Fermilab

FESHCom
Electrical Safety Subcommittee

ESS Determination D2019-01 14 February 2019

Written versus Complex LOTO

Scope:

This determination applies to the Lockout / Tagout (LOTO) program of Fermi National Accelerator Laboratory, and is applicable to operations at the main site in Batavia, Illinois and any leased spaces. Where subcontractors are permitted to follow their own LOTO program and their program has been found to comply with 10 CFR 851 requirements, this determination does not apply.

Motivation:

Fermi Research Alliance (FRA) is required to comply with OSHA safety requirements for general industry as found in 29 CFR 1910 and with the requirements of NFPA 70E, *Standard for Electrical Safety in the Workplace* by the operations and maintenance contract with the U. S. Department of Energy. These two standards have differing requirements to permit LOTO to be performed without a documented LOTO procedure specific to the equipment or system to be placed under LOTO. Each standard contains conditions [29 CFR 1910.147(c)(4)(i) *Exception* and NFPA 70E [2018] 120.5(A)(5)(a)] that require the use of a documented procedure which do not appear in the other list, so it is not a simple matter of adopting the more stringent of the two. Also, the applicability of a standard for electrical hazards to other types of energy hazards is not clear, and attempting to adhere to both standards in situations where both electrical and other types energy hazards are present creates opportunities for non-compliance.

Determination:

The additional conditions for Complex LOTO found in NFPA 70E are adequately addressed by elements of the Fermilab LOTO program as found in FESHM Chapter 2100. Fermilab will continue to use the General and Written terminology from FESHM Chapter 2100 to differentiate situations in which a specific documented LOTO procedure is or is not required.

Background:

The list of conditions in the OSHA standard under which a specific documented LOTO procedure is required is found in 29 CFR 1910.147(c)(4)(i):

> Procedures shall be developed, documented and utilized for the control of potentially hazardous energy when employees are engaged in the activities covered by this section.
>
> Note: *Exception:* The employer need not document the required procedure for a particular machine or equipment, when all of the following elements exist:
> (1) The machine or equipment has no potential for stored or residual energy or re-accumulation of stored energy after shut down which could endanger employees;
> (2) the machine or equipment has a single energy source which can be readily identified and isolated;
> (3) the isolation and locking out of that energy source will completely deenergize and deactivate the machine or equipment;

(4) the machine or equipment is isolated from that energy source and locked out during servicing or maintenance;
(5) a single lockout device will achieve a locked-out condition;
(6) the lockout device is under the exclusive control of the authorized employee performing the servicing or maintenance;
(7) the servicing or maintenance does not create hazards for other employees; and

(8) the employer, in utilizing this exception, has had no accidents involving the unexpected activation or reenergization of the machine or equipment during servicing or maintenance.

The list of conditions in the 2018 edition of NFPA 70E under which a specific documented LOTO procedure is required is found in Article 120.5(A)(4 & 5):

(4) Simple Lockout/Tagout Procedure. All lockout/tagout procedures that involve only a qualified person(s) de-energizing one set of conductors or circuit part source for the sole purpose of safeguarding employees from exposure to electrical hazards shall be considered to be a simple lockout/tagout. Simple lockout/tagout procedures shall not be required to written for each application. Each worker shall be responsible for his or her own lockout/tagout.

(5) Complex lockout/tagout.

(a) A complex lockout/tagout procedures shall be permitted when one or more of the following exists:
(1) Multiple energy source
(2) Multiple crews
(3) Multiple crafts
(4) Multiple locations
(5) Multiple employers
(6) Multiple disconnecting means
(7) Particular sequences
(8) Job or task that continues for more than one work period

(b) All complex lockout/tagout procedures shall require a written plan of execution that identifies a person in charge.

(c) The complex lockout/tagout procedure shall vest primary responsibility in an authorized employee for the employees working under the protection of a group lockout or tagout device, such as an operation lock or lockbox. The person in charge shall be held accountable for safe execution of the lockout/tagout.

(d) Each authorized employee shall affix a personal lockout or tagout device to the group lockout device, group lockbox, or comparable mechanism when he or she begins work and shall remove those devices when he or she stops working on the machine or equipment being serviced or maintained.

(e) All complex lockout/tagout plans shall identify the method to account for all persons who might be exposed to electrical hazards in the course of the lockout/tagout.

FESHM Chapter 2100 Article 5.7, as of the December 2018 revision, lists the following conditions that require the use of a specific Written (documented) LOTO procedure rather than following the General LOTO Procedure:

- The machine or equipment has potential for stored or residual hazardous energy or re-accumulation of stored energy to hazardous levels after shutdown which could endanger employees. (A)
- The machine or equipment has more than one hazardous energy source. (B)
- The machine or equipment has only a single hazardous energy source, but it cannot be readily identified or isolated. (C)
- The isolation and locking out of the single energy source will not completely de-energize and deactivate the machine or equipment. (D)
- The machine or equipment is not isolated from all hazardous energy sources and locked out during servicing or maintenance. (E)
- A single lockout device will not achieve a locked-out condition. (F)
- The lockout device is not under the exclusive control of the authorized employee performing the servicing or maintenance. (G)
- The servicing or maintenance does create hazards for other employees. (H)
- There have been past incidents involving the unexpected activation or re-energization of the machine or equipment during servicing or maintenance. (J)
- One or more Energy Isolating Devices are remotely operated. (K)

Capital letters have been added to the end of each FESHM bullet item for ease of reference in this determination. It is worth noting that, with the exception of the last item (which is unique to Fermilab), these FESHM conditions are a restatement of the OSHA 1910.147 conditions in a way that if any one condition is met a specific documented LOTO procedure is required, rather than requiring that all conditions be met to be exempted from having a specific documented LOTO procedure required.

Analysis:

NFPA 70E, in Article 120.5(A)(5)(a), states that "A complex lockout/tagout procedures shall be permitted…," rather than making this a requirement. While this alone could justify not proceeding any further with this analysis, it creates a legitimate concerns about how LOTO is managed. The conditions listed in NFPA 70E are listed below and a response identifying how these concerns are addressed in the Fermilab LOTO program is given for each.

(5)(a)(1) Multiple energy source

This is addressed by FESHM 2100-5.7 bullet item B.

(5)(a)(2) Multiple crews

Work under LOTO that involve multiple crews are by definition group LOTO activities. Fermilab Group LOTO policy as found in Article 2100-5.11 require that a Lead Authorized Employee be designated who "… is responsible for coordinating work forces and ensuring continuity of protection when more than one crew, craft, department, etc. is involved."

(5)(a)(3) Multiple crafts

Work under LOTO that involve multiple crafts are by definition group LOTO activities. Fermilab Group LOTO policy as found in Article 2100-5.11 require that a Lead Authorized Employee be designated who "… is responsible for coordinating work forces and ensuring continuity of protection when more than one crew, craft, department, etc. is involved."

(5)(a)(4) Multiple locations

Work under LOTO that involve multiple locations are by definition group LOTO activities. Fermilab Group LOTO policy as found in Article 2100-5.11 require that a Lead Authorized Employee be designated who "… is responsible for coordinating work forces and ensuring continuity of protection when more than one crew, craft, department, etc. is involved."

(5)(a)(5) Multiple employers

Work under LOTO that involve multiple employers are by definition group LOTO activities. Fermilab Group LOTO policy as found in Article 2100-5.11 require that a Lead Authorized Employee be designated who "… is responsible for coordinating work forces and ensuring continuity of protection when more than one crew, craft, department, etc. is involved."

(5)(a)(6) Multiple disconnecting means

This is addressed by FESHM 2100-5.7 bullet item F.

(5)(a)(7) Particular sequences

The third step of the General LOTO procedure requires "The machine or equipment shall be turned off or shutdown using proper procedures. 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 it in order 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." Once a system or piece of equipment with only one source of hazardous electrical (for NFPA 70E to relevant) energy, with one disconnect (FESHM written LOTO condition F), and no stored or residual hazardous energy (FESHM written LOTO condition A), particular sequences beyond what is already described in the General LOTO procedure is difficult to imagine.

(5)(a)(8) Job or task that continues for more than one work period

Requirements for administering a LOTO activity that extends beyond a single work period are described in FESHM Article 2100-5.12. These cover the administration, and if required, the transfer of the Lead Authorized Employee (Person in Charge) role and the

transition from LOTO to Configuration Control in event of an extended period of time during which work will not be performed on the equipment or system under LOTO.

(5)(b) All complex lockout/tagout procedures shall require a written plan of execution that identifies a person in charge.

The Electrical Hazard Analysis and Work Permit form requires the designation of a Person in Charge. In the case of an electrical-only LOTO procedure, if a single person is performing the LOTO, they are unavoidably thee Person in Charge. In a group LOTO, a Lead Authorized Employee must be designated. The responsibilities for the Lead Authorized Employee are the same as those required for the Person in Charge.

(5)(c) The complex lockout/tagout procedure shall vest primary responsibility in an authorized employee for the employees working under the protection of a group lockout or tagout device, such as an operation lock or lockbox. The person in charge shall be held accountable for safe execution of the lockout/tagout.

The Fermilab policy on Group LOTO addresses this concern in Section 5.11.1: “Both [Type A and Type B Group LOTO] 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.” These Lead Authorized Employee responsibilities are the same as those required for the Person in Charge.

(5)(d) Each authorized employee shall affix a personal lockout or tagout device to the group lockout device, group lockbox, or comparable mechanism when he or she begins work and shall remove those devices when he or she stops working on the machine or equipment being serviced or maintained.

The Fermilab policy on Group LOTO addresses this concern. Type A Group Lockout in Section 5.11.1 addresses the use group lockout devices, “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.”

Type B Group Lockout in Section 5.11.2 addresses the use lockboxes, “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 where the energy isolating device(s) cannot accommodate the weight or volume of personal lockout devices needed. The lead authorized employee performs or directs the performance of the LOTO activity. The key(s) from the equipment lockout device(s) are then captured in the job lockbox that is then secured with a personal lockout and tagout device 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. The lead

authorized employee shall be the last to remove personal lockout and tagout devices while returning the equipment to service."

(5) (e) All complex lockout/tagout plans shall identify the method to account for all persons who might be exposed to electrical hazards in the course of the lockout/tagout.

This is addressed by FESHM 2100-5.8. The first step in the General LOTO procedure is "Notify," which requires that all Affected Employees be notified about the impending LOTO. The definition of "Affected Employee in FESHM 2100 would definitely includes "all persons who might be exposed to electrical hazards." FESHM 2100-5.7 bullet item H also makes this requirement clear.