex lockouts; the following describes their use for complex lockouts. For simple lockouts, a permit and sign on/off by each authorized worker are not required.

Each energy isolating device must be locked. Two methods are available for lockout of individual energy isolating devices: (1) the lead authorized worker's personal locks are applied to each device; or (2) operations locks are applied to each device.

For both methods, if using a group lockbox the key for each lock is placed in the group lockbox.

Each lock on each energy isolating device must be accompanied by a tag that identifies and provides contact information for the lead authorized worker or operations group applying the lock and tag, and for group lockout procedures, a unique identifier for the group lockout (see Section 2.10, "Lockout / Tagout Equipment").

Once energy isolation, including zero energy verification, is complete, a group lockout master lock and orange master lock tag are applied to the group lockbox. The master lock provides continuity of protection for all workers. The master lock and orange master lock tag are applied before any authorized workers lock on to perform work under the lockout and must remain in place until all work is complete and all authorized workers have removed their personal locks and tags from the group lockbox. (See Section 2.4.2.5, "Continuity of Protection.")

The master lock must be keyed differently from the energy isolating device locks. A master lock may be a lead authorized worker personal lock or an operations lock (see Section 2.10, "Lockout / Tagout Equipment").

- When the master lock is a lead authorized worker personal lock, the key must remain under the exclusive control of the lead authorized worker. The lead authorized worker applies the master lock to the group lockbox whether or not he or she will actually be in the hazard zone of the equipment during service or maintenance.
- When the master lock is an operations lock, the key(s) to the master lock must remain under exclusive control of the operations group members.

After the master lock and orange master lock tag are applied to the group lockbox, authorized workers then sign on the complex lockout permit and lock on to the group lockbox before performing any work. Each worker who will perform work under the lockout must sign on and lock on the group lockout.

Alternative to Group Lock Box

A lockout involving only a few energy isolating devices and a few workers may be performed using multi-lock hasps in lieu of a lockbox. If hasps are used then a hasp should be placed on each energy isolating device, and each worker must apply a personal lockout/tagout lock on each hasp. To ensure continuity of protection, the lead authorized worker must be the first to lock on each hasp, and the last to lock off each hasp after work is complete.

2.4.2.5 Continuity of Protection

The lead authorized worker must be the first to lock on and the last to lock off the energy isolating devices called out in the ELP or EIP, and, if used, the group lockbox or multi-lock hasp, with the following two exceptions:

1. Authorized workers may lock on to the energy isolating devices or group lockbox to perform activities associated with establishing the lockout, such as zero voltage verification.
2. An administrative lock and tag may be applied to the energy isolating devices or group lockbox for the purpose of configuration control. Whenever an administrative lock and tag is used, the lead authorized worker retains responsibility for the integrity of the lockout, including re-verifying proper energy isolation if necessary before placing the master lock and orange master lock tag on the group lockbox.

For either exception, no work may be performed under the lockout until the lockout is complete and, for group lockout, the group lockout master lock and orange master lock tag are applied to the group lockbox.

For work across multiple shifts a lead authorized worker must be designated for each shift. All authorized workers on shift must be informed of this designation. Oncoming lead authorized workers must apply their own lock(s) to the energy isolating devices or, if used, the group lockbox. The off-going lead authorized worker will communicate with the oncoming lead authorized worker to ensure proper coordination of work scopes and work groups across multiple shifts. Oncoming lead authorized workers must stay locked on the energy isolating devices or, if used, the group lockbox until work on their shift has been discontinued, or until their lead duties have been transferred to another lead authorized worker.

2.4.2.6 System Restoration

System restoration must conform to Section 2.7, “Release from Lockout / Tagout“. The sequence of steps to restore equipment to service should proceed as described in the ELP or, for a group lockout procedure, in reverse sequence listed in the EIP. If alternate sequencing is desired then a job-specific restoration plan must be prepared by a knowledgeable worker who is familiar with the equipment and associated hazards. System restoration is coordinated by the lead authorized worker or operations group members.

2.4.3 Equipment-specific Lockout Procedure

An *equipment-specific lockout procedure (ELP)* is typically prepared for standalone equipment or equipment assemblies that require lockout of multiple energy sources. A single ELP may be used for multiple identical equipment assemblies. An ELP may be used for simple or complex lockouts.

Note *For large, complicated or system-level lockouts that involve many energy isolation points, multiple work groups or employers, or multiple work locations, a group lockout procedure is typically prepared.*

2.4.3.1 Required Elements

An ELP must include the following elements (see Control of Hazardous Energy: Equipment-specific Lockout Procedure (ELP) Template for a recommended template):

1. Concurrence/approval/validation: the name, title, and date of all parties who approved, tested, or revalidated the procedure
2. Procedure name, scope, and purpose

3. Equipment: complete description (model, serial number, property control number, et cetera) and location
4. Equipment custodian and the custodian(s) of any associated/affected equipment: name and contact information
5. Potentially hazardous energy sources and types (see Control of Hazardous Energy: Hazardous Analysis Procedure): include all sources, such as electrical, thermal, mechanical, hydraulic, pneumatic, chemical, and ionizing and non-ionizing radiation
6. Isolation device associated with each energy source: identity and location and if applicable schematics and/or photos
7. Preparation and notification: steps to prepare the work area, notify the equipment custodian, and all affected workers of the lockout (and the equipment custodian(s) of any associated or affected equipment)
8. Equipment shutdown procedure: for placement, removal, and transfer of lockout and/or tagout devices and the responsibility for them
9. Energy source(s) isolation: description of method(s)
10. Stored energy dissipation: description of method(s)
11. Zero energy verification, including verification of non-operation, and zero voltage verification (ZVV) (if required): description of method(s) for testing (see Control of Hazardous Energy: Zero Voltage Verification Procedure)
12. Equipment testing: if testing is required during or after service/maintenance, description of a safe testing procedure.

    Note *If any part of the lockout is removed for testing or other reasons, zero energy verification, including ZVV, will be required again once the unlocked equipment is re-locked/re-tagged.*

13. System restoration steps: for restoring system when work is complete; must comply with Section 2.7, "Release from Lockout / Tagout"
14. Designated authorized workers who are pre-approved to implement the ELP, if applicable: names
15. A complex lockout permit (sign on/sign off form) to record the identity of the lead authorized worker and to provide accountability of all persons working under the ELP

    Note *If an existing ELP does not include a complex lockout permit, a standalone permit must be used (see Control of Hazardous Energy: Complex Lockout Permit for a recommended template).*

ELP steps must be performed in the order stated in the procedure, unless alternate sequencing is specifically addressed in the ELP.

2.4.3.2 Development and Approval

The equipment custodian writes or, in consultation with the responsible manager or supervisor, ensures that a knowledgeable worker familiar with the equipment is designated to write an ELP and another knowledgeable worker is designated to be the lead reviewer. The ELP preparer and lead reviewer must be current in their training. For ELPs involving research and development or experimental equipment the ELP author and lead reviewer must be *competent persons* as defined in this chapter. Each ELP must be reviewed and approved before it is implemented the first time.

2.4.3.3 Annual Revalidation

Every ELP must be revalidated by a same-system or equipment authorized worker once per year unless an ELP has not been used within the past 12 months. In this case, the ELP must be revalidated at the next use. If the ELP is accurate, the revalidation must be documented on its approval and validation page. If the ELP is found to be inaccurate, a redlined copy must be forwarded to the equipment custodian for resolution.

2.4.4 Group Lockout Procedure

A group lockout procedure is typically used for large, complicated, or system-level lockouts that involve many energy isolation points, multiple work groups or employers, or multiple work locations, although it may also be used for simple lockout. (See Control of Hazardous Energy: Group Lockout Procedure.)

Under group lockout a *lead authorized worker* coordinates multiple authorized workers and work scopes to be worked under the group lockout.

Note *For standalone equipment or equipment assemblies that require lockout of multiple energy sources, an ELP is typically prepared.*

2.4.4.1 Energy Isolation Plan (EIP) Development

Group lockout energy isolation must be carried out under a written *energy isolation plan (EIP)* that is developed in accordance with Control of Hazardous Energy: Group Lockout Procedure. The plan must include

- A unique group lockout identifier that will applied to all associated forms and tags
- A separate step for locking and tagging each individual energy isolating device. Each device must have its own step.
- A separate step for each individual zero energy verification, verification of non-operation, and release of stored energy. Each verification/release must have its own step.
- Drawings or sketches that identify energy isolating devices, if needed to assist authorized workers in understanding the EIP

The responsible manager or supervisor, in consultation with the equipment custodian, must designate a knowledgeable worker familiar with the equipment and work scope to prepare the EIP and a second knowledgeable worker to review it. EIP preparers and lead reviewers must be current in the required training. In some cases a member of the owning or custodial group may be the best choice to prepare or review an EIP, even though that group may not be involved with the servicing or maintenance activities.

For a recommended EIP template, see Control of Hazardous Energy: Group Lockout Energy Isolation Plan Template. An EIP may be reused but it must be reviewed and approved for each use.

Energy isolation steps must be implemented in the order stated on the EIP unless alternate sequencing is specifically addressed in the plan.

2.4.5 Zero Energy Verification

The zero energy state is the lowest achievable energy state for machinery, equipment, or systems. Achieving zero energy state is unique to each lockout, depending on the equipment and energy source. Generally, the zero energy state is achieved by

- Attempting to start the equipment using normal operating controls to check that the equipment does not start or become energized (verification of non-operation).
  - Return the operating control(s) to the NEUTRAL or OFF position before proceeding with servicing or maintenance work
- De-energizing electrical energy sources, including discharging capacitive and inductive elements (absence of voltage, current, and stored electrical energy). See Section 2.4.5.1 for *zero voltage verification*.
  - Where the potential for re-accumulation of electrical energy exists, apply grounding devices such as ground hooks or grounding clips and wire
- Totally blocking or releasing mechanical (kinetic or potential) energy, including movement such as fan windmilling and equipment with stored spring energy (such as switchgear breakers)
- Allowing surface or liquid temperatures to moderate to prevent thermal burns
- Removing all differential pneumatic or hydraulic pressure to equal atmospheric pressure
  - Use temporary or permanently installed pressure indicators to confirm zero pressure
  - When blank flanges are used, install a fitting to attach a pressure indicator to the blank flange if no other pressure indicator is available within the lockout boundary
  - Always include a locked open vent valve or drain valve (or both) in the lockout procedure to prevent re-accumulation of pressure while the lockout is in place

Note *If any part of the lockout is removed for testing or other reasons, zero energy verification, including ZVV, will be required again once the unlocked equipment is re-locked/re-tagged.*

2.4.5.1 Zero Voltage Verification

When work is to be performed within the *limited approach boundary* or *arc flash protection boundary* of exposed electrical parts a *zero voltage verification* must be performed. Zero voltage verification is performed after verification of non-operation (Section 2.4.5).

A qualified electrical worker using an appropriately rated meter must test all circuit elements and electrical parts to which workers may be exposed. The qualified electrical worker must lock on to the lockout before performing any tests. (See Control of Hazardous Energy: Zero Voltage Verification Procedure).

In addition to the zero voltage verification, electrical workers should use a proximity tester or other voltage testing device to periodically confirm absence of voltage at the work location (that is, liberal use of “test before touch”) including after pauses in work or if the work site has be left unattended. Non-electrical workers may request the support of qualified electrical workers to perform these tests. Electrical workers must oblige these requests.

2.5 Pauses in Work

Authorized workers should remain locked on to a lockout on until their work is complete. The single key for each personal lock must remain in the possession of the worker who placed it. When work continues beyond one work day, each worker must verify that his or her lock is still in place before beginning work each day. If a lock is removed for any reason, the worker must re-verify proper energy isolation before locking on and resuming work.

2.6 Lock and Tag Removal for Testing

An authorized worker may temporarily remove his or her lock(s) and tag(s) for the purpose of testing machines, equipment, or a process, or to carry out any other necessary sub-task such as positioning equipment. When locks are removed for testing the lockout is no longer intact and no work may be performed. All workers must remain clear of the equipment hazard zone.

After completing testing or positioning, the authorized worker must implement safe de-energization and zero energy/voltage verification and replace locks and tags before continuing with the original task.

For complex lockouts, the lead authorized worker must coordinate lock removal for testing, and restoration of the lockout following testing. All workers must be informed of the test activities, and no work may be performed until the lockout is re-established.

2.7 Release from Lockout / Tagout

The following equipment restoration steps apply to all lockouts:

- Check the machine/equipment and surrounding area to ensure that non-essential objects have been removed, guards have been reinstalled, and that the machine/equipment is operationally intact
- Verify machine/equipment controls are in the NEUTRAL or OFF position
- Verify that all affected workers and other authorized workers are out of harm's way
- Remove locks and tags and prepares to restart the machine/equipment
- Before restarting machinery/equipment, notify affected workers and the equipment custodian, equipment owner, or system owner, as applicable, that work is complete, that locks and tags have been removed, and that normal operations may proceed

The lead authorized worker coordinates these steps out for complex lockouts; the authorized worker for simple.

2.8 Alternative Process for Lockout / Tagout Device Removal

The only person authorized to remove a red personal lock and tag is the worker who applied it. If the worker is not available and is unable to return to site to remove the lock, the lock may be cut off and removed with the concurrence of the worker's supervisor or manager. The following steps must be taken (see Control of Hazardous Energy: Alternative Authorization for Removing Locks and Tags Form):

1. Verify that the worker who installed the lock is not on the site or may not return to the site
2. Make all reasonable efforts to contact the worker
3. Record in writing all the circumstances and reasons for cutting off the lock
4. Determine that it is safe to energize
5. Cut off the lock
6. Make sure that worker is informed that the lock has been removed before he/she resumes work at the job site

Note *These restrictions do not apply to removing administrative locks and tags, which are neither red nor used for worker protection (see Section 2.11, "Administrative Lock and Tag Control").*

2.9 Tagout Only

In some cases lockout may not be possible because energy isolation devices are not lockable. If an energy isolation device is not lockable, *tagout only* may be used if all the following requirements are satisfied:

- Tagout-only tags must be attached at the same location that the lockout device would have been attached.
- In demonstrating that the level of safety achieved using tagout only is equivalent to the level of safety obtained by using full lockout, the authorized person using tagout only must implement at least one additional safety measure at each energy isolation location to reduce the likelihood of inadvertent energization by doing one or more of the following:
  - Remove and tag an additional isolating circuit element (for example, fuses)
  - Lift, safe-off, and tag circuit power leads
  - Open and tag an extra disconnecting device
  - Remove and tag a valve handle
  - Post a safety guard at the energy isolating device to ensure the device remains in the isolation position. The safety guard must have no other duties and must not leave his station for any reason.
- Tagout-only tag attachment means must be of a non-reusable type, attachable by hand, self-locking, and non-releasable, with a minimum unlocking strength of no less than 50 pounds and having the general design and basic characteristics of being at least equivalent to a one-piece, all environment-tolerant nylon cable tie.

2.10 Lockout / Tagout Equipment

2.10.1 General Requirements

Important Workers must never depend upon another worker's lock(s) and must always apply their personal lock(s) to the energy isolation device(s) or group lockbox.

All necessary lockout/tagout equipment must be provided by the authorized worker's employer.

Depending on the lockout/tagout requirements for specific circumstances, required supplies may include a lock, hasp, tag, tag attachment means, chains, wedges, key blocks, adapter pins, self-locking fasteners, or other hardware. Adhesive lock labels may be used subject to the requirements of Section 2.10.6, "Lockout Tags and Adhesive Lock Labels".

Lockout devices, tags, and adhesive lock labels must meet the following requirements:

- Lockout locks and hardware and lockout tags and adhesive lock labels must be capable of withstanding the environment to which they are exposed for the maximum period of time that exposure is expected.
- Lockout locks and hardware must be substantial enough so that they cannot be removed without the use of excessive force or unusual techniques (such as bolt cutters or other metal cutting tools).
- Lockout tags, including their means of attachment, must be substantial enough to prevent inadvertent or accidental removal.
- Lockout tags and adhesive lock labels must be constructed and printed so that exposure to weather conditions or wet and damp locations will not cause the tag or label to deteriorate or the message on the tag or label to become illegible.
- Lockout tags and adhesive lock labels must not deteriorate when used in a corrosive environment, such as in an area where acid or alkali chemicals are handled or stored.

2.10.2 Personal Lock

Authorized worker *personal locks* must:

- Be red (SLAC authorized workers) or otherwise be uniquely identified (subcontractor authorized workers)
- Have only one key, and that key must remain in control of the worker (multiple locks with a single unique key are permitted)
- Not be used for any purpose other than lockout/tagout

2.10.3 Operations Lock

An *operations lock* differs from a personal lock in that they are under the exclusive control of operations group members.

Operations locks

- Must be red
- May be marked or labeled to identify the owning group
- Must not be used for any purpose other than lockout/tagout
- If used for complex lockout energy isolation, must have only one key
- If used as group lockout master locks, may have one or more keys, all of which are in the control of the group members[1]

1 This is the only red lock in the SLAC CoHE program that may have more than one key.

2.10.4 Lead Authorized Worker Lock

Lead authorized worker locks are personal locks and may be used by a lead authorized worker for group lockout energy isolation. When lead authorized worker locks and a group lockbox are used for group lockout energy isolation, the key for each lock must be placed in the group lockbox.

2.10.5 Group Lockout Master Lock

When a group lockbox is used, a *group lockout master lock* and orange master lock tag (see 2.10.6) are placed on the group lockbox to signify that energy isolation is complete and that the system or equipment is ready for maintenance or servicing.

Group lockout master locks must be red. When energy isolation is complete and the lockout has been established, the master lock is the first lock on and the last lock off the group lockbox. The master lock provides continuity of protection for all workers performing work under the group lockout. The master lock must be keyed differently from the locks used for energy isolation. The master lock may be a lead authorized worker personal lock or an operations lock.

2.10.6 Lockout Tags and Adhesive Lock Labels

All lockout locks must be accompanied by a lockout tag or adhesive lockout lock label that identifies the authorized worker who applied the lock.

- All lockout tags and lock labels must have a white background with black letters and must include a red, white, and black ANSI danger symbol.

  Exception The group lockout master lock tag has an orange background (see Control of Hazardous Energy: Tag Templates).

- Lockout tags and lock labels must state explicit instructions such as DO NOT OPERATE, DO NOT START, DO NOT ENERGIZE, DO NOT REMOVE, MY LIFE IS ON THE LINE or similar warning of the hazardous condition.
- For personal locks, including individual workers working under group lockout or an ELP, a lockout tag or lockout lock label that identifies the worker and worker contact information is required.

Note Worker name and contact information may be on an adhesive label or engraved on one side of the lock with an adhesive label containing the danger symbol and required wording on the other side.

- Group lockout tags affixed to energy isolating device locks must
  - Contain the words GROUP LOCKOUT or GROUP LOTO
  - Include a unique group lockout identifier
  - Include the name and contact information of the lead authorized worker or operations group
- Group lockout master lock tags must
  - Have an orange background with black lettering and contain a red, white and black ANSI danger symbol
  - Contain the words GROUP LOCKOUT MASTER LOCK or GROUP LOTO MASTER LOCK

- Include a unique group lockout identifier
- Include the name and contact information of the lead authorized worker or operations group who applied the lock

Note *Group lockout tags may be used for ELPs involving multiple workers.*

For tag templates, see Control of Hazardous Energy: Tag Templates.

2.11 Administrative Lock and Tag Control

The purpose of *administrative lock and tag control* is to allow workers or groups to control energy isolating devices for purposes other than the control of hazardous energy while servicing and maintenance is performed. Administrative lock and tag is typically used for exercising configuration or operational control.

Important Never rely on administrative lock and tag control when lockout/tagout for hazardous energy control is required. For servicing and maintenance of machines, equipment, or systems formal lockout is always required.

2.11.1 Requirements

Administrative lock and tag control may be used by individual workers or by groups responsible for control and maintenance of equipment, machinery, or systems. Administrative lock and tag control is commonly used when

- Equipment must be shut down because it is defective (further use may cause damage or equipment failure)
- A particular configuration must be maintained
- Equipment operation may result in undesirable consequences
- Special training or authorization may be required to use the equipment
- Newly installed equipment or systems have not yet been fully tested or approved for use
- Equipment has been removed from service and its energy source is locked off

Note *Contact the electrical safety officer for guidance on the use of administrative lock and tag to mitigate hazardous energy in out-of-service equipment. In particular, note that administrative lock and tag must not be used where one end of a cable or piping branch line has been disconnected from equipment, and the other end is connected to a source of hazardous energy.*

Another use of administrative lock and tag involves locking out equipment by a SLAC worker so that a subcontractor who will be performing work can apply the required personal lock and tag for control of hazardous energy (see Section 2.2, “Subcontractors”). If the SLAC worker will not perform work or be within the hazard zone of the equipment and is not the lead authorized worker, an administrative lock and tag should be used in lieu of a lockout/tagout personal lock and tag.

These two examples illustrate this use:

- In preparation for subcontractor service to a chiller, SLAC Facilities and Operations Division personnel shut down the chiller and apply administrative lock and tag to the chiller's energy isolating devices. The subcontractor's employees then apply their personal lock and tag before beginning work.
- In preparation for subcontractor installation of new electrical equipment, a SLAC qualified electrical worker de-energizes the circuit, applies a personal LOTO lock and tag, and performs zero voltage verification. The SLAC worker then replaces their personal LOTO lock and tag with an administrative lock and tag. The subcontractor's electricians then apply their personal LOTO locks and tags before beginning work.

2.11.2 Locks

An administrative lock may be any color but red and may have more than one key. Administrative locks may be used by an operations group, such as SLAC Facilities and Operations or Accelerator Operations, with keys accessible to multiple group members.

2.11.3 Tags

Tags used for administrative lock and tag are informational, and must not resemble red, white, and black danger tags used for control of hazardous energy.

Administrative control tags

- Must not use the lockout/tagout DANGER red, white, and black graphic. They may use DO NOT ENERGIZE, ADMINISTRATIVE LOCK AND TAG, NOTICE, INFORMATION, or similar wording, and may include department-specific language such as KTL CONTROL TAG.
- Should be distinguishable by their color in that they do not resemble the white/black/red danger tag used for lockout/tagout; blue and white is a good choice
- Should be standard size
- Must include the following information:
  - Department/organization/worker name
  - Telephone number/contact information for responsible department or person(s)
- Durable adhesive lock labels or other durable lock labeling methods may be used in lieu of tags provided the labels provide the information required above.

For tag templates, see Control of Hazardous Energy: Tag Templates.

2.12 Alternative Energy Controls

Alternative energy control requirements apply if the equipment must be energized to perform the required servicing task. When alternative energy controls are used, lockout/tagout is not required for the control of hazardous energy.

For example, in laser work, alignments, creating new beam paths, and replacing optics are servicing tasks performed with lasers partially or fully energized. These tasks require the use of alternative energy controls.

These controls must use the necessary combination of engineering controls (such as barriers and fixed guards, interlocks for moveable equipment guard devices, key control), warning and alert systems, administrative controls, and personal protective equipment to achieve effective control of hazardous energy protection for workers. These controls must be documented and reviewed and approved as follows:

- Electrical equipment: by the electrical safety officer (ESO). See Chapter 8, "Electrical Safety", in particular the requirements for preparation, review, and approval of electrical work plans (EWPs) and energized electrical work permits (EEW).
- Laser safety systems: by the laser safety officer (LSO). See Chapter 10, "Laser Safety", for alternative energy controls documented in standard operating procedures (SOPs)
- Radio frequency (rf) systems: by the non-ionizing radiation program manager. See Chapter 50, "Non-Ionizing Radiation".
- Ionizing radiation: by the radiation safety officer (RSO). See Chapter 9, "Radiological Safety"
- Machine shop / fabrication areas. See Chapter 25, "Machine and Portable Tools"

2.13 Out-of-Service Equipment

Out-of-service equipment should be placed in a safe state that is economical to monitor and maintain for an extended period, until the eventual decommissioning of the equipment. Maintaining equipment in a safe state ensures that potential hazards to workers, the public, and the environment are minimized. Elimination or mitigation of hazardous energy in out-of-service equipment should occur as soon as practicable following removal of equipment from service.

Contact the electrical safety officer for guidance on the use of administrative lock and tag to mitigate hazardous energy in out-of-service equipment.

2.14 Hot Tap Operations

Hot tap operations are processes to establish a connection to a pressurized piping system without first establishing a zero hazard state. Hot taps involve the use of specialized drilling equipment to tap into in-service, pressurized process piping for the purpose of attaching a mechanical or welded branch fitting

Hot taps are allowed only when all these conditions are met:

- Continuity of service is essential
- Shutdown of the system is impractical
- Documented procedures are followed
- Special equipment is used that will provide proven, effective protection for workers

Permission to hot tap a process system is limited to situations in which system shutdown is impossible (such as a leaking tank or other non-isolable leak) or where hot tapping is shown to be less hazardous than shutting down and locking out the system and performing a cold tap. In other words, the decision to hot tap must be safety-based. It must be shown that, on the whole, it is safer to perform the hot tap than to shut down, depressurize, and lock out the system.

The responsible person must prepare a job safety analysis (JSA) that substantiates the recommendation to perform the hot tap. The JSA may consider the hazards and risks associated with shutting down and depressurizing the system or loop, including installation of temporary power and other temporary equipment necessary for facility operation.

The JSA must be reviewed and approved by the responsible supervisor and the CoHE program manager. If the JSA does not demonstrate that the hot tap is the lower-risk path, then the hot tap will not be permitted. In that case system shutdown, depressurization, and lockout are required.

3 Procedures, Forms, and Templates

The following are required procedures:

- Control of Hazardous Energy: Hazard Analysis Procedure (SLAC-I-730-0A10C-002). Describes process for determining hazardous energy sources and provides thresholds and other references
- Control of Hazardous Energy: Simple Lockout Procedure (SLAC-I-730-0A10C-003). Describes process for performing a simple lockout (a written plan of execution is required: this procedure, a custom plan, an ELP, or a group lockout procedure may be used)
- Control of Hazardous Energy: Group Lockout Procedure (SLAC-I-730-0A10C-006). Describes process for conducting a complex, group lockout
- Control of Hazardous Energy: Zero Voltage Verification Procedure (SLAC-I-730-0A10C-004). Describes process for verifying zero voltage
- Control of Hazardous Energy: Authorized Worker Certification Procedure (SLAC-I-730-0A10C-005). Describes process for certifying authorized workers on assigned lockout procedures

The following forms and systems are required by these requirements:

- Control of Hazardous Energy: Alternative Authorization for Removing Locks and Tags Form (SLAC-I-730-0A10J-002). Form for authorizing removal of a personal red lock and tag if the person who applied it is not available and is unable to return to site
- Control of Hazardous Energy: Request for Authorized Worker Certification Form (SLAC-I-730-0A10J-010). Form for requesting certification of authorized workers
- Control of Hazardous Energy: Authorized Worker Certification Form (SLAC-I-730-0A10J-004). Form for certifying authorized workers on assigned lockout/tagout procedures (restricted access, available form the Control of Hazardous Energy Program Site [SharePoint])

The following are recommended templates. Equivalent forms may be used:

- Simple lockout plan template and instructions. Template for creating a simple lockout plan; lists required elements (available from Control of Hazardous Energy Program Site [SharePoint])
- Control of Hazardous Energy: Equipment-specific Lockout Procedure (ELP) Template (SLAC-I-730-0A10J-001). Template for creating an equipment-specific lockout procedure (ELP); lists required elements of an equipment-specific lockout procedure (ELP)
- Control of Hazardous Energy: Group Lockout Energy Isolation Plan Template (SLAC-I-730-0A10J-005). Template for creating group lockout energy isolation plans (EIPs); lists required elements of an energy isolation plan

- Control of Hazardous Energy: Complex Lockout Permit (SLAC-I-730-0A10J-006). Form for documenting lead authorized worker and sign on and sign off of workers for complex LOTO
- Control of Hazardous Energy: Tag Templates (SLAC-I-730-0A10J-003). Templates for creating tags

These are other program documents and resources:

- Control of Hazardous Energy Program Site (SharePoint). Contains additional information and documents for implementing CoHE requirements

4 Recordkeeping

The following recordkeeping requirements apply for these requirements:

- See specific procedures

5 References

SLAC Environment, Safety, and Health Manual (SLAC-I-720-0A29Z-001)

- Chapter 51, "Control of Hazardous Energy"
  - Control of Hazardous Energy Program Site (SharePoint)
- Chapter 2, "Work Planning and Control"
  - Work Planning and Control: Job Safety Analysis Form
- Chapter 8, "Electrical Safety"
- Chapter 9, "Radiological Safety"
- Chapter 10, "Laser Safety"
- Chapter 25, "Machine and Portable Tools"
- Chapter 50, "Non-Ionizing Radiation"

Other SLAC Documents

- ESH Course 157PRA, Simple and Complex Lockout/Tagout for Authorized Workers Practical (ESH Course 157PRA)
- ESH Course 157JN, Joining Established Group Lockout/Tagout for Authorized Workers Practical (ESH Course 157JN)

Other Documents

- National Fire Protection Association (NFPA) 70E, "Standard for Electrical Safety in the Workplace" (NFPA 70E)

ENVIRONMENT, SAFETY & HEALTH DIVISION

Chapter 51: Control of Hazardous Energy

Alternative Authorization for Removing Locks and Tags Form

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URL: https://www-group.slac.stanford.edu/esh/eshmanual/references/coheFormLOTORemove.pdf

The purpose of this form is to attain authorization to remove a personal red lock and tag intended to control hazardous energy if the person who applied it is not available and is unable to return to site. (See Control of Hazardous Energy: General Requirements [SLAC-I-730-0A10S-004]).

Note *This form does not apply to removing administrative locks and tags, which are neither red nor used for worker protection. An administrative lock or tag must be removed by one or more operations staff members who control the key(s).*

Request *(completed by requester)*		
Reasons/circumstances for removing lock/tag		
Requester (authorized worker requesting removal of lock/tag)	Dept / group	Phone number
Signature	Date requested	
Lock/tag *(completed by requester)*		
Owner (authorized worker who applied lock, named on lock/tag)	Dept / group	Phone number
Location (building/room)	Description of machinery, equipment, or system	
Efforts made to confirm availability of owner *(completed by requester or authorizing supervisor)*		
Authorization *(completed by authorizing supervisor or by requester if approval by telephone)*		
Authorizing supervisor (supervisor or manager of employee whose lock is to be removed)	Dept / group	Phone number
Signature	Date approved	
Closeout		
Date lock/tag removed *(completed by requester)*		Requester initial
Efforts made to inform lock owner that the personal lock/tag was removed *(completed by authorizing supervisor)*		Authorizing supervisor initial

Authorizing supervisor to keep completed form for 12 months.

NATIONAL ACCELERATOR LABORATORY

ENVIRONMENT, SAFETY & HEALTH DIVISION

Chapter 51: Control of Hazardous Energy

Hazard Analysis Procedure

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URL: https://www-group.slac.stanford.edu/esh/eshmanual/references/coheProcedHazAnalysis.pdf

1 Purpose

The purpose of this procedure is to determine if the *energy source(s)* associated with *service or maintenance* performed on any machinery, equipment, or system has the potential to harm workers. If so, the *hazardous energy* must be controlled using an appropriate *lockout* procedure (see Control of Hazardous Energy: General Requirements). This procedure covers determining whether hazardous energy may exist. It applies to workers, supervisors, equipment custodians, and area and building managers.

2 Procedure

Step	Person	Action
1.	Responsible manager or supervisor or equipment custodian	Assigns a worker to conduct a hazard analysis (or to confirm there is an existing *equipment-specific procedure [ELP]* or *energy isolation plan [EIP]* for the work). For group lockouts using new ELPs or EIPs, the hazard analysis is prepared by the ELP/EIP preparer. For other lockouts, the hazard analysis is prepared by an *authorized worker*, familiar with the equipment and work scope.
2.	Worker	Reviews the scope of work and affected machine, equipment, or system
3.	Worker	Identifies all energy sources (electrical, mechanical, thermal, potential, pneumatic, hydraulic, chemical, and radiological, et cetera) (see Section 2.1, "Energy Types: Additional Information and References")
4.	Worker	Determines if any energy sources are hazardous (see Table 1) ▪ If the value of the hazardous energy falls in the "Evaluate Hazard and Consider Lockout" column, lockout should be used if the authorized worker determines that lockout is warranted based on an evaluation of all hazards, including secondary hazards and combined hazards, associated with the work scope and equipment or system conditions; otherwise lockout is not required. ▪ If the value falls in the "Lockout Required" column, lockout is required. For energy types without an explicit value, consults additional applicable resources to make a determination (such as information in this document and relevant ESH Manual chapters, and the control of hazardous energy [CoHE] program manager, responsible directorate ESH coordinator, safety officer, and subject matter experts)
5.	Worker	Evaluates each task including setup, installation, removal, adjusting, cleaning, troubleshooting, and programming to analyze for hazards
6.	Worker in consultation with building or area manager, if necessary	Evaluates the work environment for potentially hazardous combinations (see "Potentially Hazardous Energies in Combination" below)
7.	Worker	For *complex lockouts*, documents results of the hazard analysis in an ELP or EIP and submits for approval (or confirm the adequacy of the existing ELP or EIP)

Table 1 Hazardous Energy Thresholds

Energy Form	Evaluate Hazard and Consider Lockout	Lockout Required
Electrical (AC or DC)	< 50 V and ≥ 5 mA or ≥ 50 V and < 5 mA or > 0.25 J and ≤ 10 J stored energy	≥ 50 V and ≥ 5 mA or < 50 V and ≥ 1000 W or > 10 J stored energy
Thermal (hot)	Liquids or gases ≤ 125°F (52°C) Surfaces ≤ 140°F (60°C)	Liquids or gases > 125°F (52°C) Surfaces ≥ 140°F (60°C)
Thermal (cold)	Liquids and surfaces ≥ 27°F (-3ºC)	Liquids and surfaces < 27°F (-3°C)
Magnetic fields	No threshold with respect to control of hazardous energy; each situation must be evaluated. Refer to Chapter 50, "Non-Ionizing Radiation", for magnetic field exposure limits.	
Kinetic	No threshold; each situation must be evaluated	
Potential	No threshold; each situation must be evaluated	
Pneumatic and hydraulic	No threshold; each situation must be evaluated	
Chemical	No threshold: each situation must be evaluated based on the chemical's hazardous properties	
Non-ionizing radiation other than lasers (3 kHz to 300 GHz, or > 1 mm)	Many sources of non-ionizing electromagnetic radiation involve electrical hazards that must be considered even when the radiation emitted is not hazardous. See Chapter 50, "Non-ionizing Radiation", for requirements and maximum permitted exposures (MPEs)	
	≤ MPEs	> MPE
Lasers (180 nm to 1 mm)	Class 3B or Class 4 lasers: use lockout or controls equivalent to lockout approved by the laser safety officer. See Chapter 10, "Laser Safety".	
Ionizing radiation	Any work that involves ionizing radiation must be performed in accordance with requirements set forth in Chapter 9, "Radiological Safety". For equipment that could potentially expose a worker to ionizing radiation above an administrative control level in a short time period during servicing and maintenance on that equipment, the use of lockout should be considered as part of the work planning phase. Work that requires breaching accelerator-related vacuum systems requires lockout of the RF source(s) in accordance with the requirements of this chapter. Call the Radiation Protection Department (ext. 4299) for information on areas controlled for radiological purposes, dosimetry, training, and work planning.	
1. Double valve isolation is required when the operating temperature exceeds 200°F or the operating pressure exceeds 500 psig.		

2.1 Energy Types: Additional Information and References

2.1.1 Electrical

For more information, see Chapter 8, "Electrical Safety".

2.1.2 Thermal

Thermal energy – what we experience as heat or cold – is commonly produced by mechanical devices (combustion and/or friction), electrical resistance, and chemical reactions (or changes of state). Thermal energy can be controlled and/or dissipated.

Burns can occur due to both heat and cold, and the severity of a burn depends on temperature and duration or contact. The threshold for injury due to contact with hot liquids (which can cause burns or scalding) is 120°F (52°C). The threshold for injury to tissues due to cold is slightly below freezing (27°F [-3°C]). All cryogenic liquids present a cryogenic burn hazard.

Contact hazards with hot or cold surfaces are typically controlled with insulation, personal protective equipment (PPE), and/or time sufficient to allow cooling or warming.

2.1.3 Kinetic

Kinetic energy is the extra energy an object possesses due to its motion (for example, rotating gears, fans, fan belts, pulleys, flywheels, and rolling or pressing components). Setting an object into motion requires that the object be accelerated to attain motion, and this energy, if hazardous, must be dissipated. No threshold is proposed for kinetic energy; each situation must be evaluated.

2.1.4 Potential

Potential energy can be thought of as the energy stored within a physical system. Objects at an elevated level, for instance, contain more potential energy than when they are physically lowered. This also referred to as configurational energy and can be eliminated by lowering an object in a controlled manner. Potential energy is also stored in a compressed spring, which can be released in a controlled manner. No threshold is proposed for potential energy; each situation must be evaluated.

2.1.5 Pneumatic and Hydraulic

Pneumatic and hydraulic energy refers to the energy inherent in the pressure that a gas or liquid is under. Pressure is generally expressed as psig (pound-force per square inch gauge), which expresses pressure relative to the surrounding atmosphere. A system can be under positive pressure (greater than atmospheric pressure) or negative pressure (vacuum).

Pneumatic refers to pressurized air or gas, as in compressed air or gas in a compressed gas cylinder. Hydraulic refers to pressurized liquid, such as water in a hose pressurized by a pump. Releasing pneumatic or hydraulic pressure involves identifying the pressure source. If equipment is producing pressure, turn it off. If the pressure is stored, allow it to release or dissipate under controlled conditions.

Note *This section discusses non-hazardous gases; hazardous gases and liquids at any pressure must be locked out due to their chemical hazards (for example toxic, flammable, reactive).*

2.1.5.1 Pneumatic Injury

Provided that skin and eyes are protected and no potential for deadheading (point blank exposure of the jet to bare skin) exists, the pressure required to inflict pneumatic jet injuries to healthy unbroken skin is over 600 psi. Pneumatic sources directed at eyes or ears can cause injuries at significantly lower pressures, depending on the proximity and diameter of the jet. Cal/OSHA (8 CCR 3301) limits air pressure to 10 psi for blowing dirt, chips or dust from clothing while it is being worn.

Note *The Cal/OSHA limit of 10 psi for using compressed air to clean clothes does not protect from particulates that may be generated by cleaning with pressurized air below 10 psi.*

2.1.5.2 Hydraulic Injury

The pressure required to break intact healthy skin delivered by a hydraulic jet is more than 600 psi. Depending on the diameter of the jet and distance between it and the affected area, much lower pressures are hazardous to eyes, ear drums, and open wounds. Hydraulic injection injuries at distances up to 4 inches between the skin and jet have been recorded.

In larger piping systems, a hazard may be present if the liquid momentum conveyed by water and other liquids is sufficient to knock a worker down.

2.1.5.3 Compressed Air and Water Utility Systems

Nearly every industrial or commercial installation uses utility water or compressed air systems operating at pressures up to 150 psig. Common practice has shown that wearing normal PPE such as coveralls, gloves, and safety glasses provides worker protection and lockout is not normally used or required for servicing and maintenance of these systems.

The need for lockout may be indicated at relatively low pressures in such systems due to secondary factors such as working at elevation, since a sudden release could activate the startle reflex that may cause a fall. Take into account all secondary hazards present in a particular work environment.

2.1.5.4 Compressed Gas Cylinders

Compressed gas cylinders or subsequent valves feeding downstream systems are subject to lockout where 1) the system is being serviced or modified, and 2) the gas is flammable, the gas is toxic, or the delivery pressure with the regulator valve fully open could result in an injury. Lockout does not apply to cylinder installation and removal.

2.1.6 Chemical

There is no threshold below which it can be categorically stated that no hazard exists for a system that may release hazardous chemical solutions at any pressure. This also applies to systems that contain flammable liquids or gases or any gases with a potential of creating a hazardous atmosphere, including gases used for fire suppression systems. Lockout may be necessary based on the hazardous properties of the chemical or to prevent a chemical release that poses environmental consequences. For more information on the properties of hazardous chemicals, see Chapter 40, “Chemical Lifecycle Management”.

2.1.7 Non-ionizing Radiation and Magnetic Fields

Non-ionizing radiation is a form of electromagnetic radiation that can be hazardous at exposure levels above the specified maximum permissible exposure (MPE) levels even though it does not cause ionization of molecules. Non-ionizing radiation includes high intensity visible and invisible light (ultraviolet and infrared) sources, microwaves, radiofrequency waves, and magnetic fields.

Where non-ionizing radiation sources exceed their respective MPE, the hazard must be evaluated. Service and maintenance on radiofrequency and microwave systems generally need hazardous energy control and lockout when exposure above the MPE is possible. For more information refer to Chapter 50, "Non-ionizing Radiation".

Refer to ESH Manual Chapter 50 Non-Ionizing Radiation for magnetic field exposure limits.

2.1.8 Lasers

Where workers could be exposed to beams from Class 3B and Class 4 lasers while performing service or maintenance on those systems, procedures to achieve control of hazardous energy must be evaluated, including the possible need for lockout. Lockout may apply in such situations as

- Connecting or disconnecting fiber terminations if the fiber transmits Class 3B or Class 4 laser radiation
- Maintenance or service work on equipment associated with a laser transport line

Laser SOPs are developed in compliance with ANSI Z136.1 to address potential hazards associated with service and maintenance during normal production operations using alternative energy controls. For example, in cases where the beam cannot be shut down for maintenance, but instead will be controlled using electromagnetically- or pneumatically-controlled shutters, an effective beam stop bolted in place and tagged LASER SAFETY DEVICE – DO NOT REMOVE would provide additional protection and meet the intent of the lockout requirements. Refer to Chapter 10, "Laser Safety".

Personal protective eyewear is required when laser personnel work in a nominal hazard zone where laser radiation may be present above the MPE.

2.1.9 Ionizing Radiation

When the potential exists for a worker to exceed an administrative control level in a short time period, consider the use of lockout as part of the work planning phase. For more information see Chapter 9, "Radiological Safety".

Lockout may apply:

- To prevent external radiation exposure during service or maintenance of radiation-generating devices
- To prevent external radiation exposure during use of exposure systems with sealed sources having pneumatic or mechanical transport systems

2.2 Potentially Hazardous Energies in Combination

The following partial list of possible dangerous combinations of hazardous energies is meant to illustrate the types of configurations to watch for; many other combinations of energies may be hazardous.

- **Water and electricity.** Consider the potential for shock or arc flash hazard when working on water lines over electrical components or when working on electrical systems in a wet location.
- **Compressed air and toxic materials.** Consider results of inadvertent activation (will it generate toxic or radioactive dusts or aerosols that create contamination or personal exposure?)
- **Work on a ladder and unexpected energy or noise.** Consider the location of overhead water or air lines when placing the ladder; consider the effect of unexpected impact of air or water or elevated noise level from release of compressed air. (A startled worker may fall or drop tools.)
- **Inert gas in a confined space.** Consider asphyxiation hazards in a work location with poor or no ventilation; shut the gas source off and lock it out avoids oxygen depletion.

- **Magnetic fields and metal.** Consider that ferrous tools may be propelled by strong magnetic fields.
- **Pneumatic and thermal.** Consider thermal and pneumatic hazards near live steam or pressure relief valves.

3 Forms

The following forms and systems are required by this procedure:

- None

4 Recordkeeping

The following recordkeeping requirements apply for this procedure:

- None

5 References

SLAC Environment, Safety, and Health Manual (SLAC-I-720-0A29Z-001)

- Chapter 51, "Control of Hazardous Energy"
- Chapter 8, "Electrical Safety"
- Chapter 9, "Radiological Safety"
- Chapter 10, "Laser Safety"
- Chapter 14, "Pressure Systems"
- Chapter 40, "Chemical Lifecycle Management"
- Chapter 50, "Non-ionizing Radiation"

Other Documents

- Title 8, *California Code of Regulations*, "Industrial Relations", Division 1, "Department of Industrial Relations", Chapter 4, "Division of Industrial Safety", Subchapter 7, "General Industry Safety Orders", Group 2, "Safe Practices and Personal Protection", Article 7, "Miscellaneous Safe Practices", Section 3301, "Use of Compressed Air or Gases" (8 CCR 3301)
- American National Standards Institute (ANSI) Z136.1, "Safe Use of Lasers" (ANSI Z136.1)

ENVIRONMENT, SAFETY & HEALTH DIVISION

Chapter 51: Control of Hazardous Energy

Simple Lockout Procedure

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URL: https://www-group.slac.stanford.edu/esh/eshmanual/references/coheProcedLOTOSimple.pdf

1 Purpose

The purpose of this procedure is to prevent worker exposure to *hazardous energy* (such as from unexpected energization, startup, or release of stored energy).

It covers locking out a machine, equipment, or system for which all the following conditions are met:

1. Has a single source of hazardous energy that can be readily identified, isolated, and locked out; and the single source controls all hazards, with no potential for stored hazardous energy
2. Involves only one department, group, craft, or employer, and does not involve a shift change
3. Contains no potential to release a hazardous material

Lockouts that meet these conditions are considered *simple*.

Note *This procedure, a custom plan, or an* equipment-specific lockout procedure (ELP) *or a* group lockout procedure *(for example, if more than one worker from the same crew is involved) may be used for simple lockouts.*

Note *A simple lockout procedure may be used for locking out multiple molded case breakers in a panel board with a single cable-type lockout device.*

If any of these conditions are not met (for example, there are multiple energy sources or multiple groups), the lockout is considered *complex* and this procedure may not be used. Instead, an *equipment-specific lockout procedure (ELP)* or a *group lockout procedure* must be used (see Control of Hazardous Energy: General Requirements).

This procedure applies to workers, supervisors, and equipment custodians.

2 Procedures

2.1 Establishing a Lockout

Step	Person	Action
1.	Authorized worker or supervisor	Contacts the equipment custodian
2.	Equipment custodian	▪ Grants permission to work on equipment

Step	Person	Action
		▪ Provides additional contacts, if any, for work coordination
3.	Authorized worker	Notifies affected workers before shutdown: ▪ Notifies affected workers that a lockout is about to take place, the reason for it, and the specific affected machinery or equipment ▪ Clears the area of people and any non-essential objects
4.	Authorized worker	Identifies and locates the energy source and energy isolating device (see Control of Hazardous Energy: Hazard Analysis Procedure) ***Important:*** *confirms lockout is simple or complex: if more than one energy source is identified follows a complex lockout procedure*
5.	Authorized worker or equipment operator	Shuts the machine or equipment down using the normal stopping procedure
6.	Authorized worker or equipment operator or qualified electrical worker	Operates the disconnect switch, circuit breaker, valve, or other energy isolating device to isolate (disconnect) the machine or equipment from its energy source For electrical equipment with viewing window, verifies all blades are fully open. Switchgear-type breakers must be open and racked out to the fully disconnected position. Rackable motor control center (MCC) buckets must be fully withdrawn with the breaker open. *Note: wears appropriate personal protective equipment (PPE) per the arc flash hazard label*
7.	Authorized worker	Applies personal LOTO lock and tag to the energy isolating device **For subcontracted work,** SLAC worker locks on first, followed by subcontractor; for non-electrical lockouts the SLAC worker may apply a non-red administrative lock. For lockouts involving an electrical hazard the SLAC red LOTO lock should be replaced with a non-red administrative lock after completion of ZVV (see Step 10). If both the SLAC worker(s) and the subcontractor worker(s) will perform work under the lockout, then the lockout is complex and the general lockout procedure may not be used. A complex lockout procedure is required.
8.	Authorized worker	Relieves, exhausts, or restrains stored or residual energy in the machine or equipment by grounding, blocking, bleeding down, et cetera
9.	Authorized worker	Verifies zero energy by ▪ Attempting to start the equipment using normal operating controls to check that the equipment does not start or become energized (, that is, verification of non-operation) ▪ Returning the operating control(s) to the NEUTRAL or OFF position before proceeding with servicing or maintenance work ▪ Ensuring zero energy state appropriate to the type of hazardous energy involved
10.	Qualified electrical worker	If work will be performed within the *arc flash protection boundary* or *limited approach boundary,* performs *zero voltage verification (ZVV)* of circuit elements and electrical parts to which worker(s) may be exposed (see Control of Hazardous Energy: Zero Voltage Verification Procedure) *Note: wears appropriate PPE per the arc flash hazard label*

Step	Person	Action
		Note: the electrical worker in charge must control access to electrical equipment per the boundaries on the arc flash hazard label
11.	Authorized worker	Proceeds with servicing or maintenance work
12.	Authorized worker	Returns equipment to service as described in Section 2.2, "Returning Equipment to Service"

2.2 Returning Equipment to Service

Step	Person	Action
1.	Authorized worker	Checks the machine/equipment and surrounding area to ensure that non-essential objects have been removed, guards have been reinstalled, and that the machine/equipment is operationally intact
2.	Authorized worker	Verifies machine/equipment controls are in the NEUTRAL or OFF position
3.	Authorized worker	Verifies that all affected workers and other authorized workers are out of harm's way
4.	Authorized worker	Removes locks and tags and prepares to restart the machine/equipment
5.	Authorized worker	Before restarting machinery/equipment, notifies affected workers and the equipment custodian, equipment owner, or system owner, as applicable, that work is complete, that locks and tags have been removed, and that normal operations may proceed

3 Forms

The following forms and systems are required by this procedure:

- None

The following are recommended templates. Equivalent forms may be used:

- Simple lockout plan template and instructions (available from Control of Hazardous Energy Program Site [SharePoint]). Template for creating a simple lockout plan; lists required elements

The following checklists are provided as guidance:

- Control of Hazardous Energy: Simple Lockout Checklist (SLAC-I-730-0A10J-008). Checklist for completing a simple lockout

4 Recordkeeping

The following recordkeeping requirements apply for this procedure:

- None

5 References

SLAC Environment, Safety, and Health Manual (SLAC-I-720-0A29Z-001)

- Chapter 51, "Control of Hazardous Energy"
  - Control of Hazardous Energy: General Requirements (SLAC-I-730-0A10S-004)
  - Control of Hazardous Energy: Hazard Analysis Procedure (SLAC-I-730-0A10C-002)
  - Control of Hazardous Energy: Zero Voltage Verification Procedure (SLAC-I-730-0A10C-004)
  - Control of Hazardous Energy Program Site (SharePoint)

NATIONAL ACCELERATOR LABORATORY

ENVIRONMENT, SAFETY & HEALTH DIVISION

Chapter 51: Control of Hazardous Energy

Group Lockout Procedure

Product ID: 531 | Revision ID: 2305 | Date published: 18 June 2021 | Date effective: 18 June 2021
URL: https://www-group.slac.stanford.edu/esh/eshmanual/references/coheProcedLOTOGroup.pdf

1 Purpose

The purpose of this procedure is to prevent worker exposure to *hazardous energy* (such as from unexpected energization, start-up, or release of stored energy). It covers locking out a machine, equipment, or system for which any of the following conditions are met:

- Multiple energy sources
- Multiple crews
- Multiple crafts
- Multiple locations
- Multiple employers
- Multiple disconnecting means
- Particular sequences of operation are necessary to establish the locked out condition safely
- Work involves a shift change

Such lockouts are considered *complex* and may be performed only under this procedure or an *equipment-specific lockout procedure (ELP)* (see Control of Hazardous Energy: General Requirements). This procedure applies to workers, supervisors, and equipment custodians.

2 Procedure

Step	Person	Action
Define the Work		
1.	Work scope owner (manager, supervisor, project engineer, or field construction manager)	Designates a *lead authorized worker* to be responsible for the group lockout *Note: when a group lockout is established by an operations group, the functions and responsibilities of the lead authorized worker may be transferred to the operations group. Operations group members involved with execution of the group lockout must themselves be* authorized workers.
Identify and Analyze Hazards and Develop and Implement Controls		
2.	Work scope owner	Designates a knowledgeable worker familiar with the equipment and work scope to prepare an *energy isolation plan (EIP)* and a second knowledgeable worker to review it

Step	Person	Action
3.	EIP preparer	Identifies hazardous energy sources following Control of Hazardous Energy: Hazard Analysis Procedure: ▪ Reviews as-built drawings, equipment labels, and other available information ▪ Consults with persons knowledgeable with the system or equipment ▪ Identifies required *energy isolation devices* ▪ Identifies sources of stored energy ▪ Identifies location(s) to perform verification of non-operation, *zero energy verification*, and *zero voltage verification (ZVV)*
4.	EIP preparer	Develops the energy isolation plan (see Control of Hazardous Energy: Group Lockout Energy Isolation Plan Template and Control of Hazardous Energy: General Requirements, Section 2.4.4.1)
5.	EIP reviewer	Performs an independent review of the energy isolation plan
6.	EIP preparer	Prepares a *complex lockout permit* (see Control of Hazardous Energy: Complex Lockout Permit and Control of Hazardous Energy: General Requirements, Section 2.4.2.1)
7.	Lead authorized worker (if not the EIP preparer)	Reviews energy isolation plan with knowledgeable individuals (may include the project manager, project engineer, electrical supervisor, subcontractor supervisor, safety inspectors, electrical safety officer, or other subject matter experts)
Authorization and Release		
8.	Lead authorized worker	Establishes permission and obtains release to remove equipment from service
9.	Lead authorized worker	Notifies *affected workers* before equipment shutdown ▪ Notifies *affected workers* that a lockout is about to take place, the reason for it, and the specific affected machinery or equipment ▪ Clears the area of people and any non-essential objects
Perform the Work within Controls		
10.	Lead authorized worker	Locates each energy isolation device listed in the energy isolation plan
11.	Qualified electrical worker	Wears appropriate personal protective equipment (PPE) per the arc flash label for switching and ZVV (see Control of Hazardous Energy: Zero Voltage Verification Procedure)
12.	Qualified electrical worker	Assists the lead authorized worker with switching as needed to establish energy isolation
13.	Authorized worker	Assists the lead authorized worker with equipment operation as needed to establish energy isolation
14.	Lead authorized worker	▪ Places/verifies each energy isolation device in the required LOTO position ▪ Applies personal red lockout lock and tag (lead authorized worker) or operations lock and tag (operations group) to each isolation device (each tag must call out the unique ID assigned to the group lockout) ▪ Signs off each point on the energy isolation plan as locks are placed ▪ Places the key for each lock in the group lockbox

Step	Person	Action
		▪ Performs or witnesses each verification of zero energy or verification of non-operation, and each release of stored energy. For electrical equipment with viewing window, verifies all blades are fully open. Switchgear-type breakers must be open and racked out to the fully disconnected position. Rackable MCC buckets must be fully withdrawn with the breaker open. ▪ Signs off each verification of zero energy or verification of non-operation
15.	Qualified electrical worker	Assists the lead authorized worker in establishing an electrically safe condition by performing ZVV of **all circuit elements and electrical parts to which worker(s) may be exposed** as listed in the energy isolation plan
16.	Lead authorized worker or qualified electrical worker	Signs off each ZVV step on the energy isolation plan
17.	Lead authorized worker	▪ When all energy isolation plan steps are complete affixes a personal red lockout lock and orange group lockout master lock tag to the group lockbox. This *group lockout master lock* is the first lock to be applied on the group lockbox and the lock must stay in place for the duration of all work. ***Important:*** *the lead authorized worker must be the first to lock on, and the last to lock off, the energy isolating devices or group lockbox, with the following two exceptions: 1) authorized workers may lock on to the energy isolating devices or group lockbox to perform activities associated with establishing the lockout, such as zero voltage verification; 2) an administrative lock and tag may be applied to the energy isolating devices or group lockbox for the purpose of configuration control. Whenever an administrative lock and tag is used, the lead authorized worker retains responsibility for the integrity of the lockout, including re-verifying proper energy isolation if necessary prior to placing the master lock on the group lockbox.* *For either exception, no work may be performed under the lockout until the lockout is complete and the group lockout master lock and orange master lock tag are affixed to the group lockbox.* ▪ Signs Section 2 of the complex lockout permit indicating that the group lockout is complete and the system is safe to work
18.	Authorized worker	▪ Informs the lead authorized worker of intent to lock on to the group lockout ▪ Reviews the energy isolation plan, including associated drawings and/or sketches ▪ Optional: walks down energy isolation points to verify proper lockout ▪ Verifies all energy isolation plan steps are complete and signed off ▪ Verifies lead authorized worker approval in Section 2 of the complex lockout permit ▪ Verifies lead authorized worker master lock and orange master lock tag are applied to the group lockbox ▪ Subcontractor: verifies is authorized by supervisor to lock on to the lockout ▪ Signs on the group lockout permit and affixes a personal lockout lock and tag to the group lockbox. Each worker must apply his or her own personal LOTO lock. Never rely on another worker's lock. ▪ Re-verifies personal lock on lockbox at the beginning of each shift. ***Important:*** *authorized workers must complete this step each time they lock on.*

Step	Person	Action
19.	Lead authorized worker	Coordinates multiple work groups under group lockout **For work across multiple shifts** a lead authorized worker must be designated for each shift. All authorized workers on shift must be informed of this designation. Oncoming lead authorized workers must apply their own lock(s) to the energy isolating devices or, if used, the group lockbox. The off-going lead authorized worker will communicate with the oncoming lead authorized worker to ensure proper coordination of work scopes and work groups across multiple shifts. Oncoming lead authorized workers must stay locked on the energy isolating devices or, if used, the group lockbox until work on their shift has been discontinued, or until their lead duties have been transferred to another lead authorized worker.
20.	Authorized worker	▪ Performs work under group lockout ▪ Restricts equipment access in accordance with the arc-flash label(s) whenever there are exposed electrical parts ***Important:*** *the electrical worker in charge must control access to electrical equipment per the boundaries on the arc flash label.*
21.	Authorized worker	▪ Upon completion of work informs the lead authorized worker of intent to lock off ▪ Signs off the complex lockout permit ▪ Removes personal red lockout lock and tag from the group lockbox *Note: to lock back on repeats Step 18.*
22.	Lead authorized worker	Upon completion of work verifies all authorized workers have signed off the complex lockout permit and all authorized worker locks and tags have been removed
23.	Lead authorized worker	Checks the machine/equipment and surrounding area to ensure that non-essential objects have been removed, guards have been reinstalled, and that the machine/equipment is operationally intact
24.	Lead authorized worker	Verifies machine/equipment controls are in the NEUTRAL or OFF position
25.	Lead authorized worker	Verifies that all affected workers and authorized workers are out of harm's way
26.	Lead authorized worker	Removes group lockout master lock and tag from the group lockbox *Note: at this time the group lockout is no longer in effect.*
27.	Lead authorized worker	Removes personal red lockout locks from each energy isolation device in the reverse sequence from which they were installed ***Important:*** *if alternate sequencing is desired then a job-specific restoration plan must be prepared by a knowledgeable worker who is familiar with the equipment and work scope.*
28.	Lead authorized worker	Before restarting machinery/equipment, notifies either *affected workers* that work is complete and that locks and tags have been removed or the equipment custodian, equipment owner, or system owner that the lockout is complete and that normal operations may proceed

3 Forms

The following are recommend templates. Equivalent forms may be used:

- Control of Hazardous Energy: Group Lockout Energy Isolation Plan Template (SLAC-I-730-0A10J-005). Template for creating group lockout energy isolation plans (EIPs); lists required elements of an energy isolation plan
- Control of Hazardous Energy: Complex Lockout Permit (SLAC-I-730-0A10J-006). Form for documenting lead authorized worker and sign on and sign off of workers for complex LOTO
- Control of Hazardous Energy: Tag Templates (SLAC-I-730-0A10J-003). Templates for creating tags

The following checklist is provided as guidance:

- Control of Hazardous Energy: Group Lockout Checklist (SLAC-I-730-0A10J-007). Checklist for completing a group lockout

4 Recordkeeping

The following recordkeeping requirements apply for this procedure:

- The supervisor or manager in charge of the work or operations group leader should retain the group lockout forms (energy isolation plan and complex lockout permit) for at least 12 months.

5 References

SLAC Environment, Safety, and Health Manual (SLAC-I-720-0A29Z-001)

- Chapter 51, "Control of Hazardous Energy"
  - Control of Hazardous Energy: General Requirements (SLAC-I-730-0A10S-004)
  - Control of Hazardous Energy: Hazard Analysis Procedure (SLAC-I-730-0A10C-002)
  - Control of Hazardous Energy: Simple Lockout Procedure (SLAC-I-730-0A10C-003)
  - Control of Hazardous Energy: Zero Voltage Verification Procedure (SLAC-I-730-0A10C-004)

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Chapter 51: Control of Hazardous Energy

Zero Voltage Verification Procedure

Product ID: 444 | Revision ID: 2307 | Date published: 18 June 2021 | Date effective: 18 June 2021
URL: https://www-group.slac.stanford.edu/esh/eshmanual/references/coheProcedZVV.pdf

1 Purpose

The purpose of this procedure is to place equipment in an electrically safe work condition in accordance with National Fire Protection Association (NFPA) 70E, "Standard for Electrical Safety in the Workplace" (NFPA 70E). It covers *zero voltage verification (ZVV)* when a lockout is being performed; it must be followed in all cases in which an electrical hazard exists and the equipment or system must be *de-energized* and locked out before work is performed. It applies to *authorized workers* and *qualified electrical workers*.

Workers who perform ZVV must have met the training requirements in Chapter 51, "Control of Hazardous Energy", and be able to

- Distinguish exposed live parts of electrical equipment
- Determine the nominal voltage of exposed live parts
- Know the approach boundaries specified in NFPA 70E
- Identify and avoid electrical hazards associated with electrical equipment and work methods

In most instances, verifying zero voltage/energy involves crossing the *arc flash protection boundary* and *limited approach boundary* of exposed electrical parts. A special work plan or an energized electrical work permit is not required as long as proper safe work practices and personnel protective equipment (PPE) are used and **no physical work** is performed. (See Chapter 8, "Electrical Safety".)

2 Procedure

Step	Person	Action
1.	Authorized worker	Before beginning service and maintenance tasks under a lockout procedure, requests zero voltage verification
2.	Qualified electrical worker	Identifies electrical hazards and required controls ▪ Determines all electrical energy sources ▪ If non-electrical hazardous energies are present, coordinates with an authorized worker to ensure they are identified ▪ Conducts a field survey to verify the accuracy of the documentation and correct any discrepancies ▪ Reads all arc flash and other warning labels posted on the equipment ▪ Gathers all test meters and test voltage sources

Step	Person	Action
		▪ Dons the personal protective equipment (PPE) stipulated on the arc flash hazard label and any additional required PPE
3.	Authorized worker	Notifies all *affected workers* of the intent to de-energize the equipment
4.	Authorized worker and qualified electrical worker	De-energizes the equipment ***Important:*** *only SLAC qualified electrical workers may perform switching of electrical equipment.* ▪ Electrical worker: wears appropriate PPE for the arc flash and voltage hazards as indicated on the warning and danger labels ▪ Electrical worker: turns equipment off. Opens the energy disconnect / isolation device. Attempts to operate the equipment and verifies it does not operate. **For equipment with viewing window**, verifies all blades are fully open. Switchgear-type breakers must be opened and racked out to the fully disconnected position. Rackable motor control center (MCC) buckets must be fully withdrawn with the breaker open. Multiple locks may be necessary to lock the both the breaker/bucket and the racking mechanism. ▪ Authorized worker: once it is determined that equipment will not operate, locks and tags energy isolating / disconnect devices following the appropriate lockout/tagout procedure ▪ Electrical worker: discharges and grounds all energy storage components The equipment is now de-energized but not yet in an electrically safe condition.
5.	Qualified electrical worker	Performs zero voltage verification of **all circuit elements and electrical parts to which workers may be exposed** using appropriately rated test meter(s) ▪ If not already locked on, apply a personal lockout lock(s) to the energy isolation device(s) or group lockout device ▪ With a known good voltage source ensures the test meter is working ▪ Tests all phase conductors or exposed circuit parts from phase to ground and then from phase to phase ▪ Retests the test meter with the voltage source ▪ If the electrical worker will not perform work under the lockout, then remove any personal lockout locks that were applied in the first bullet of this step. All energy isolation locks must remain in place. The equipment is now in an electrically safe condition. **For an AC circuit** perform an AC pre-test and post-test; for a DC circuit perform a DC pre-test and DC post-test. ***Important:*** *if the lockout is modified the original lockout and original zero voltage verifications are no longer valid. A new lockout is required and new zero voltage verifications must be performed when establishing the new lockout.* *Note: electrical workers should use a proximity tester or other voltage testing device to periodically confirm absence of voltage at the work location (liberal use of "test before touch") including after pauses in work or if the work site has be left unattended.*

3 Forms

The following forms are required by this procedure:

- None

4 Recordkeeping

The following recordkeeping requirements apply for this procedure:

- None

5 References

SLAC Environment, Safety, and Health Manual (SLAC-I-720-0A29Z-001)

- Chapter 51, "Control of Hazardous Energy"
  - Control of Hazardous Energy: General Requirements (SLAC-I-730-0A10S-004)
  - Control of Hazardous Energy: Simple Lockout Procedure (SLAC-I-730-0A10C-003)
  - Control of Hazardous Energy: Group Lockout Procedure (SLAC-I-730-0A10C-006)
- Chapter 8, "Electrical Safety"

Other Documents

- National Fire Protection Association (NFPA) 70E, "Standard for Electrical Safety in the Workplace" (NFPA 70E)

ENVIRONMENT, SAFETY & HEALTH DIVISION

Chapter 51: Control of Hazardous Energy

Authorized Worker Certification Procedure

Product ID: 449 | Revision ID: 2610 | Date published: 22 April 2024 | Date effective: 22 April 2024
URL: https://www-group.slac.stanford.edu/esh/eshmanual/references/coheProcedWorkerCert157PRA.pdf

1 Purpose

The purpose of this procedure is to ensure that each authorized worker is familiar with the SLAC control of hazardous energy (CoHE) program, understands their responsibilities under the program, and demonstrates proper lockout technique and lockout procedure compliance when performing a lockout.

This procedure covers certifying authorized workers.

It applies to workers, supervisors, CoHE assessors, and SLAC Training.

Important Only workers who have completed this certification process are considered authorized to perform lockouts and only for the types of lockout for which they are certified. Workers must be re-certified each year following this same process.

2 Procedure

A worker must complete this procedure before first performing lock and tag at SLAC, then annually.

2.1 Prerequisites

Before beginning this process, the worker must have been assigned and completed the following courses:

- ESH Course 431, Human Performance Improvement (HPI) Tools for Workers (ESH Course 431)
- ESH Course 432, Hazard Recognition and Risk Tolerance Seminar (ESH Course 432)
- ESH Course 157, Control of Hazardous Energy (ESH Course 157) or ESH Course 157R, Control of Hazardous Energy (CoHE) Refresher (ESH Course 157R)

The worker must also view the computer-based Master Lock Lockout/Tagout video.

The worker must become familiar with Chapter 51, "Control of Hazardous Energy", and review in particular the following:

- General Requirements
- Hazard Analysis Procedure
- Simple Lockout Procedure
- Simple Lockout Checklist

- Group Lockout Procedure
- Group Lockout Checklist
- Group Lockout Energy Isolation Plan Template
- Zero Voltage Verification Procedure
- Complex Lockout Permit
- Equipment-specific Lockout Procedure (ELP) Template

2.2 Procedure

Step	Person	Action
1.	Supervisor	Assigns either ▪ ESH Course 157PRA, for authorized workers establishing or leading a lockout, or ▪ ESH Course 157JN, for authorized workers who are only joining, not establishing a lockout
2.	Supervisor	Completes the Control of Hazardous Energy: Request for Authorized Worker Certification Form Checks one or more types of lockout the worker will be participating in: ▪ **Simple lockout.** Worker will be applying a single lock on an energy isolation point for equipment with a single energy source, without hazardous stored energy and with no potential to release a hazardous material. ▪ **Group lockout.** Worker will be joining an established group lockout, not applying their own personal locks to equipment. ▪ **Complex lockout.** Worker will be deploying multiple locks on a piece of equipment following an approved plan for energy isolation. ▪ **Lead authorized worker.** Worker will be serving as the lead authorized worker on a group or complex lockout.
3.	Supervisor	Sends completed request for certification form to the worker
4.	Worker	Contacts an assessor in their department to arrange the practical
5.	Worker and assessor	Schedule practical
6.	Worker	Brings to the practical ▪ Completed request for certification form ▪ Own personal lock and tag
7.	Worker	Attests that their personal LOTO locks have only one key Follows the assigned procedure and properly locks out equipment or applies a personal LOTO lock and tag to a group lockbox
8.	Assessor	Leads discussion, ensuring all applicable topics are covered Confirms, through discussion and observation, that the worker is knowledgeable in the SLAC CoHE / LOTO program and understands their responsibilities
9.	Assessor	Completes the Control of Hazardous Energy: Authorized Worker Certification Form

Step	Person	Action
		Following instructions on the certification form, submits the completed request for certification and certification forms
10.	SLAC Training	Credits the worker for completed 157PRA or 157JN

3 Forms

The following forms and systems are required by this procedure:

- Control of Hazardous Energy: Request for Authorized Worker Certification Form (SLAC-I-730-0A10J-010). Form for requesting certification of authorized workers
- Control of Hazardous Energy: Authorized Worker Certification Form (SLAC-I-730-0A10J-004). Form for certifying authorized workers on assigned lockout/tagout procedures (restricted access, available form the Control of Hazardous Energy Program Site [SharePoint])
- CoHE Assessor List. List of CoHE assessors by department (available form the Control of Hazardous Energy Program Site [SharePoint])

4 Recordkeeping

The following recordkeeping requirements apply for this procedure:

- Certification records and completed forms are maintained by the control of hazardous energy program manager.
- SLAC Training maintains the training records.

5 References

SLAC Environment, Safety, and Health Manual (SLAC-I-720-0A29Z-001)

- Chapter 51, "Control of Hazardous Energy"
  - Control of Hazardous Energy: General Requirements (SLAC-I-730-0A10S-004)
  - Control of Hazardous Energy: Hazard Analysis Procedure (SLAC-I-730-0A10C-002)
  - Control of Hazardous Energy: Simple Lockout Procedure (SLAC-I-730-0A10C-003)
  - Control of Hazardous Energy: Simple Lockout Checklist (SLAC-I-730-0A10J-008)
  - Control of Hazardous Energy: Group Lockout Procedure (SLAC-I-730-0A10C-006u)
  - Control of Hazardous Energy: Group Lockout Checklist (SLAC-I-730-0A10J-007)
  - Control of Hazardous Energy: Group Lockout Energy Isolation Plan Template (SLAC-I-730-0A10J-005)
  - Control of Hazardous Energy: Zero Voltage Verification Procedure (SLAC-I-730-0A10C-004)
  - Control of Hazardous Energy: Complex Lockout Permit (SLAC-I-730-0A10J-006)

- Control of Hazardous Energy: Equipment-specific Lockout Procedure (ELP) Template (SLAC-I-730-0A10J-001)
- Control of Hazardous Energy Program Site (SharePoint)

Other SLAC Documents

- SLAC Training Assignment (STA)
- ESH Course 157, Control of Hazardous Energy (ESH Course 157)
- ESH Course 157R, Control of Hazardous Energy (CoHE) Refresher (ESH Course 157R)
- ESH Course 157PRA, Control of Hazardous Energy Practical (ESH Course 157PRA)
- ESH Course 157JN, Joining Established Group Lockout/Tagout for Authorized Workers Practical (ESH Course 157JN)
- ESH Course 431, Human Performance Improvement (HPI) Tools for Workers (ESH Course 431)
- ESH Course 432, Hazard Recognition and Risk Tolerance Seminar (ESH Course 432)
- Master Lock Lockout/Tagout video

NATIONAL ACCELERATOR LABORATORY

ENVIRONMENT, SAFETY & HEALTH DIVISION

Chapter 51: Control of Hazardous Energy

Request for Authorized Worker Certification Form

Product ID: 772 | Revision ID: 2677 | Date Published: 22 April 2024 | Date Effective: 22 April 2024

URL: https://www-group.slac.stanford.edu/esh/eshmanual/references/coheFormWorkerCertRequest157PRA.pdf

The purpose of this form is to document the request for certification of authorized workers. It is to be completed by the worker's supervisor. The completed form is to be brought by the worker to the practical, submitted by the CoHE assessor along with the certification form, and maintained by the control of hazardous energy program manager. (See the Control of Hazardous Energy: Authorized Worker Certification Procedure [SLAC-I-730-0A10C-005]).

Process

1. Supervisor assigns as supervisor required or mandatory either:
   - ESH Course 157PRA, Control of Hazardous Energy Practical (ESH Course 157PRA), for authorized workers establishing or leading a lockout, or
   - ESH Course 157JN, Joining Established Group Lockout/Tagout for Authorized Workers Practical (ESH Course 157JN), for authorized workers who are only joining, not establishing a lockout
2. Supervisor completes this form and sends it to the worker
3. Worker contacts an assessor in their department to arrange the practical; brings to the practical
   - This completed form
   - Their own personal lock and tag
4. Worker and assessor conduct the CoHE LOTO practical assessment
5. Assessor completes the Authorized Worker Certification Form
6. Assessor submits this form and the Authorized Worker Certification Form to SLAC Training
7. SLAC Training credits the worker for completed 157PRA or 157JN

Section 1: Supervisor Training
It is strongly recommended that supervisors understand the training and requirements for ESH Course 157. Check this box if you have completed the class. ☐ I have completed ESH Course 157, Control of Hazardous Energy

Section 2: Worker Training	
I am requesting the following be certified as a CoHE worker, authorized to apply locks and tags under the SLAC control of hazardous energy (CoHE) / lockout/tagout (LOTO) program:	
Worker name *(print)*	SLAC System ID (SLAC Directory)
The worker has the following courses on their STA as supervisor required or mandatory and is current in the training: ☐ ESH Course 431, Human Performance Improvement (HPI) Tools for Workers ☐ ESH Course 432, Hazard Recognition and Risk Tolerance Seminar ☐ ESH Course 157, Control of Hazardous Energy Additional electrical safety training if applicable to worker's authorized work: ☐ ESH Course 251, Electrical & General Safety Awareness for R&D **or** ☐ ESH Course 274, Electrical Safety – Low / High Voltage Training	
The worker has one of the following practical courses assigned on their STA as supervisor required or mandatory. *(check one)* For authorized workers establishing or leading a lockout ☐ ESH Course 157PRA, Control of Hazardous Energy Practical (ESH Course 157PRA) For authorized workers who are only joining, not establishing a lockout	

Section 2: Worker Training
☐ ESH Course 157JN, Joining Established Group Lockout/Tagout for Authorized Workers Practical (ESH Course 157JN)
The worker is being certified for the following types of lockout: *(check all that apply)* ☐ Simple lockout *Worker may be applying a single lock on an energy isolating point for equipment with a single, readily identifiable energy source with no potential for stored energy and no potential to release a hazardous material.* ☐ Group lockout *Worker will be joining an established lock box group LOTO and will not be applying their personal locks on individually locked-out equipment.* ☐ Complex lockout *Worker will be deploying multiple locks on a piece or pieces of equipment following an approved energy isolation plan.* ☐ Lead authorized worker *Worker will serve as the lead authorized worker on a group or complex lockout.*

Section 3: Supervisor Approval
Supervisor name *(print)*
Signature
Date

Sample form, see URL at top of page