Fermilab

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Memorandum

November 11, 2005

To: Gerald Brown

From: William Griffing

Subject: Revised FESHM Chapter 5120 – FERMILAB ENERGY CONTROL PROGRAM (LOCKOUT/TAGOUT)

Enclosed you will find revised FESHM Chapter 5120, FERMILAB ENERGY CONTROL PROGRAM (LOCKOUT/TAGOUT)" has been revised. The changes were made in the Group LOTO section, and well as to update the reference section. Specific requirements that are unique to electrical LOTO will be placed in FESHM 5048, which is currently undergoing revision.
The Electrical Safety Subcommittee has reviewed and concurred on the changes. Since the changes did not establish new policy, a site wide review is not necessary.

After final approval, please return this approval page to Elizabeth May at MS119 for posting on the web.

Encl.

Recommended for Approval:

Gerald Brown — Date 11/14/2005

Approved:

Piermaria Oddone — Date 11/14/05

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FERMILAB ENERGY CONTROL PROGRAM (LOCKOUT/TAGOUT)

1. INTRODUCTION

The servicing and/or maintenance of machines and equipment are frequent activities that can be hazardous. The related hazards may include energized electrical circuits, capacitors or batteries; pneumatic or hydraulic systems; the mechanical movement of levers, presses, pump shafts or fan blades; vacuum vessels or chambers; and pressurized fluids released from tanks, pipes or valves. Fermilab is required to establish an energy control program and to utilize procedures for applying appropriate lockout devices or tagout devices to energy isolating devices, and to otherwise disable machines or equipment to prevent the unexpected energization, start-up or release of stored energy in order to prevent injury to employees.

This Chapter establishes the Fermilab Energy Control Program. This Program may also be referenced as the Fermilab Lockout/Tagout Program or more simply as the LOTO Program. Important elements of the LOTO Program include energy control procedures, employee training and periodic inspections. Adherence to the requirements and procedural steps outlined in this Chapter are essential to the safety of all employees and the overall success of the Fermilab Safety Program.

2. PURPOSE

The purpose of this Chapter is:

- To establish a Fermilab Energy Control Program in compliance with referenced documents
- To establish procedures for applying appropriate lockout devices or tagout devices to energy isolating devices
- To describe the procedural steps to be followed by the Authorized Employee who must control the release of hazardous energy during servicing and/or maintenance of machines and equipment
- To describe the evaluation necessary to determine whether or not a written lockout/tagout procedure is required
- To present guidelines for the Knowledgeable Employee, who shall prepare written lockout/tagout procedures
- To outline the requirements for training and retraining of personnel relative to the Program
- To describe necessary periodic inspections

3. APPLICATION

This LOTO Program Does Apply:

- To the control of hazardous energy during the servicing and/or maintenance of machines and equipment where the unexpected energization, start-up or release of stored energy could reasonably be expected to cause injury to personnel
- To work activities on or near electrical conductors, circuits or equipment which are or may be energized and where there is significant potential for electrical shock or other injuries from arcing, flash burns, electrical burns or arc blast
- To the servicing or maintenance that takes place during normal production operations if the employee is required to remove or bypass a guard or other safety device, or if the employee 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

This LOTO Program Does Not Apply:

- To work on cord and plug connected electric equipment when the plug is under the exclusive control of the employee performing the servicing or maintenance, and when unplugged contains no hazardous stored energy and cannot be unexpectedly energized or started up
- To general access to accelerator or beamline enclosures under controlled or supervised access provided that the employee is not working on or in close proximity to exposed electrical conductors that are de-energized and locked out by the enclosure access procedures
- To minor tool changes and adjustments, and other minor servicing activities, which take place during normal production operations, provided that they are routine, repetitive, and integral to the use of the equipment for production and that the work is performed using alternative measures which provide effective protection
- To installations under the exclusive control of electric utilities for the purpose of power generation, transmission, and distribution, included related equipment for communication or metering
- To exposure to electrical hazards from work on, near, or with conductors or equipment that involves inspection or testing activities, or that involve energized work activities as covered by Fermilab ES&H Chapters 5041 and 5042
- To hot tap operation involving transmission and distribution systems for substances such as gas, steam, water, or petroleum products when they are

performed on pressurized pipelines, provided that Fermilab demonstrates that: 1) continuity of service is essential, 2) shutdown of the system is impractical, 3) documented procedures are followed and special equipment is used that will provide proven effective protection for employees
- When Fermilab can conclusively demonstrate that de-energizing introduces additional or increased hazards or is infeasible due to equipment design or operational limitations

4. DEFINTIONS

Affected Employee

An employee whose job requires him/her to operate or use a machine or equipment on which servicing or maintenance is being performed under lockout or tagout, or whose job requires him/her to work in an area in which such servicing or maintenance is being performed.

Authorized Employee

An authorized employee is one who:

- Locks out or tags out machines or equipment in order to perform servicing, maintenance or modification on that machine or equipment
- Is authorized by line management to perform the work
- Is qualified by training and experience to perform such work
- Is able to identify the hazards associated with such work
- Is responsible for determining whether or not a written procedure exists for the LOTO activity
- For the case of a written procedure, is trained in the use of the written procedure.

Capable of Being Locked Out

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

Employee

The term employee or personnel as related to the Fermilab Energy Control Program includes Fermilab employees, term and temporary employees, contract technicians, users, experimenters, graduate students, experimental collaborators, visiting or guest scientists and engineers, and DOE Fermi Site Office employees.

Energized

Connected to an energy source or containing residual or stored energy.

Energy Isolating Device

A mechanical device that physically prevents the transmission or release of energy, including but not limited to the following:

- Manually operated electrical circuit breaker
- Disconnect switch
- 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
- Line valve
- Block
- Any similar device used to block or isolate energy.

Push buttons, selector switches and other control circuit type devices are not energy isolating devices. An interlock system may not be considered as an energy isolating device with respect to LOTO activities.

Energy Source

Any source of electrical, mechanical, hydraulic, pneumatic, chemical, thermal, or other energy.

Exclusive Control

As applied to the LOTO exemption for working on cord and plug electrical equipment, exclusive control means that the plug is within sight and reach of the employee so as to preclude the possibility of its being plugged into an energy source.

Hot Tap

A procedure used in the repair, maintenance, and service activities that involves welding on a piece of equipment (pipelines, vessels, or tanks) under pressure, in order to install connections or appurtenances. It is commonly used to replace or add sections of pipeline without the interruption of service for air, gas, water, steam, and petrochemical distribution systems.

Job Lockbox

A container or device into which one or more keys from locks used in LOTO activities are captured by all members of a work crew by the attachment of their own locks and tags.

Knowledgeable Employee

An employee who assesses the energy source(s) subject to lockout/tagout, and who writes the procedural steps for the lockout and tagout of the machine or equipment being assessed. This employee has sufficient understanding of the operation and configuration of the machine or equipment so as to fully identify and evaluate its associated hazards.

Lead Authorized Employee

A lead authorized employee is an authorized employee who performs or coordinates one or more LOTO activities for multiple personnel involved in the servicing and/or maintenance of machines and equipment.

Lockout

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

Lockout Device

A device that utilizes a positive means, such as a keyed lock, to hold an energy isolating device in a safe position and prevent the energizing of a machine or equipment. Included are blank flanges and bolted slip binds.

Servicing and/or Maintenance

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

Supervised LOTO

The placement of lockout and tagout devices on an energy isolating device by an employee or non-employee who has not completed the Fermilab course for LOTO Level 2 when under the direct supervision of a Fermilab authorized employee.

Tagout

The placement of a tagout device on 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.

Tagout Device

A prominent warning device, such as a tag and means of attachment, which 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.

5. GENERAL REQUIREMENTS

5.1 All employees at the Laboratory shall comply with the Fermilab Energy Control Program as described in this Chapter. **Disciplinary action shall be taken, up to and including termination, for any unauthorized removal of or failure to use locks and/or tags for the control of hazardous energy sources.**

5.2 Deviations from the requirements of this Chapter shall only be permitted with the written approval of the area Division/Section Head. Such deviations are often formalized in written procedures that are approved by the area Division/Section Head.

5.3 Machines and equipment shall be physically isolated from sources of energy at an energy isolating device before performing servicing and/or maintenance activities to prevent the unexpected energization, start-up or release of stored energy in order to prevent injury to employees. (Reference Section 3 for exceptions.) Physical isolation requires that the positive control point be locked out and tagged out wherever possible.

5.4 When the energy isolating device is not capable of being locked out, the machine or equipment shall be turned OFF and tagged out in accord with the requirements of this Chapter. When using only a tagout device to control the energy isolating device, additional steps such as barricades, blocking of a controlling switch, removal of an isolating circuit element, or the posting of personnel shall be taken to increase the overall level of safety equivalent to that of a lockout. If at all reasonable, the machine or equipment should be modified to accept a lockout device at the energy isolating device as soon as possible.

5.5 Whenever replacement or major repair, renovation or modification of a machine or equipment is performed, and whenever new machines or equipment are installed, energy isolating devices for such machine or equipment shall be designed to accept a lockout device.

5.6 Fermilab supervisory personnel, and in particular Department Heads or Group Leaders, shall determine, with the assistance of knowledgeable personnel, whether or not a written LOTO procedure is required for particular servicing and/or maintenance work activities. If so required, such supervisors shall ensure that the

written procedure be drafted, approved, made available, and that selected authorized employees be trained in the use of the written procedure.

5.7 An authorized employee may perform a Written LOTO Procedure only if trained in the use of that procedure. If a group lockout involves execution of a Written LOTO Procedure, members of the work group not actually performing the procedure need not be trained in the use of the particular Written LOTO Procedure.

5.8 Before performing a LOTO procedure, the authorized employee is responsible for determining whether or not a written procedure has been generated that applies to the LOTO activity at hand. If there is a written procedure and the authorized employee is trained in and authorized to use the procedure, he or she shall follow the written procedure. If there is no Written LOTO Procedure for the activity, the authorized employee shall follow the General LOTO Procedure described hereafter.

5.9 If the authorized employee encounters a work activity for which there is no Written LOTO Procedure, yet by personal knowledge or experience believes that there should be a written procedure, he or she shall bring the situation to the immediate attention of a supervisor for resolution before continuing the work activity.

5.10 During a planned electrical power outage, non-related work activities may be scheduled to occur during and in the area of the outage. When these other work activities involve the isolation of electrical energy, the applicable LOTO procedure shall be performed and completed at least thirty minutes before the planned onset of the outage. This requirement facilitates positive evidence of isolation at the verification step that is not otherwise possible due to the absence of the energy source during the outage.

6. LOCKOUT and TAGOUT DEVICES

The lockout and tagout devices of the Fermilab LOTO Program shall be singularly identified as described below. These devices shall be the only devices used for controlling energy and shall not be used for other purposes. Lockout and tagout devices shall be durable and capable of withstanding the environment to which they are exposed for the maximum period of time that exposure is expected.

The lockout device for the Fermilab LOTO Program shall be a uniquely keyed lock with a body that is RED in color. Red colored locks shall not be used for any purpose other than LOTO. Each lock shall have only a single key. If a lock is provided with more than one key, additional keys shall be destroyed or otherwise discarded. A non-red lock may be converted to a LOTO lock by application of red tape or red shrink-on tubing to the lock body. The use of combination type locks is not allowed. When multiple locks are required for a single LOTO activity, locks with a common key may be used. (The Fermilab Locksmith is capable of re-keying stockroom locks to a common key.)

The tagout device for the Fermilab LOTO Program shall be a plastic tag imprinted with "DANGER - DO NOT OPERATE". The tag shall be colored white, black and red and shall have a space for the authorized employee's name. The tag shall have a reinforced eyelet capable of accepting a lock shackle of 0.25 inch diameter. The "DANGER - DO NOT OPERATE" tags shall not be used for any purpose other than LOTO.

As a convenience, the following items are stocked by Fermilab for use in LOTO activities. Additional or equivalent items may be used and are often available through local Division/Section ES&H Departments.

- 1268-500500 Red Padlock, American Lock Co. 1107R.
- 2650-400300 DANGER DO NOT OPERATE Tag, Including Nylon Tie Attachment Device, Panduit PVT-41 or Equivalent.
- 2650-400400 DANGER DO NOT OPERATE Tag, Self-Laminating, Electromark 13704 or Equivalent.
- 2650-500000 Multiple Lockout Device Tree, Osborn OG-80 or Equivalent.

7. LOCKOUT and/or TAGOUT DEVICE APPLICATION

7.1 Lockout and/or tagout devices shall be applied to each energy isolating device only by authorized employees actually performing the servicing and/or maintenance work activity. (Reference Sections 7.10, 7.11, 9, and 14.2 for exceptions.)

7.2 Each authorized employee actually performing the servicing and/or maintenance work activity must apply his or her own lockout and/or tagout devices.

7.3 Lockout devices, where used, shall be applied in such a manner as to hold the energy isolating device in a "safe" or "off" position.

7.4 Tagout devices, where used, shall be applied in such a manner as will clearly indicate that the operation or movement of energy isolating devices from the "safe" or "off" position is prohibited.

7.5 When an authorized employee has applied a lockout device, he or she shall maintain exclusive control of the key to the lockout device.

7.6 When a lockout device is applied, a tagout device must also be applied to the lock shackle.

7.7 It is permissible to use only a tagout device when the energy isolating device is not capable accepting a lockout device. In such cases the machine or equipment shall be turned OFF and then tagged out. The tagout device shall be placed as close as possible to the energy isolating device and shall be securely attached so that it cannot be inadvertently detached during use. Reference Section 5.4 for additional requirements that apply when only a tagout device is used.

7.8 The tagout device must clearly and legibly display the name of the authorized employee applying the tagout device. The tagout device **may** also display a picture of the authorized employee, the date of application, and other information pertinent to the LOTO activity. The tagout device shall be securely attached when applied. The use of string or tape for attachment is not allowed.

7.9 Only the authorized employee may remove his or her applied lockout and/or tagout device. (Reference Section 8 for exceptions.)

7.10 Fermilab supervisory personnel, including construction coordinators and task managers, may also apply lockout and/or tagout devices even though they are not actually performing the servicing, maintenance or construction work activity. Such supervisory applications of locks and/or tags do not relieve or replace the requirement that each authorized employee actually performing the servicing and/or maintenance work activity must apply his or her own lockout and/or tagout devices. These supervisory applications may be desirable for the purpose of overall work activity control, job safety, and of facilitating field inspections of work in progress.

7.11 Special situations may warrant an employee or non-employee who has not completed the Fermilab course for LOTO Level 2 having to perform LOTO for his or her own personal safety. In accommodation, an authorized employee may supervise the application of lockout and tagout devices to an energy isolating device by such individuals. This activity is referred to as "**Supervised LOTO**" and is subject to the following conditions:

- When the LOTO activity involves a written procedure, the authorized employee must perform the steps of the procedure and apply his or her own lockout and tagout devices
- When the LOTO activity involves a written procedure, the subject individual is not required to perform the specific steps, excepting LOTO device application and verification
- The machine or equipment is capable of accepting a lockout device
- The subject individual is briefed by the authorized employee on the major applicable tenets of the LOTO Program - especially with regard to lock key control and lockout and tagout device removal
- If the subject individual is an employee, he or she will be scheduled for the earliest available LOTO Level 2 training

An additional requirement to notify the area SSO of instances of Supervised LOTO is at the discretion of individual Divisions and Sections.

8. ALTERNATIVE REMOVAL OF LOCKS AND TAGS

Certain situations may arise where the authorized employee is not reasonably available to remove the lockout and/or tagout devices that he or she applied and where such

removal and the return to the availability of service of the machine or equipment becomes programmatically urgent. For such a case, supervisory personnel, preferably the authorized employee's direct supervisor, can take the following steps to achieve an alternative removal of the lockout and/or tagout devices.

- Take all reasonable efforts to contact the authorized employee and to confirm that he or she is not available.
- Obtain written approval from the area Division/Section Head or designee for the alternative removal of the lockout and/or tagout devices.
- Direct a suitably authorized employee to return the machine or equipment to the availability of service while following the normal procedural steps.
- Take appropriate steps to ensure that the authorized employee is aware that his or her lockout and/or tagout devices have been alternatively removed before the authorized employee resumes work activities at the Laboratory.
- Maintain a record of the alternative removal by keeping a copy of the Division/Section Head's written approval on file

For cases where supervisory personnel are able to verbally communicate with the authorized employee and where he or she is not reasonably available to remove their lockout and/or tagout devices, the following substitute steps can be taken to achieve an alternative removal of the lockout and/or tagout devices.

- Solicit verbal permission from the absent authorized employee for the alternative removal of their lockout and/or tagout devices.
- Discuss with the absent authorized employee any special steps to be taken or related concerns.
- Discuss the alternative removal with the area Division/Section Senior Safety Officer (SSO) or designee and solicit verbal permission to proceed.
- Once given permission from both the absent authorized employee and the area SSO, direct a suitably authorized employee to return the machine or equipment to the availability of service while following the normal procedural steps.
- Document and keep on file a record of the alternative removal

9. SUBCONTRACTOR ENERGY CONTROL PROGRAMS

Subcontractors, including vendors and outside servicing personnel, are required to have their own energy control program if their work activities involve the potential of injury to personnel by the unexpected energization, start-up or release of stored energy. Subcontractors are not required to adhere to the specific requirements of the Fermilab Energy Control Program except as noted below. Subcontractor programs and practices may differ minimally from Fermilab's Program or more substantially, as is the case for subcontractors involved in construction activities.

Employees are advised that the use of the "DANGER - DO NOT OPERATE" tagout device employed by the Fermilab LOTO Program is common to numerous subcontractor energy control programs.

Whenever subcontractors engage in activities at Fermilab that employ their own energy control program or encounter the Fermilab Energy Control Program, Fermilab and the subcontractor shall inform each other of the restrictions and prohibitions of their respective lockout and tagout procedures. Fermilab informs subcontractor personnel of its Program by means of the required Subcontractor Safety Orientation training. Subcontractor programs are submitted to the Fermilab Contract Administrator and are subsequently reviewed and accepted by the ES&H Section. Fermilab shall ensure that affected employees understand and comply with the restrictions and prohibitions of the subcontractor's energy control program.

While subcontractors are not required to adhere to the specific requirements of the Fermilab Energy Control Program, two exceptions are required. Designated subcontractors and their employees for the Electrical Time and Material Subcontract and the Heating and Ventilation Service Time and Material Subcontract shall adhere to the specific requirements of the Fermilab Energy Control Program. This requirement stems from the frequency with which these subcontractors perform LOTO activities and the large associated group of affected employees. Fermilab shall provide, at no cost to these two T&M subcontractors, LOTO Level 2 training for these subcontractor employees.

As has been stated, Fermilab supervisory personnel, including construction coordinators and task managers, may apply lockout and/or tagout devices even though they are not actually performing the servicing, maintenance or construction work activity. Such applications by Fermilab employees are to be in accord with the Fermilab Program rather than the subcontractor's program, if different. The subcontractor shall be specifically informed of each such application.

10. WRITTEN LOTO PROCEDURE

Particular servicing and/or maintenance work activities may be subject to the specific requirements of a Written LOTO Procedure rather than those of the General LOTO Procedure. Written LOTO procedures may be appropriate in accord with machine or equipment complexity, magnitude of encountered hazards, supervisory discretion, or other factors. Additionally and in particular, a Written LOTO Procedure is required for a particular machine or equipment when any of the following elements exist.

1. The machine or equipment has potential for stored or residual energy or re-accumulation of stored energy after shutdown which could endanger employees.
2. The machine or equipment has more than one energy source.

3. The machine or equipment has only a single energy source, but it cannot be readily identified and isolated.
4. The isolation and locking out of the single energy source will not completely de-energize and deactivate the machine or equipment.
5. The machine or equipment is not isolated from that energy source and locked out during servicing or maintenance.
6. A single lockout device will not achieve a locked-out condition.
7. The lockout device is not under the exclusive control of the authorized employee performing the servicing or maintenance.
8. The servicing or maintenance does create hazards for other employees.
9. There have been past incidents involving the unexpected activation or re-energization of the machine or equipment during servicing or maintenance.

The Written LOTO Procedure shall be drafted by one or more knowledgeable employees and approved by a line manager at the Department Head level or higher. Such procedures shall include all elements of the General LOTO Procedure described hereafter, be operationally particular in related actions to be taken, and specifically address the particular element(s) that cause or demand that the procedure be written. The elements of Return to Service, also described hereafter, should be included in the procedure, especially if special actions or precautions are to be taken. It is suggested that the written procedure be in a sequential checklist format to enhance its proper performance.

For cases where the machine or equipment has potential for stored or residual energy or re-accumulation of stored energy after shutdown, the procedure shall address how such energy shall be relieved, disconnected, restrained, or otherwise rendered safe following the application of lockout or tagout devices to energy isolating devices. If there is a possibility of re-accumulation of stored energy to a hazardous level, verification of isolation shall be required to be continued until the servicing or maintenance is completed, or until the possibility of such accumulation no longer exists.

A single Written LOTO Procedure is allowed for multiple machines or pieces of equipment that are similar in design, have the same type and magnitude of energy to be controlled, and have similar types of controls.

If machinery or equipment is altered in a manner that impacts its Written LOTO Procedure, the procedure shall be revised accordingly.

Written LOTO Procedures must be reviewed annually in accord with Section 17. Those authorized employees who are trained in and authorized to use a Written LOTO Procedure must also be re-certified annually.

11. GENERAL LOTO PROCEDURE

If there is no written procedure relating to a particular servicing and/or maintenance work activity, the authorized employee shall follow the here described General LOTO Procedure. This procedure requires that the authorized employee shall perform the following six steps to lock out and tag out machinery or equipment before initiating the work activity.

NOTIFY: The authorized employee or Fermilab shall, as necessary, notify affected employees of the impending shutdown of machinery or equipment and of the application of lockout devices or tagout devices.

PREPARE: The authorized employee shall understand the type and magnitude of the energy, the hazards of the energy to be controlled, and the method or means to control the energy.

SHUTDOWN: The machine or equipment shall be turned off or shutdown using the procedures established for the machine or equipment. An orderly shutdown must be utilized to avoid any additional or increased hazard(s) to employees as a result of the equipment stoppage. If the machine or equipment is already shutdown, it may be beneficial to re-energize or turn it on so as to positively identify the connection to the energy isolating device. Such re-energization should be performed only if there is no additional or increased hazard(s) to employees or danger of damage to the machine or equipment.

ISOLATE: The energy isolating device that is needed to control the energy to the machine or equipment shall be physically located and operated in such a manner as to isolate the machine or equipment from the energy source.

LOCKOUT and/or TAGOUT DEVICE APPLICATION: Lockout and/or tagout devices shall be applied to the energy isolating device by the authorized employee.

VERIFY: The authorized employee shall check by conclusive test that the source of energy has actually been isolated and that the machine or equipment is inoperable. If applicable or reasonable, use the normal operating controls to attempt to start the machine or equipment and then return these controls to the "safe" or "off" positions.

Verification is the most critical step of the LOTO procedure.

The machine or equipment is now locked out and/or tagged out and the servicing and/or maintenance activity may be performed.

12. RETURN TO SERVICE

Before energy is restored to the machinery or equipment after the servicing and/or maintenance work activity, the authorized employee shall perform the following five steps.

CHECK EQUIPMENT: The work area shall be inspected to ensure that nonessential items have been removed and to ensure that machine or equipment components are operationally intact.

CHECK WORK AREA: The work area shall be checked to ensure that all employees have been safely positioned or removed.

VERIFY: Verify that the machine or equipment controls are in the "safe" or "off" position.

REMOVE LOCKOUT and/or TAGOUT DEVICES: Each lockout or tagout device shall be removed from each energy isolating device by the authorized employee who applied the device.

NOTIFY: Before the machine or equipment is started, notify affected employees that lockout and/or tagout devices have been removed.

The servicing and/or maintenance and LOTO activities are now complete and machine or equipment is now ready for service. The source of energy may now be connected if appropriate.

13. TEMPORARY REMOVAL OF LOCKS AND TAGS FOR TESTING OR POSITIONING

In situations where lockout or tagout devices must be temporarily removed from the energy isolating device(s) and the machine or equipment energized to test or position the machine, equipment, or component thereof, the Return to Service procedure shall be followed before energization. After testing or positioning, the steps of the Written or General LOTO Procedure shall then be followed. Unless warranted, the "Notify" steps of these procedures need not be performed for such temporary removals of LOTO devices.

14. GROUP LOTO PROCEDURES

Servicing or maintenance activities frequently involve two or more employees performing the work activity. While each employee is required to apply LOTO devices, it is impractical to demand that each employee always explicitly perform each procedural step. Two types of group LOTO procedures are available to address such situations. Both involve a designated lead authorized employee who performs or coordinates one or more LOTO activities. The lead authorized employee is responsible for coordinating work forces and ensuring continuity of protection when more than one

crew, craft, department, etc. is involved. The other participants of a group lockout shall inform the lead authorized employee of any irregularities, restrictions or concerns during or at the conclusion of their specific work activity.

In all cases it is essential that each authorized employee of the group be satisfied that the personal safety provided by the group lockout is acceptable and equivalent to the safety provided by an individual lockout and tagout. Each authorized employee of the group has the right to verify individually that all hazardous energy sources have been isolated.

14.1 TYPE A GROUP LOCKOUT

In a Type A group lockout, the lead authorized employee performs the LOTO activity and each member of the work group shall apply a personal lockout and/or tagout device to the energy isolating device(s). If the energy isolating device(s) cannot accept multiple LOTO devices, a multiple lockout device tree should be used. These other members of the work group shall remove their LOTO devices after their work activity is completed.

14.2 TYPE B GROUP LOCKOUT

A Type B group lockout is meant to accommodate complex LOTO activities that may involve multiple pieces of equipment, multiple energy isolating devices, and/or multiple individuals performing the servicing and/or maintenance activities. The lead authorized employee performs or directs the performance of the LOTO activity. The associated key(s) are then captured in the job lockbox that is then secured with an additional lock and tag by the lead authorized employee so as to retain control of the captured key(s). Each member of the work group shall then apply their personal lockout and tagout device to the job lockbox. These other members of the work group shall remove their LOTO devices after their work activity is completed.

15. SHIFT OR PERSONNEL CHANGES

Normally, authorized employees may leave their lockout and/or tagout devices in place until the work activity is complete – even if the activity spans more than one day or a weekend.

In non-group lockouts, the work activity may need to be completed by another authorized employee. LOTO continuity is simply achieved by the off-going employee removing his or her LOTO devices immediately followed by the on-coming employee applying his or her LOTO devices. There must be direct communication between the two employees as to any special circumstances of the LOTO or work activity. All of the steps of the LOTO procedure performed before commencement of the work activity need not be repeated, but the on-coming employee shall verify that the machinery or equipment is de-energized before continuing the work activity.

In group lockouts, responsibilities of all members are specified in Section 14. Normally the job lockbox and captured keys remain under the singular control of the lead authorized employee for the duration of the work activity – even over shift and personnel changes. If absent, the lead authorized employee may designate another as "designated" lead authorized employee while retaining control of the job lockbox. Here, the lead authorized employee must return to enable the machinery or equipment to be returned to service.

Special circumstances may warrant the complete transfer of responsibility from the initial lead authorized employee to another lead authorized employee. Here the off-going and on-coming leads would simultaneously remove and apply their respective locks and tags to the job lockbox, thus insuring control of the captured keys. The on-coming lead would have authority to remove the lockout and tagout devices placed by the initial lead authorized employee. Such transfers must be documented and authorized by the area SSO or Division/Section Head.

Machinery or equipment that is initially shutdown with a LOTO procedure but remains unattended for significant periods of time and not ready for return to service should be considered for transfer to configuration control until the LOTO work activity resumes. Reference the "Configuration Control Policy" Appendix of this Chapter. After transfer to configuration control from LOTO control, the machinery or equipment must be controlled to and in a safe state.

16. TRAINING

Fermilab provides LOTO Level 1 and LOTO Level 2 training courses to ensure that the purpose and function of the Energy Control Program are understood by employees and that the knowledge and skills required for the safe application, usage, and removal of the energy controls are acquired by employees. All employees must be trained. LOTO Level 2 training is required for authorized employees. Additional on-the-job training may be required for the authorized employee for specific machinery or equipment before work is performed. Additional training is always required for the authorized employee to perform a specific Written LOTO Procedure.

16.1 LOTO Level 1 Training

All employees shall be trained:

- To know the definition of a lockout/tagout
- To recognize the locks and tags used at the Laboratory
- To recognize LOTO activities in their areas
- To understand the purpose and use of LOTO procedures
- To respect the locks and tags that have been placed by other employees
- To understand the consequences of unauthorized removal of locks and tags

16.2 LOTO Level 2 Training

Authorized employees shall be trained:

- In the elements of LOTO Level 1 training
- To recognize hazardous energy sources that may be encountered
- To know the type and magnitude of the energy available in the workplace
- To know the methods and means necessary for energy isolation and control
- To understand the limitations of using only tagout devices

16.3 Retraining

Retraining shall be required for individual authorized and affected employees whenever any of the following conditions exist.

- Significant changes in job assignments
- Significant changes in machines, equipment or processes that present a new hazard
- Significant changes in General or Written LOTO Procedures
- Reasons to believe that there are deviations from or inadequacies in the employee's knowledge or use of General or Written LOTO Procedures

17. PERIODIC INSPECTIONS and AUDITS

Divisions/Sections shall perform and document inspections at least annually to assure that each required Written LOTO Procedure continues to be implemented properly in accord with the Fermilab Energy Control Program. The periodic inspection shall consist of three parts.

17.1 Each required Written LOTO Procedure (ref. Section 10) shall be reviewed by a designated knowledgeable employee. Any mistakes, deviations from Program requirements, or inadequacies identified in this review of the procedure shall be corrected.

17.2 The Written LOTO Procedure shall then be reviewed with all employees authorized to perform the procedure. This review shall be performed by a designated authorized employee (the inspector) other than those authorized to perform the procedure being reviewed. The inspector shall ensure that each employee authorized to perform the procedure understands the procedure and is familiar with his or her responsibilities under the procedure.

17.3 The inspector shall observe a sampling of authorized employees performing the written procedure and shall discuss the implementation with all other authorized employees present. Any inadequacies or potential improvements identified relative to the procedure or its performance shall be noted and corrected.

The periodic inspection for a particular written procedure may need to be performed in more than one meeting if all those employees authorized to perform the procedure are not able to attend. The periodic inspection may serve as an occasion for re-certification of authorized employees or for training new employees in the use of the written procedure being inspected. Such inspections also provide an excellent opportunity to emphasize the importance and primary elements of the LOTO Program.

The Fermilab ES&H Section will conduct periodic audits of the Program as necessary.

18. RECORDS AND DOCUMENTATION

Divisions/Sections must certify that periodic inspections have been performed. Documentation must include the machine or equipment on which the energy control procedure was used, the date of the inspection, the employees included in the inspection, and the names of the knowledgeable and authorized employees performing the inspection. The attached Written LOTO Procedure sample form includes space to document an annual periodic inspection, though other methods of documentation are acceptable.

Documentation related to deviations to the requirements of this Chapter, to periodic inspections, to transfers of responsibility between lead authorized employees, or to the alternative removal of locks and tags shall be kept on file at the Division/Section office, the D/S ES&H Department, or other suitable locations. Such documentation shall be retained for the calendar year plus three additional years.

19. REFERENCED AND RELATED DOCUMENTS

The following documents in their most current form or edition are referenced or related to the Fermilab Energy Control Program.

29CFR1910.147 The Control of Hazardous Energy (Lockout/Tagout)
29CFR1910.301-399 Subpart S – Electrical
29CFR1926 Safety and Health Regulations for Construction
National Electrical Code NFPA 70
Standard for Electrical Safety in the Workplace NFPA 70E
Fermilab Environment, Safety and Health Manual
- Chapters in the 5030 Series relating to Pressurized Gas Safety
- Chapter 5041 Electrical Utilization Equipment Safety
- Chapter 5042 AC Electrical Power Distribution Safety
- Chapter 5048 Hazard Mitigation for Electrical Workers, Work Practices and Selection and Use of Personnel Protective Equipment
- Chapter 7010 Subcontractor Construction Safety Program

20. LOTO PROCEDURE EXAMPLES

Two examples are provided to offer guidance for the General and a specific Written LOTO Procedure. Both are in check list format. The Written LOTO Procedure example includes steps to isolate multiple energy sources and accommodation for the documentation of its periodic inspection.

FERMILAB GENERAL LOTO PROCEDURE

Perform the following steps before initiating work activity.

☐ **NOTIFY** Notify affected employees, as necessary, of the impending shutdown.

☐ **PREPARE** Understand the type, magnitude, hazards, and means and methods of controlling the energy involved.

☐ **SHUTDOWN** Turn off or shutdown the machine or equipment using normal procedures.

☐ **ISOLATE** Locate and operate the energy operating device to isolate the machine or equipment from the energy source.

☐ **LOCKOUT and/or TAGOUT DEVICE APPLICATION** Apply RED lock and DANGER – DO NOT OPERATE tag to energy isolating device.

☐ **VERIFY** Check by conclusive test that the source of energy has been isolated and that the machine or equipment is inoperable.

Perform work activity. When complete, perform the following steps for Return to Service.

☐ **CHECK EQUIPMENT** Remove nonessential items and ensure that machine or equipment components are operationally intact.

☐ **CHECK WORK AREA** Ensure that all employees are safely positioned or removed.

☐ **VERIFY** Verify that machine or equipment controls are in safe or off position.

☐ **REMOVE LOCKOUT and/or TAGOUT DEVICES** Locks and tags removed by employee(s) who placed them.

☐ **NOTIFY** As appropriate and before the machine or equipment is started, notify affected employees that locks and tags have been removed.

The LOTO activity is now complete. Machine or equipment is ready for service.

FERMILAB WRITTEN LOTO PROCEDURE (EXAMPLE)

V100 C Magnet Power Supply at MI-60 North Equipment Gallery

Knowledgeable Employee _____ *Department Head* _____
Prepared By Date Approved By Date

Reason for Written Procedure: Multiple Energy Sources and Past Failure of Capacitor Discharge Circuit

Perform the following steps before initiating work activity.

❒ **NOTIFY** Notify Main Control Room (x3721) of the impending shutdown.

❒ **PREPARE** 120 and 480 VAC electrical power sources to be isolated by circuit breakers. Prepare to check capacitor discharge circuit.

❒ **SHUTDOWN**
- ❒ Turn OFF Front Panel Controls
- ❒ Turn OFF 480 VAC main breaker of PS and interior 120 VAC breaker.

❒ **ISOLATE** Sourcing electrical panelboards are located at front and rear of power supply.
- ❒ Turn OFF 300A 480 VAC Circuit Breaker #20 at SWBD-MI60-5A
- ❒ Turn OFF 20A 120 VAC Circuit Breaker #15 at PP-MI60-4A-3A.

❒ **LOCKOUT and/or TAGOUT DEVICE APPLICATION** Apply locks and tags to above breakers.

❒ **VERIFY** Attempt to turn the power supply ON by use of normal front panel controls. Test the adequately rated voltage testing device for proper operation before use. The voltage testing activity of supply conductors has a Hazard/Risk Category of 2 and requires protective clothing with a minimum rating of 8 cal/cm^2. Check line side of the two power supply breakers in the power supply with a voltage meter to verify that ungrounded conductors are de-energized. Test voltage testing device for proper operation after use.

❒ **CHECK C12 CAPACITOR** Interior capacitor C12 normally operates at 100 VDC with a 10K ohm 1W discharge resistor across it. The resistor is prone to failure. Inspect the resistor for damage and measure the voltage across C12. Voltage should be less than 1 VDC.

Perform work activity. When complete, perform the following steps for Return to Service.

❒ **CHECK EQUIPMENT** Remove all tools from interior of PS. Close and secure doors to PS.

❒ **CHECK WORK AREA** Ensure that all employees are safely positioned or removed.

❒ **VERIFY** Verify that the power supply's controls are in the OFF position.

❒ **REMOVE LOCKOUT and/or TAGOUT DEVICES** Remove locks and tags from sourcing breakers and turn breakers ON.

❒ **NOTIFY**
- ❒ Notify the MCR (x3721) that the work on E:V100 is complete and that locks and tags have been removed.
- ❒ Ask the MCR Crew Chief if the power supply should be turned on and enabled locally.

FERMILAB WRITTEN LOTO PROCEDURE (EXAMPLE)

V100 C Magnet Power Supply at MI-60 North Equipment Gallery

TRAINED AUTHORIZED EMPLOYEES

The following employees, including those listed under the Periodic Inspection, have been trained in this procedure and are authorized to use it. Include date of training or re-certification.

PERIODIC INSPECTION

Written Procedure Review

_____

Knowledgeable Employee Date

Procedure Performance Review

_____

Performed By Date

Authorized Employees Included:

APPENDIX TO

FERMILAB ENERGY CONTROL PROGRAM (LOCKOUT/TAGOUT)

CONFIGURATION CONTROL POLICY

INTRODUCTION

This Appendix sets policy about administrative locks and/or tags used as configuration controls. Specifically, it sets policy regarding the selection, use, application and removal of these configuration controls used to prevent unauthorized access or operation of equipment or systems. Configuration control activity is often instrumental in controlling hazards; in avoiding accidental injury to employees or the public, or both; and in protecting property or equipment from damage.

LOCKOUT/TAGOUT vs CONFIGURATION CONTROL

In the broad sense, the lockout/tagout activities defined in FESHM Chapter 5120 can, and often do involve configuration control. However, LOTO activities are distinguished by the fact that employees (or subcontractors) are actively engaged in service or maintenance work where the isolation (i.e. configuration control) of an energy source directly protects them from injury. Briefly, the goal of LOTO is to protect employees and subcontractors performing work. LOTO is not at all concerned with the protection of property or equipment.

The activities of configuration control discussed here deal with other applications of locks and/or tags to control the state or operation of equipment or systems where individuals are not actively engaged in servicing or maintenance. Improper removal of these locks and/or tags may lead to accidental injury of personnel or the public, damage to equipment, disruption of normal process, or degradation of system performance.

Examples of configuration control include:

- Locking electrical equipment cabinets or vaults to prevent access by unqualified personnel
- Locking an access door to the top of an elevator shaft
- Locking out an overhead crane electrical disconnect to ensure use by only authorized personnel
- Locking and/or tagging of equipment while awaiting repair or replacement of a component part

- Locking and/or tagging of a valve to control the flow of fluids
- Locking and/or tagging of equipment or a system that is shut down for safety concerns or violations
- Locking a high voltage configuration switch in the 13.8 kV electrical distribution system to control the flow of electricity
- Locking a radioactive waste container to prevent unauthorized addition or removal of material

GENERAL REQUIREMENTS

Locks and tags used for configuration control are not a substitute for LOTO locks and tags. Configuration control locks and tags must be different from those used in the LOTO Program. Specifically, the use of red colored locks or "Danger – Do Not Operate" tags are prohibited for configuration control. The use of combination locks is allowed and keyed locks may have more than one key.

The use of locks without tags is allowed where their use is obvious or clearly understood by personnel who might need to remove the lock. Examples include the locking of magnet power supply doors and the locking of high voltage switchgear. Identification may be applied to the lock body. The use of tags without locks is also allowed.

Administrative or configuration control tags may include text indicating "Danger" (but not "Danger – Do Not Operate"), "Warning," or "Notice." CFR 1910.145 offers guidance on tag selection. Manila tags are acceptable. Yellow "Caution" tags are available from the Fermilab stockroom (Stock #2650-400600).

When used, tags must indicate the name and telephone number of the person or group placing the tag. When appropriate, tags should also indicate the date of application, reason for application, and conditions for removal.

Locks and/or tags should be applied at a positive control point and readily visible. The use of a multiple lockout device tree may be advised with certain lock applications. Tags should be durable and adequately attached.

Configuration control locks and/or tags are typically removed by the person or group who applied the devices after due consideration to the reason(s) for their application. Removal by other qualified and authorized personnel is permissible if there is assurance that the removal and subsequent change of configuration will not create an unsafe condition for individuals or equipment.

Individual Divisions and Sections may impose additional requirements pertinent to removal of configuration control locks and/or tags.