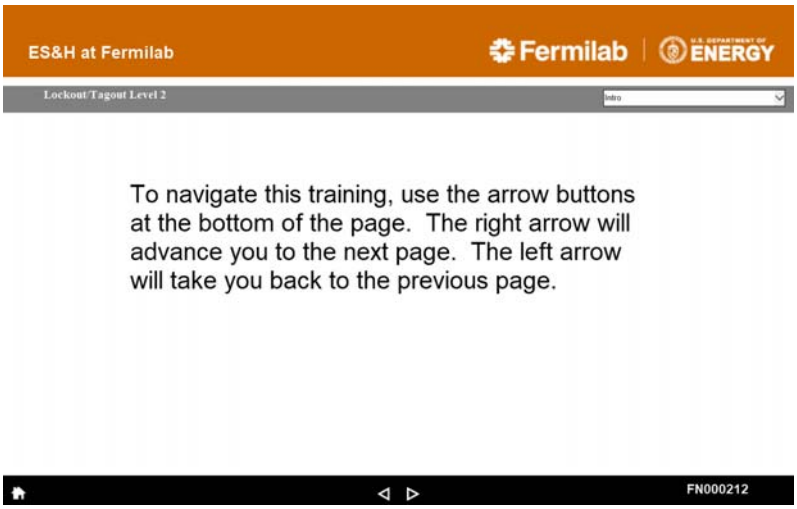
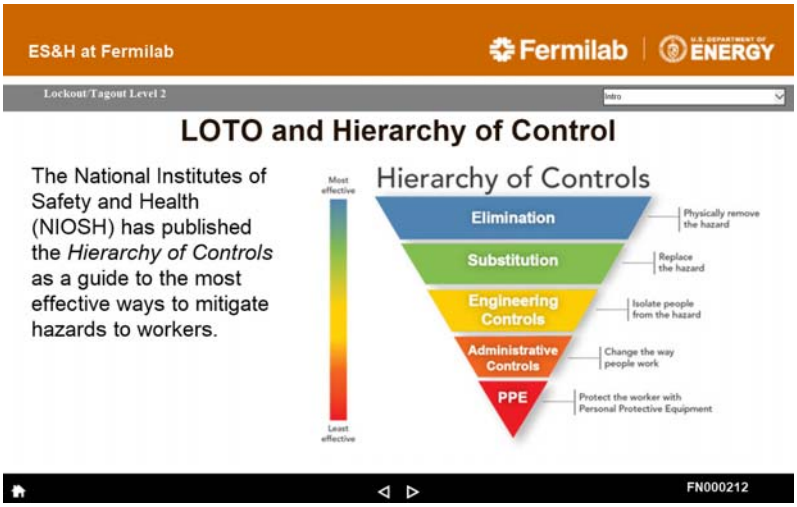
* General Employee Radiation Training

All employees of Fermilab are required to complete General Employee Radiation Training. In addition, subcontractors and users who enter those areas at Fermilab that are posted as Controlled Areas, as part of their job but do not work with radioactive materials (including radioactive sources) must receive this training.





LOTO and Hierarchy of Control

- Some versions of this hierarchy add "Awareness" between Engineering and Administrative Controls.
- LOTO is only an administrative control – second from last.
- The more effective controls should be addressed before proceeding to use LOTO.
- There is nothing wrong about "defense in depth," employing multiple levels and types of hazard controls.

ES&H at Fermilab
Fermilab | U.S. DEPARTMENT OF ENERGY
Lockout/Tagout Level 2
Intro

LOTO is A Part of Work Planning and Hazard Analysis

- LOTO is an important part of Fermilab's Work Planning and Hazard Analysis program [FESHM Chapter 2060].
- The goal of work planning is "… to initiate thought about the hazards associated with work and how it can be performed safely "
- Work planning ensures:
  - the scope of the job is understood
  - appropriate materials are available
  - all hazards have been identified
  - mitigation efforts established
  - all affected employees understand what is expected to them

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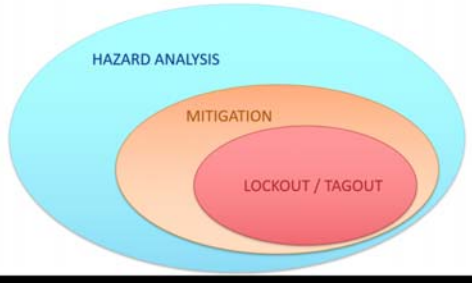
LOTO

- **Note that LOTO is the only "mitigation efforts" part of Work Planning and Hazard Analysis.**

LOTO is A Part of Work Planning and Hazard Analysis



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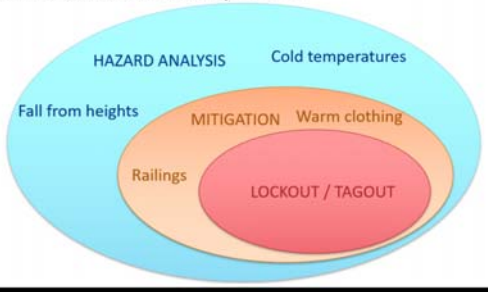
Lockout/Tagout Level 2
Intro

LOTO is a Part of Work Planning and Hazard Analysis

Some risks cannot be addressed by LOTO



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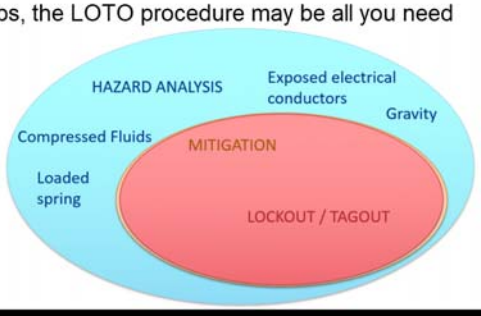
Lockout/Tagout Level 2
Intro

LOTO is A Part of Work Planning and Hazard Analysis

For some jobs, the LOTO procedure may be all you need



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* Read these objectives to the class.

You Should Already Know

- How to recognize LOTO activities.
- How to recognize the locks & tags used at Fermilab.
- The consequences of unauthorized removal of locks & tags.

Objectives of this training

- Comply with OSHA 1910, which is part of our "Work Smart" set of standards.
- State the definition of a Lockout/Tagout.
- Recognize hazardous energy sources.
- Learn steps for energy isolation & control.

Objectives of this training

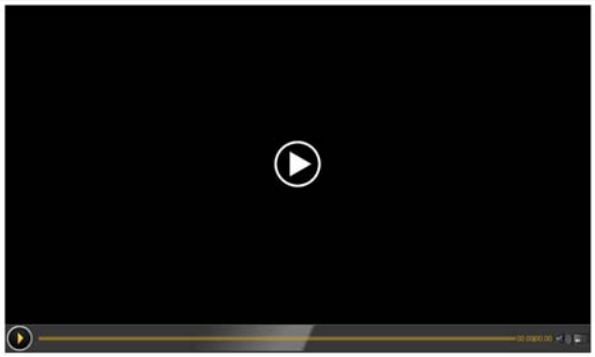
- Understand the limitations of tagout devices used without locks.
- Understand the differences between type A and type B group lockouts.
- Recognize when a written LOTO procedure is required.
- Understand the LOTO requirements during shift changes.
- Understand requirements for sub-contractors.

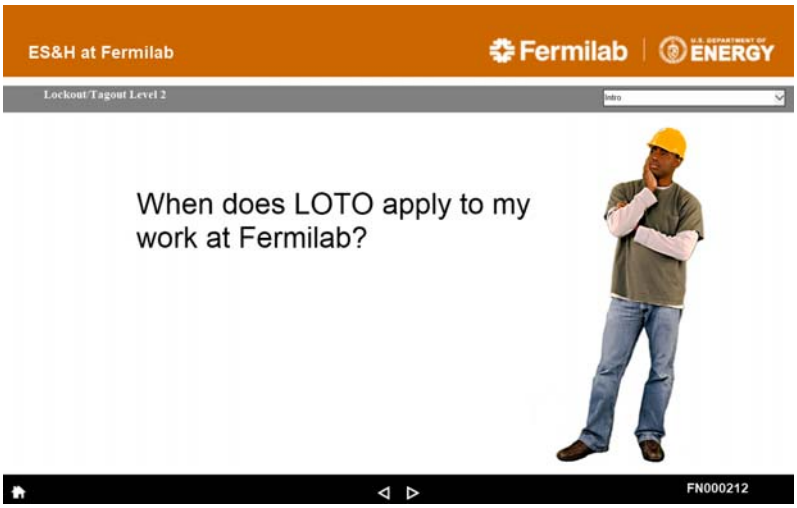
Why is it so important to follow LOTO procedures?

Click here for the answer

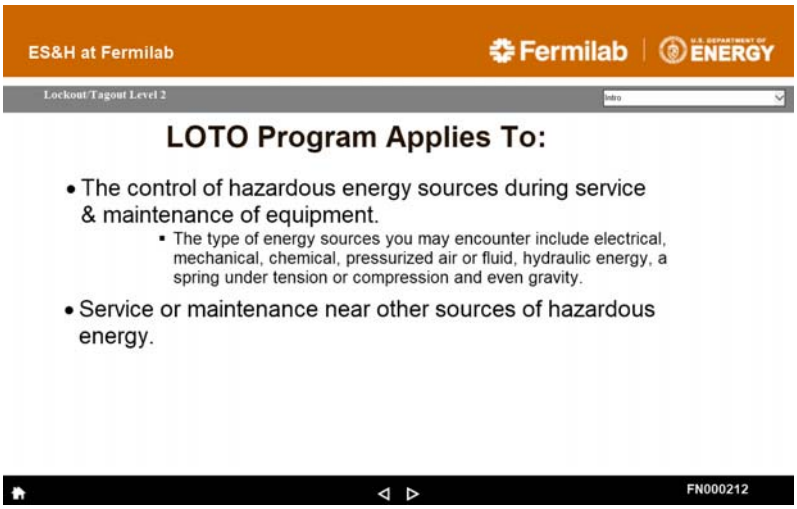
LOTO saves lives!

Before coming to Fermilab, Dave Mertz of the ES&H section was injured in an incident where LOTO procedures were not followed. He is very lucky his injuries were not worse. Dave will share his story on the next page.





* Now, there are specific situations when lockout/tagout applies and some when it does not apply. The next three slides describe when and where application of LOTO is required and also when LOTO does not apply.

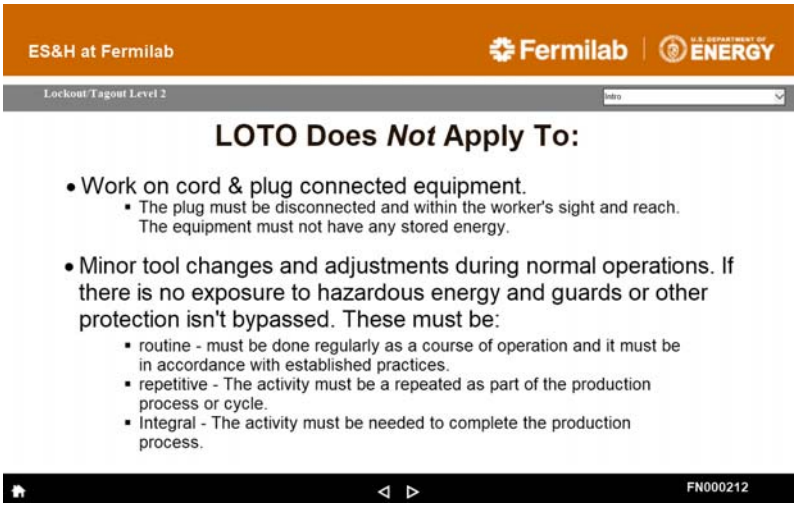


* These are the three points to remember about the application of the program:

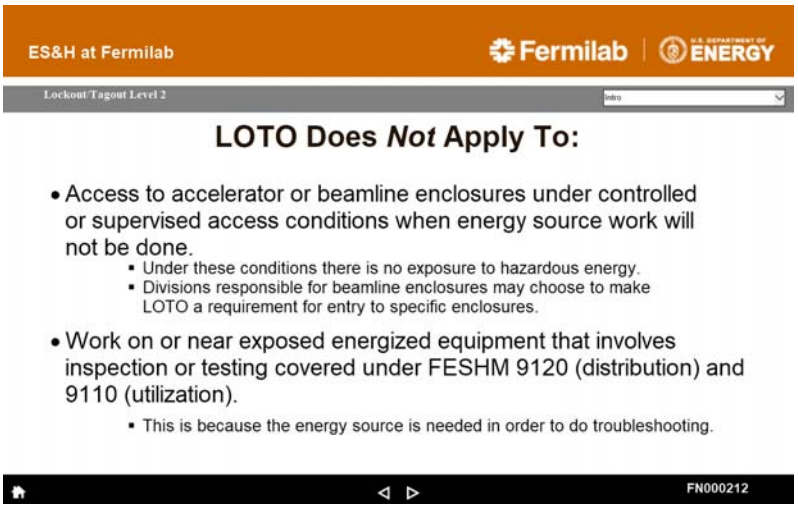
A hazardous energy source must be present.
-What are these energy sources? Can you name some? Electrical, mechanical, chemical, pressurized air or fluids, hydraulic energy, a spring under tension or compression

There is potential for injury

Because guards and protection are bypassed during servicing or maintenance, the worker is not protected except for the lock and tag.



* Cord and plug connected equipment-
Why? (try to get some answers from the students). Employee must be in control of the plug and the equipment does not have hazardous stored energy. What does control of the plug means to you? It means within sight and reach.
Adjustments and Tool Changes: The operation must be:
A. routine - must be done regularly as a course of operation and it must be in accordance with established practices.B. repetitive - The activity must be a repeated as part of the production process or cycle.C. Integral - The activity must be needed to complete the production process.
Access to accelerator -
However, if you are going to be working on energy sources, LOTO applies. See the LOTO chapter page 2.

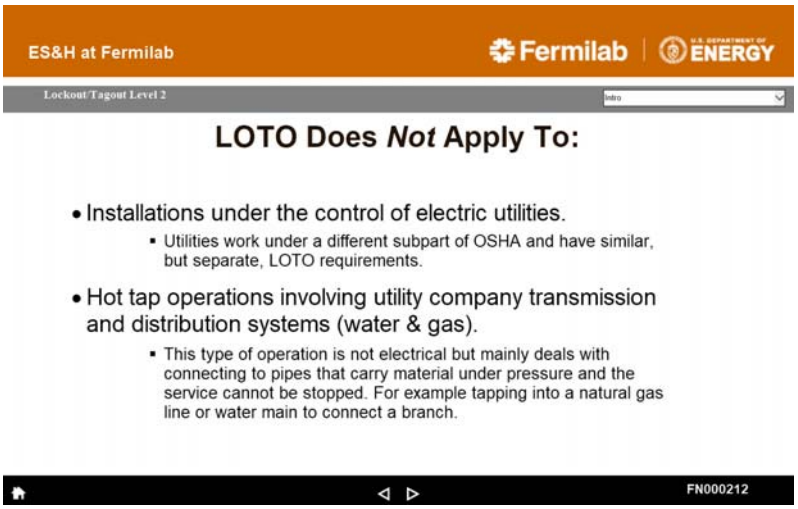


*

Inspection and testing and we may add troubleshooting – why? Because the energy source is needed in order to do troubleshooting.

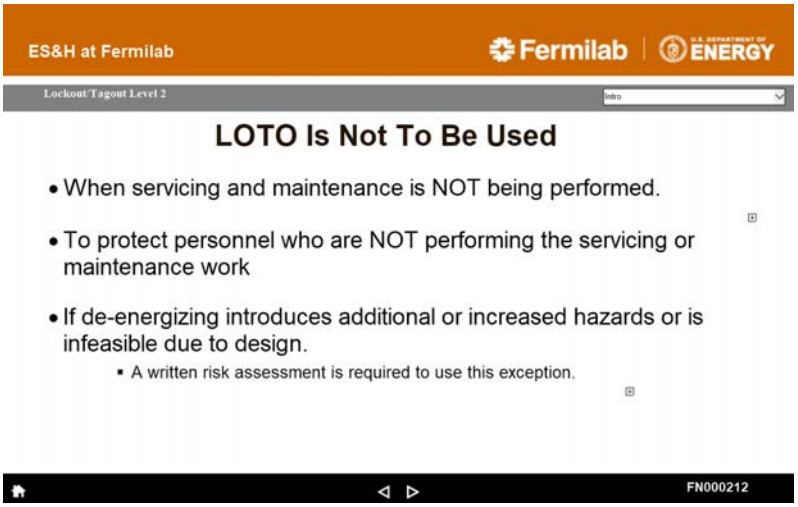
FESHM 9120 deals with the AC Power Distribution system while FESHM 9110 deals with utilization equipment. There are specific processes for doing this type of work.

Utilities work under a different subpart of OSHA and have separate LOTO requirements although similar.

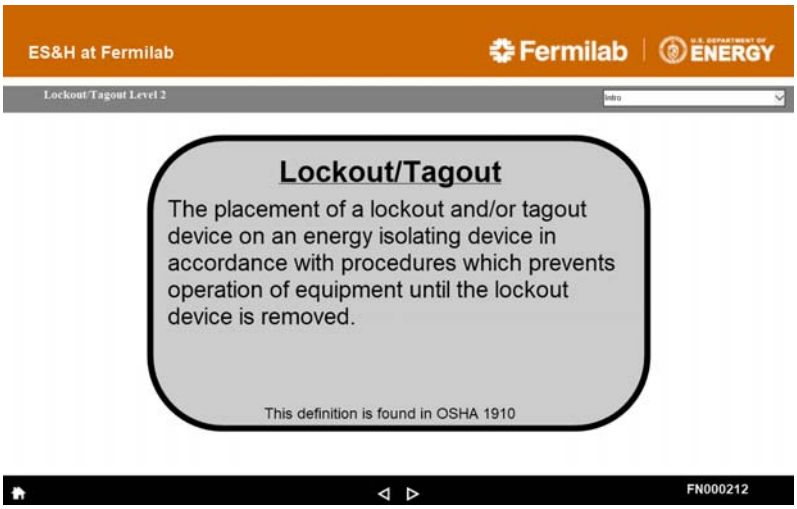


* Hot Tap Operations: This type of operation is not electrical but mainly deals with welding on pipes that carry material under pressure and the service cannot be stopped. For example tapping into a natural gas line or water main to connect a branch.

If De-energizing Introduces Additional or Increased Hazards or is Infeasible Due to Design – Happens very infrequently. An example of increased hazards is shutting power off to an intensive care unit in a hospital.



* Now, let us try a change of pace and cover some definitions to help you understand who and what we are talking about.

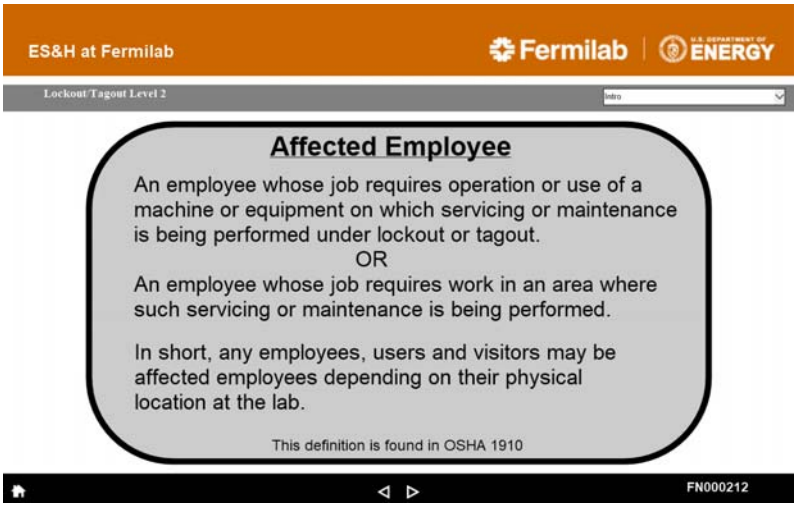


Here is the definition of Lockout/Tagout - Read the definition to the class. We'll discuss devices such as Job lockboxes and other lockout and tagout devices later.

The term "Lockout/Tagout" allows the use of a lockout device with a tag, or a tagout device alone.

* In short this means a user or an area resident is an affected employee.

This definition is found in the general industry OSHA standard.



Who might be an Affected Employee?

Click here for the answer

Everyone at the Laboratory!!!

An **Authorized Employee** is someone who is:

- Authorized to lockout/tagout equipment in order to perform maintenance
- Authorized by line management
- Qualified by training and experience

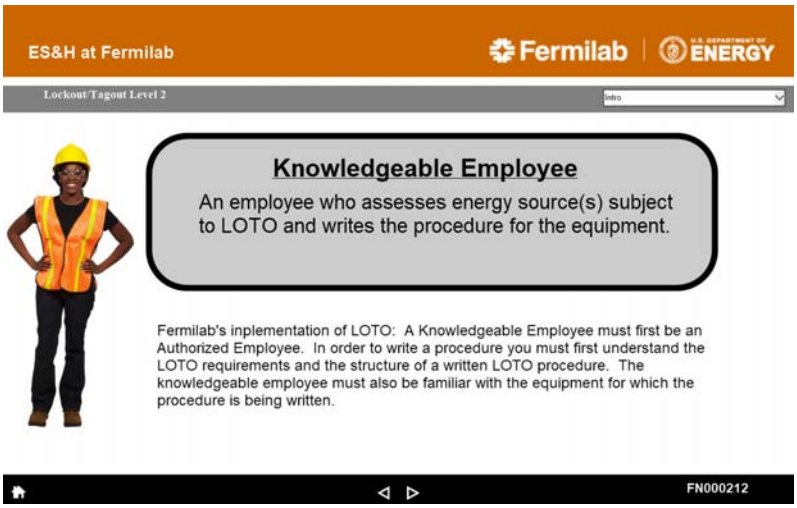
This definition is found in OSHA 1910

A **Lead Authorized Employee** is:

- An authorized employee who performs or coordinates one or more LOTO activities for multiple personnel.
- Often the most senior or experienced person, but this is NOT a requirement.

This definition is found in OSHA 1910

* This definition is found in the general industry OSHA standard. A Lead Authorized Employee's role is used for group lockout/tagout, which we'll talk about later.
The Lead Authorized Employee is assigned the lead role for coordinating a LOTO procedure between crews, crafts, department, or other groups.
The most senior or experienced person does not have to perform this role. A more junior person who is an Authorized Employee may do this.

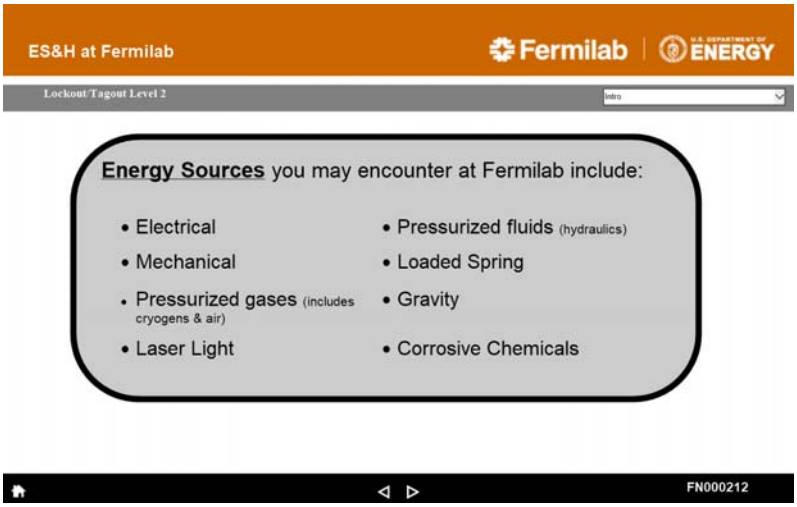


* This term is not found in OSHA nor anywhere else. This is a Fermi-coined term that suits our purpose. By looking at the definition, you can conclude from it that this person has a higher level of knowledge and understanding from which the procedures are developed.

Does the knowledgeable employee have to be first an Authorized Employee? The answer is YES. In order to write a procedure you must first understand the LOTO requirements and the structure of a written LOTO procedure.

* In the case of cord and plug equipment it means that the plug is in your possession or within sight and reach. Reach means at arms length.
Use as an example repairs on a copier.

*



* What are some of the energy sources we should be aware of?

Play the slide by clicking the mouse and it will bring one item at a time. After pressurized fluids ask the question…. Can you think of any others? Then after the class cannot provide answers click once for “Loaded Spring” and again for “Gravity”

ES&H at Fermilab

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Lockout/Tagout Level 2

Intro

Energy Isolating Device

1. A **mechanical device** that **physically prevents** the **transmission or release of energy**.

2. Pushbuttons, selector switches, or other control circuit type devices are not energy isolating devices because they do not physically block transmission or release of energy.

This definition is found in OSHA.

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* What are the primary characteristics of an energy isolating device? It is mechanical, and it physically prevents energy transmission or release.

The OSHA standard clearly states that control circuit devices are not energy isolators.

The definition identifies two energy isolation device types by their function. The first prevents transmission of “fresh” energy into the system to be LOTOed, The second dissipates or safely contains energy that is already in the system to be LOTOed.

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Lockout/Tagout Level 2

Intro

Personal Lockout Device

A lockout device, the key for which is under the exclusive control of an individual.

It is almost always a padlock.

This is a Fermilab definition.

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Lockout/Tagout Level 2

Intro

Equipment Lockout Device

A lock and key used to hold an Energy Isolating Device in the safe position in a type B group lockout. Equipment locks may be a captured-key lock that is integral to the energy isolating device.

This is a Fermilab definition.

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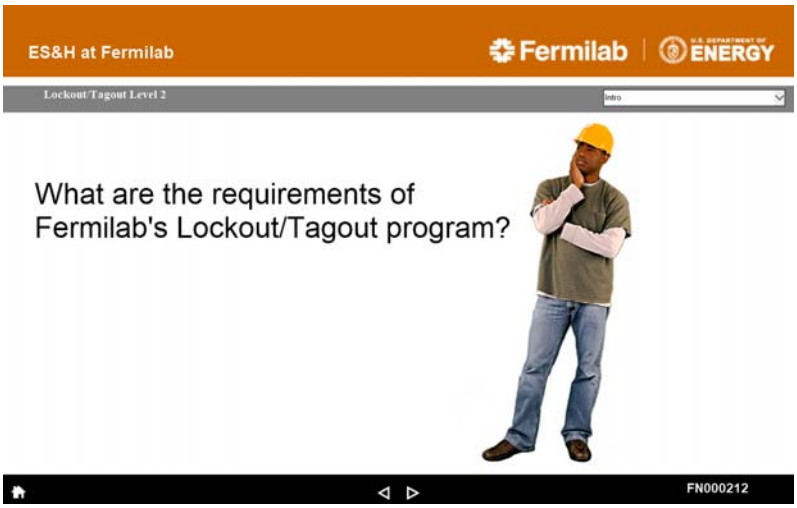
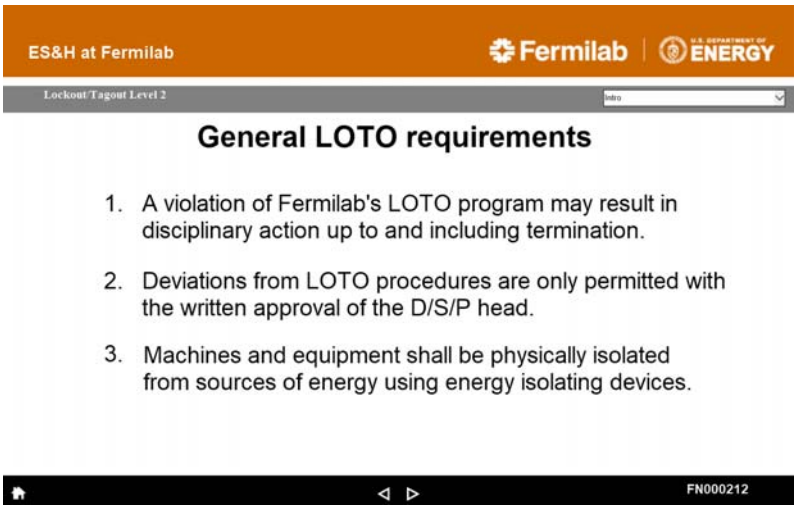
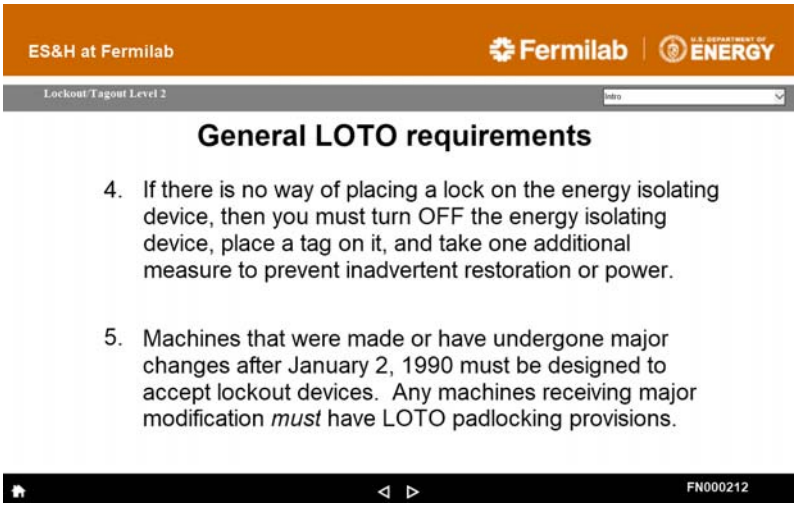


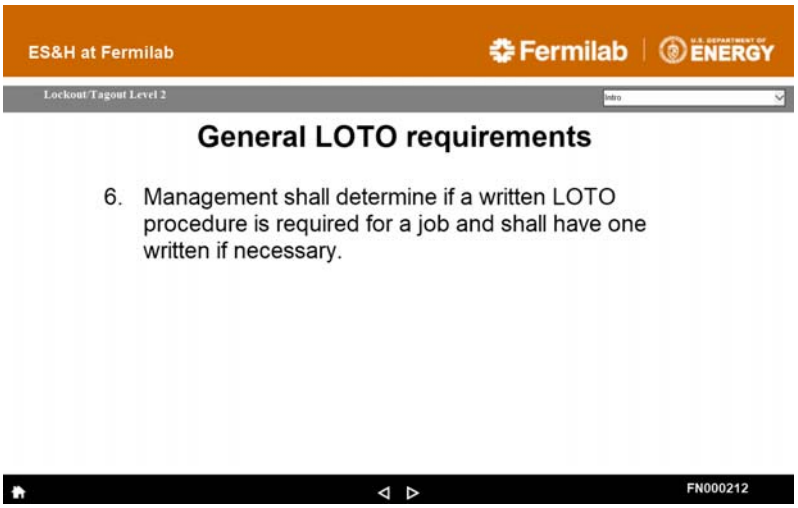
* 1. The LOTO Program is so important at Fermilab that violations could result in disciplinary action, up to and including termination.



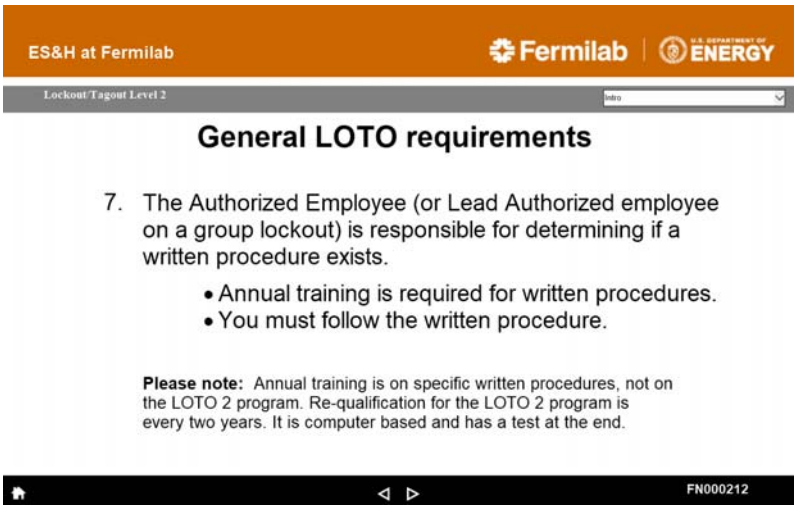
* 4. FESHM 5120, Section 5.4 requires that after placing a tag the worker must take additional steps to guarantee safety equivalent to a lock/tag condition. For example, locking the room where the equipment is located, or a person standing next to the equipment that is tagged. Refer students to FESHM 5120, Section 5.4 for more examples.

A RED Danger tag conveys the same message as a lock/tag combination except for the obvious weakness of the system which is…? ANS- Anyone can intentionally or accidentally turn ON the energy isolating device.

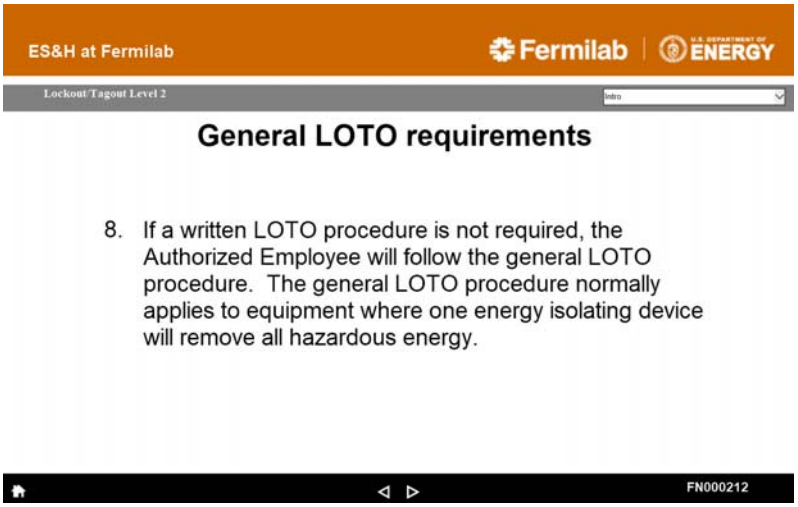




* 6. Management determines when a LOTO written LOTO procedure is necessary and will have one written.



* 7. Yearly training is on specific written procedures not on the LOTO 2 program. Re-qualification for the LOTO 2 program is every two years. It is computer based and has a test at the end.



* 8. In the absence of a written LOTO procedure the authorized employee will follow the general LOTO procedure. The General LOTO procedure normally applies to equipment where one energy isolating device will remove all hazardous energy.

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Lockout/Tagout Level 2

General LOTO requirements

9. If the Authorized Employee feels a written procedure is needed and one does not exist, he/she should notify the supervisor and should not proceed with the work.

It is your responsibility, and no one else's, to check if there is a written procedure that applies to the equipment that you will be working on. If you feel that the equipment should be under a written procedure but there is none written- DO NOT PROCEED WITH THE WORK. Contact your supervisor.

Some Divisions, Sections, and Projects have placed stickers alerting you to existence of written procedures but not all D/S/Ps have done so. The lack of such a sticker does not relieve you of the obligation of determining if one exists.

FN000212

* 9. It is your responsibility ,and no one else's, to check if there is a written procedure that applies to the equipment that you will be working on. If you feel that the equipment should be under a written procedure but there is none written- DO NOT PROCEED WITH THE WORK. Contact your supervisor.

Some Divisions, Sections, and Centers have placed stickers alerting you to existence of written procedures but not all Divisions, Sections, and Centers have done so. The lack of such a sticker does not relieve you of the obligation of determining if one exists.

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Lockout/Tagout Level 2

General LOTO requirements

10. If there is a planned utility outage and you have non-related work to do in the area you should apply LOTO at least 30 minutes before the outage. This will allow you to verify that the energy isolating device is what removed the energy.

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* 10. For a planned electrical outage do LOTO 30 minutes before to be able to verify absence of energy.

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Lockout/Tagout Level 2

What kind of Lockout/Tagout devices should I be using?

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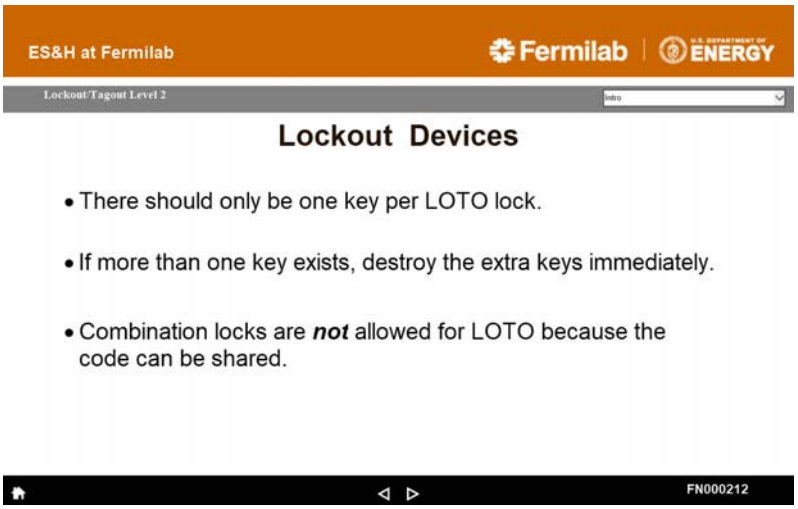
* Change of Pace. Now let us discuss the devices used for Lockout/Tagout.

You can get the American Lock Co. Red locks in the warehouse. You can also make a LOTO lock by using red tape or red shrink wrap covering the body of the lock.

* Emphasize the fact that the second key must be destroyed. There can only be one key in existence for each lock.

Combination locks not allowed because the combination can be cracked.



The Fermilab Locksmith is capable of re-keying stockroom locks to a common key. This practice still complies with the second bullet on this slide of having only one key per lock in existence.

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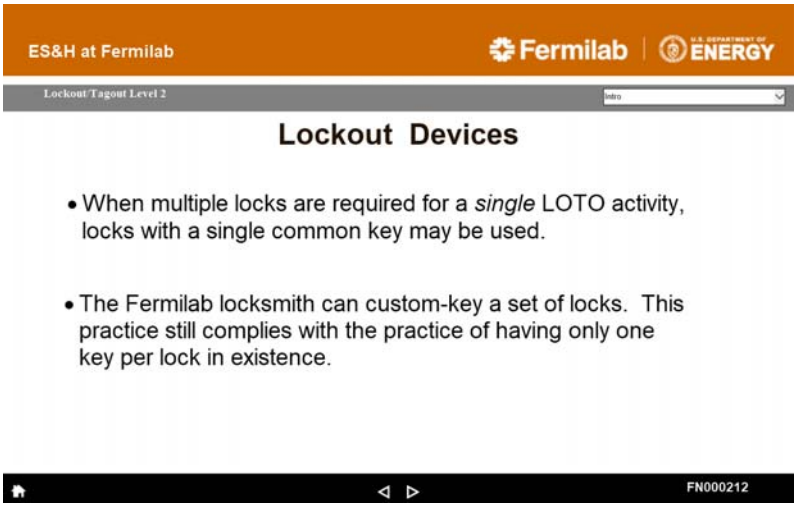
Combination locks not allowed because the combination can be cracked.



* The Fermilab Locksmith is capable of re-keying stockroom locks to a common key. This practice still complies with the second bullet on this slide of having only one key per lock in existence.

* ALL LOTO TAGS MUST HAVE THE WORDS “DANGER- DO NOT OPERATE”

MUST HAVE A SPACE FOR THE AUTHORIZED EMPLOYEE’S NAME

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Lockout/Tagout Level 2 | Intro

Tagout Devices

All LOTO tags must:

- contain the words "DANGER, DO NOT OPERATE".
- be white, black and red.
- withstand a continuous 50 pound pull.

Fermilab Stockroom numbers: 2650-400400 and 2650400300

FN000212

* [At this time show a picture or an actual TAG] Tags need to be attached in such a fashion that they can withstand a 50# pull after attachment. This gives you an idea of how strong the attachment material has to be. For example, a nylon tie is suitable.
Mention that the tag is stocked at the warehouse.
Beyond “Danger – Do Not Operate and the employee’s name, other information may be added to the tag. Common additions include the date the tag was placed, company and employee contact information, even the employee’s photo. Some companies add the general LOTO procedure steps to it as a reminder and check list.
Tag may be re-used. The means of attaching a tag for a tag-out application cannot be re-used

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Lockout/Tagout Level 2 | Intro

Tagout Devices

All LOTO tags must also have a space for the Authorized Employee’s name. Optional additions include:

- the date the tag was placed
- company and employee contact information
- employee photo

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Lockout/Tagout Level 2 | Intro

Tagout Devices

All LOTO tags:

- must have a reinforced eyelet capable of accepting a lock shackle of 0.25 inch diameter.
- are available at the Fermilab stockroom.

stockroom catalog number 2650-401100, or 2650-400100 for self-laminating tags that protect writing in harsher environments.

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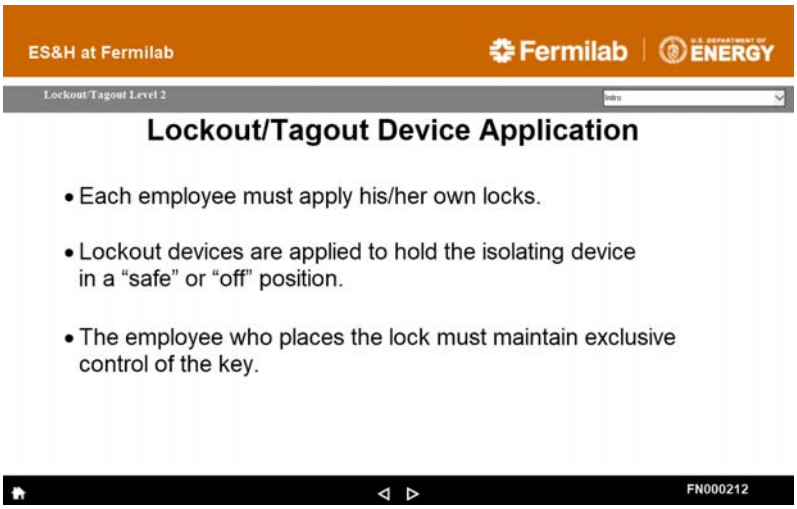
* Each employee must apply their own locks.

Lockout devices shall be applied to prevent the movement of the isolating device. Tags shall clearly indicate that the operation or movement of energy isolating devices from the “safe” or “off” position is prohibited.

What does exclusive control mean to you? (Wait for response from audience)

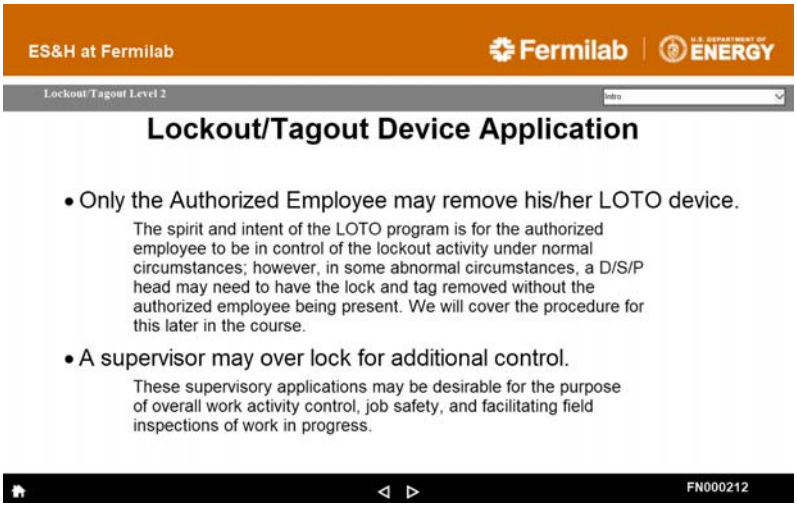


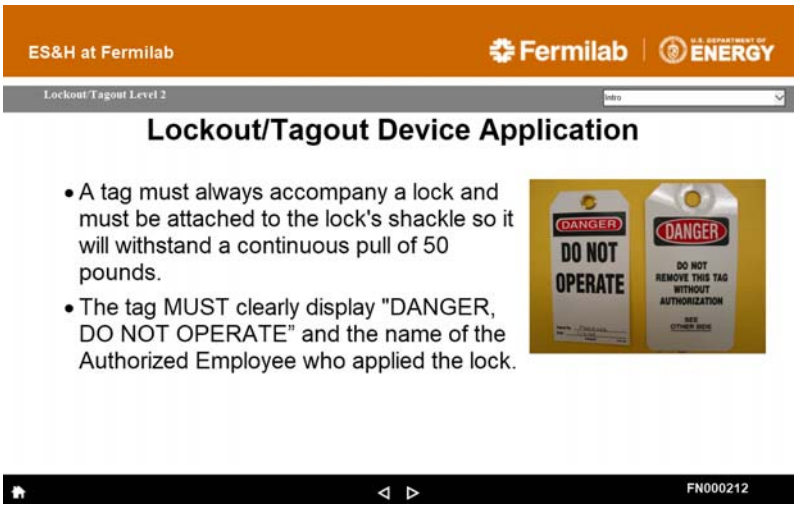
*

The spirit and intent of the LOTO program is for the authorized employee to be in control of the lockout activity under normal circumstances; however, in some abnormal circumstances, a D/S/C head may need to have the lock and tag removed without the authorized employee being present. We will cover these later in the course.

A supervisor may over lock for additional control.

These supervisory applications may be desirable for the purpose of overall work activity control, job safety, and facilitating field inspections of work in progress.

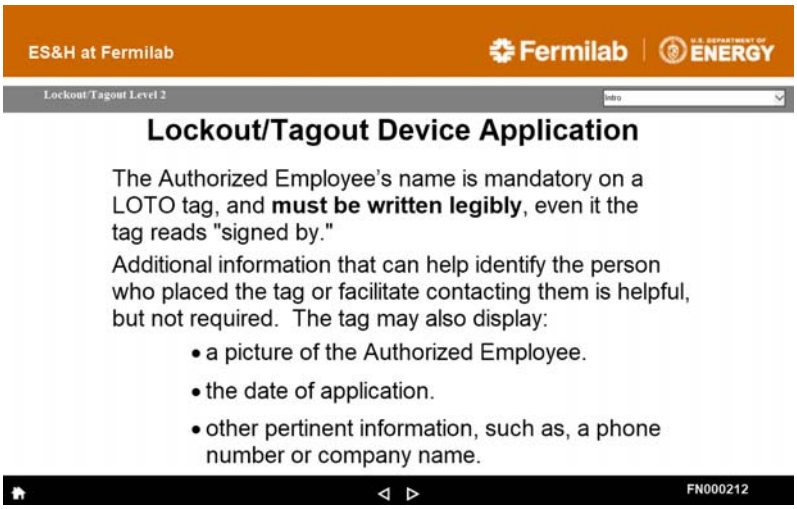




* If there is a lock then a tag must be placed also. Remind employees that the tag must be attached to the lock shackle.

The tag should withstand 50# of force when you pull on the tag.

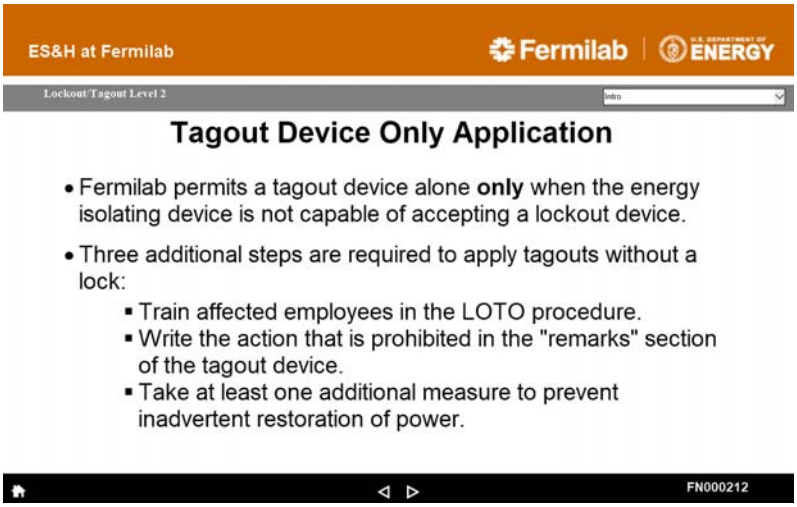
The name of the authorized employee must be legibly written on the tag. If space allows, include the phone number and any other explanatory information.



* The only two things that must appear on a Tag are the name of the authorized employee that applied the lock and the words "Danger – do not operate."

Additional information that can help identify the person who placed the Tag or facilitate contacting them is helpful, but not required.

The photo is not a requirement although some organizations issue tags with the authorized employee's photo. These are available commercially, but are expensive.



* When the energy isolating device is not capable of being locked out, the machine or equipment shall be turned OFF and tagged out. Only DANGER tags with the words DO NOT OPERATE can be used.

When you only use a tag, you must always take additional steps to guarantee the same level of safety that you would have if a lock is also used. This is subjective on the part of the worker based on the work, the physical layout and other conditions. For example, posting a person next to the tagged out disconnect, or locking the room where the disconnect is located, or removing a circuit element, removing a handle, or blocking a control switch.

Tagout Device Only Application

Train Affected Employees

- Employees that work on or near equipment being placed under tagout must be trained in the tagout procedure.
- The training for the Affected Employess should cover what they should (and should not) do to keep themselves and others safe.

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Intro

Tagout Device Only Application

Write in the tagout device "remarks" section the operation or movement that is prohibited.

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Tagout Device Only Application

When a tagout device alone is placed, at least one additional measure must be taken to prevent inadvertent restoration of power. You must gaurantee the same level of safety that you would have if a lock was also used. This is subjective on the part of the worker based on the work, the physical layout, and other conditions. Examples include:

- Removing a valve handle
- Removing fuses
- Blocking a control switch
- Locking room with isolating device inside
- Posting a person to guard tagged out device

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*

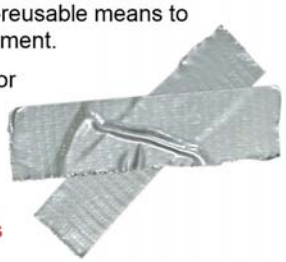
Why is it that you cannot use string or tape to secure a tag??
Ans: It will not take 50# of force as stated in the previous slide and they may be re-usable.

Tagout Device Only Application

Tags must be securely attached by non-reusable means to prevent intentional or inadvertent detachment.

Why is it not advisable to not use string or tape to a apply tag?

Click here for the answer



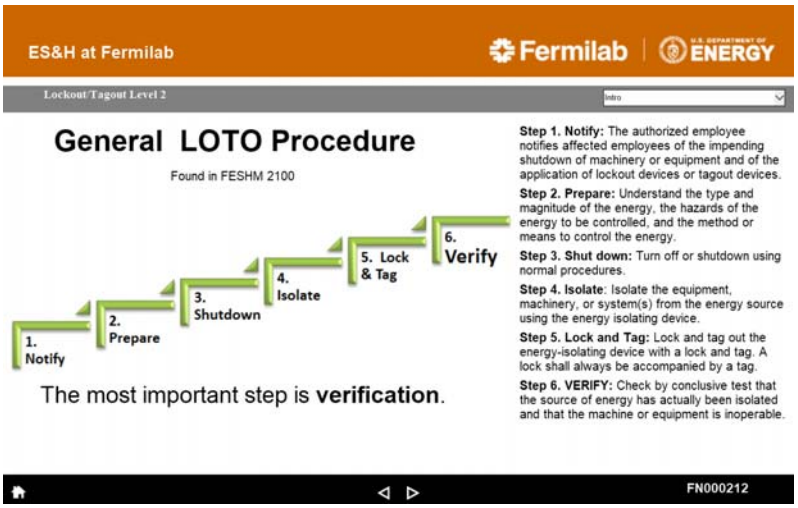
String or tape will not take 50 pounds of force and may be re-usable.

For How Long IS LOTO Valid?

OSHA 1910.147 does not specify an interval after which a LOTO placement expires.

- For how long a LOTO you have placed remains effective is your judgement call
  - When in doubt, check placement of LOTO locks and tags and repeat the verification steps to confirm that hazardous energy is still controlled.
  - Are there affected employees that should know you're restarting your servicing or maintenance after a delay? Notify them!
- If the equipment must remain locked out but no work will be done for more than a week or so, convert it to configuration control.
  - You will need to re-perform the LOTO application process when you restart work

What is Fermilab's LOTO procedure?



* Notify- The authorized employee notify affected employees of the impending shutdown of machinery or equipment and of the application of lockout devices or tagout devices. (Ask the question- Who are the affected employees? See if the audience remembers the definition given at the beginning of the presentation)

Prepare: 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.

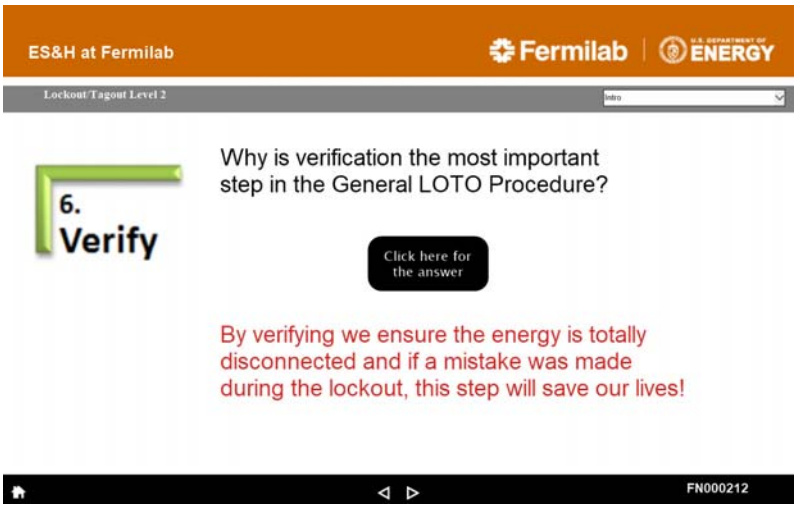
Shut down: Turn off or shutdown using normal procedures.

Isolate: Exercise normal ON-OFF Controls, then isolate the equipment, machinery, or system(s) from the energy source at the disconnect.

Lock and tag out: lock and tag out the energy-isolating device with a lock and tag. A lock shall always be accompanied by a tag.

VERIFY: Check by conclusive test that the source of energy has actually been isolated and that the machine or equipment is inoperable. This is the most critical step- why?
Ans: By verifying we ensure the energy is totally disconnected and if a mistake was made during the lockout, this step will save our lives!

Ask the students about the type of equipment they will be applying LOTO to and how will they verify for de-energization.



General LOTO Procedure

- The General LOTO Procedure is used for simple situations, such as repairing a machine tool that uses only electric power.
- General LOTO will not work in certain situations. These situations require Written LOTO instead. We will cover Written LOTO and the circumstances in which it is required shortly.

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General LOTO Procedure

Successfully completing this training qualifies you to perform General LOTO only.

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How do I Establish Electrically and Pressure Safe Work Environments?

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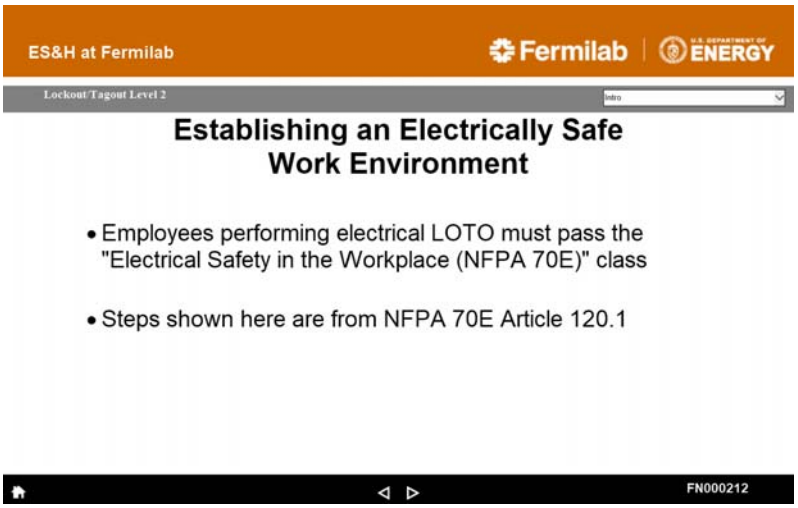
* Have the students open the handout booklet to the EHAWP form.

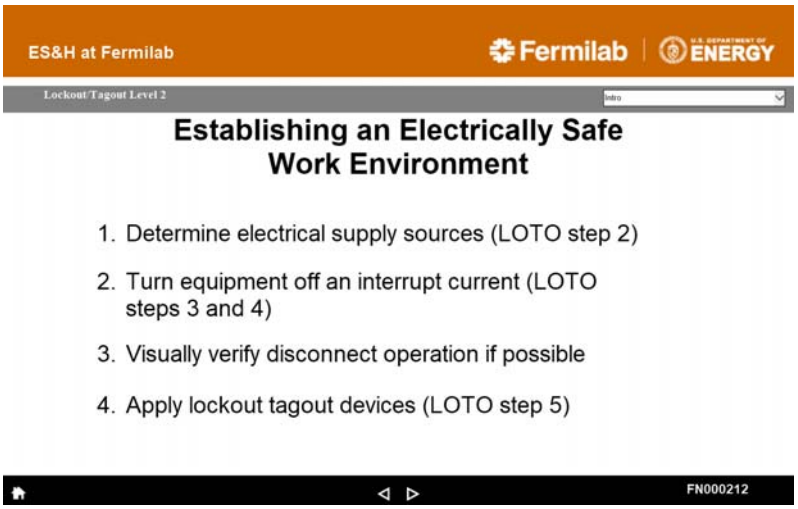


The Electrical Work Permit/Hazard Analysis has space for writing down the Hazard/Risk category, boundaries and PPE requirements.

Best done from design and as built drawings, corporate memory and personal knowledge.

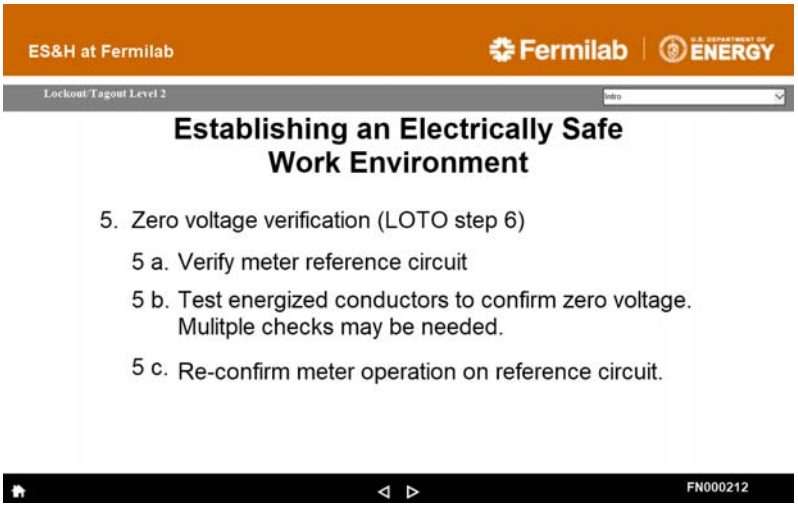
Turn the equipment or system OFF via normal means.

Open all the disconnecting devices that control the sources of energy.



* As explained before apply your lock and tag to the disconnecting device/s.

Make sure the voltmeter used for verification is rated for the voltage you are testing for. Do not use a voltmeter rated for 600 volts in a 1000v circuit. It will blow up in your face. A non-contact voltage detector is not sufficient to prove an absence of potential, but can be used as a pre-check.



Life saver! Why? Explain. NFPA 70E Art. Test on a known source-then test for absence of energy at the equipment- then back to the known source. This validates your readings by making sure the voltmeter worked before and after the reading. There are documented cases where the voltmeter failed the moment the probes touched the test points on the equipment tested for zero energy.

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Establishing an Electrically Safe Work Environment

6. Ground the phase conductors or circuit parts before touching if the possibility of induced voltages or stored energy exists.

Circuit conductors and circuit parts are considered energized until all energy is removed, disconnects are locked and tagged, and absence of electrical energy is verified.

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* This will offer a low impedance path to ground. Your body presents a higher impedance to the flow of current thus a small portion will go through you but so small that is below the range that affects your biological systems.

Very basic safety premise of electrical safety and lockout/tagout. All energy sources, whether from outside the machine or stored within it, are considered energized until proven otherwise.

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Lockout/Tagout Level 2

Consequences of unsafe electrical environment

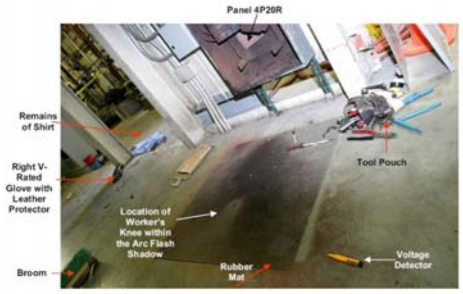

Figure 2-3. The insulating mat with the outline of BSE-1's knee in the arc flash shadow

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* This photo shows the site of an arc flash accident at a sister laboratory. In this case the electrician bypassed some work controls that would have provided protection in an arc flash incident. Notice where the worker had the right knee and the other equipment found.

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Lockout/Tagout Level 2

Consequences of unsafe electrical environment

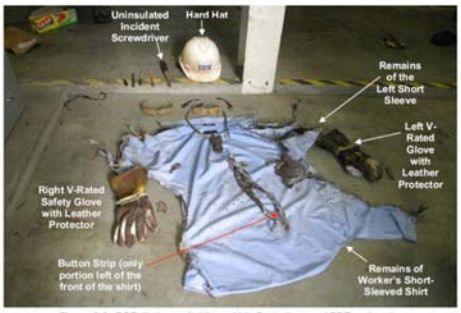

Figure 2-6. BSE-1's burned shirt and his flash-damaged PPE and tools

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* Here all equipment was placed in front of the camera in the position it would have been when worn. What is significant about this photo is what it does not show. Care to guess?

Yes, the pants- they vaporized when faced with the arc flash. The worker was severely injured from the waist down.

Any idea of the temperature of an arc flash? How about the blast from the instantaneous heating of the air?

Note to instructor: Start engaging the students in coming with a temperature. Start at 1000ºF and ask higher or lower? Play this game as long as you wish and finally give the temperature which is three times the temperature of the Sun surface or 35000ºF. The arc blast is approximately 1800 psf.

Establishing Pressure-Safe Work Environments

- Like electricity, hazardous pressure conditions are not visually obvious
- Verifying a pressure-safe condition exists most often involves:
  - An energy isolating device that prevents the delivery of pressurized fluids
  - An energy isolating device that prevents the re-accumulation of pressure
  - Observing a pressure indicator both before and after the Isolation step
  - Operating two or more energy isolating devices
  - A written LOTO procedure
- Even the most tightly shut valve will continue to pass liquid or gas, just at a greatly reduced rate. This passed fluid cannot be allowed to re-accumulate.

Pressure Safety LOTO Steps

- NOTIFY affected employees
- PREPARE
  - Find the valves and pressure indicators that will be used to verify zero pressure and confirm that they appear to be in good working condition.
  - Obtain any handle covers, chains, cables, or other devices needed to apply LOTO locks to the valves, and the proper quantity of LOTO locks and tags for the number of energy isolating devices and personnel involved.
- SHUTDOWN the equipment using normal procedures

Pressure Safety LOTO Steps

- ISOLATE
  - You may need to observe pressure indicators before or during the isolation step to be able to properly perform the Verification step later.
  - The ISOLATE step for pressure systems consists of two parts, SEPARATE and RELEASE.
  - PART 1: SEPARATE from external energy sources
    - Close supply valves
    - Many systems recirculate fluids. Return valves may need to be closed on these systems.
    - Many Fermilab systems have both local and remote (automatic) control of energy isolating devices. Both local and remote operation must be rendered inoperable

Pressure Safety LOTO Steps

- ISOLATE
  - PART 2: RELEASE stored energy and PREVENT re-accumulation
    - When the supply and return valves are shut, it is likely that pressure remains trapped in the equipment and must be released prior to starting the servicing or maintenance
    - You may need PPE to protect yourself from hazardous fluids when they are released
    - Open vent, drain, or bleed valves, remove U-tubes, or disconnect ("break") piping at flanged connections, unions, or couplings. Ensure that released fluids discharge safely
    - Seeing or hearing fluids release from a vent or drain can help confirm pressure has been released, but may not be sufficient by itself to establish that a zero pressure state exists
    - To prevent contamination of a vessel or piping system, a check valve or low-pressure relief valve is permitted to be installed at the end of the vent or drain piping
  - Some equipment may have "block & bleed" valves, which combine the SEPARATE and RELEASE functions.

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Pressure Safety LOTO Steps

- LOCKOUT DEVICE APPLICATION
  - Apply LOTO locks and tags to supply, return, vent, drain, and bleed valves.
  - Locks may be placed in the bolt holes of "broken" flanged connections
  - Other lock adapters may be needed for removed U-tubes, or "broken" couplings and unions

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Pressure Safety LOTO Steps

- VERIFY
  - Check that supply and return valves have been placed in the closed position and have been made inoperable by the LOTO locks
- VERIFY that external energy sources have been isolated
  - Check that vent, drain and bleed valves have been placed in the open position and have been made inoperable by the LOTO locks
  - Check pressure indicators. These may be mechanical gauges or electrical readouts
  - Because pressure indicators can fail or the piping to them can clog or leak, confirming that the pressure readings taken now are different from those taken before the isolation step provides a more reliable verification of zero pressure

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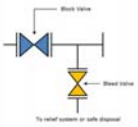
Common Pressure Isolation Devices



Block valve and bleed valve

Double block and bleed valve

Cryogenic system U-tube

Combination block and bleed valve

Consequences of a Pressure Release Incident

- 25 October 2015, Tallahassee, Florida
- National High Magnetic Field Laboratory
- One technician received minor injuries, the second was fatally injured.
  - There was no written LOTO procedure
  - No locks or tags were placed on the available pressure isolating and vent and drain valves
  - Zero energy was not re-verified on the day of the incident
  - The technicians were unfamiliar with the equipment on which they were working

Five Steps for Return to Service

1. Check the equipment and make sure it is put back together before it is energized and there are no loose parts
2. Check the work area for clutter and people. People should be in a safe area.
3. Verify that controls are in neutral, OFF or in a safe state
4. Remove Locks and Tags, and energize if appropriate
5. Notify the affected employees in the area

* These five steps are under the General LOTO Procedure for Return to Service.

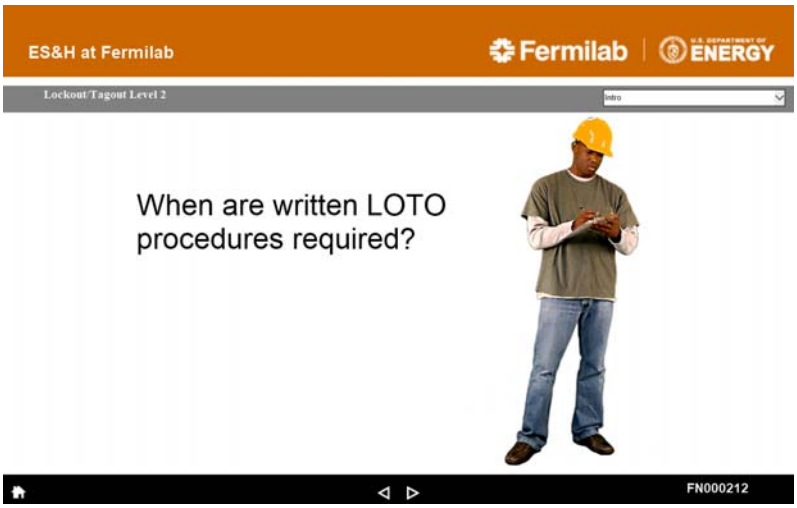
#1 Make sure equipment is put back together before it is energized and there are no loose parts.

#2 Check the work area for clutter and people. People should be in a safe area

3 Self explanatory

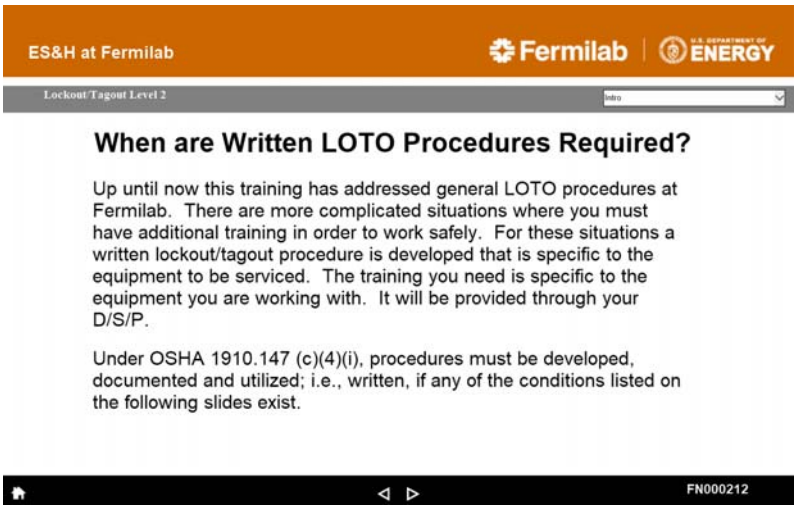
#4 Self-explanatory

#5 Notify the affected employees in the area.



* This is what the OSHA standard stipulates.

Up until now we have talked about general LOTO procedures at Fermilab. There are more complicated situations where you must have additional training in order to work safely. For these situations a written lockout/tagout procedure is developed that is specific to the equipment to be serviced. The training you need is specific to the equipment you are working with. It will be provided through you D/S/C.

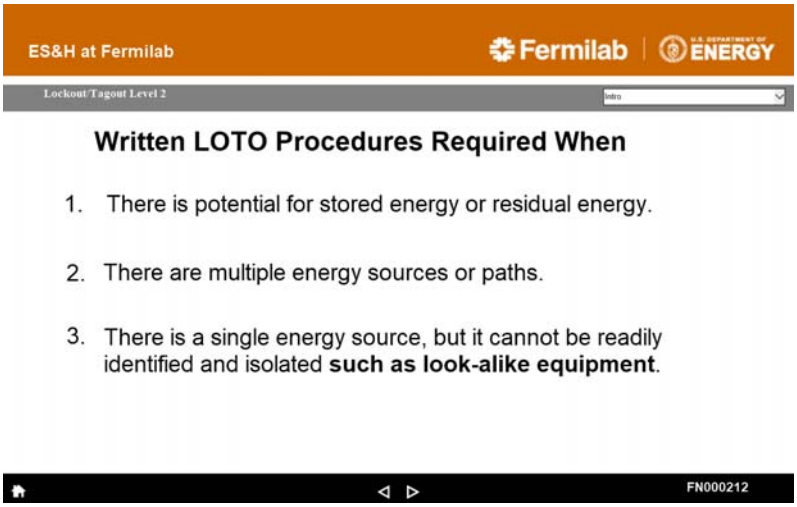


*

#2- There could be multiple paths of the same energy or two different types of energy.

#3- Self explanatory. Maybe find examples to illustrate this point.

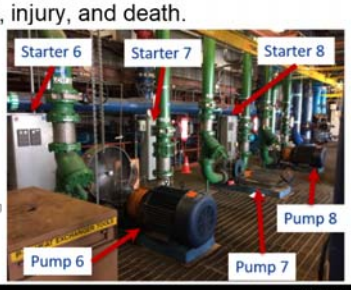
#4- Self explanatory



Look-alike Equipment

Similar equipment in a single location presents opportunities for errors leading to property damage, injury, and death.

- 12 September 2018, electricians working at the Central Utility Building (CUB) were assigned to disconnect power wiring to LCW Pump 7 at, which is located between Pumps 6 and 8.



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Look-alike Equipment

Similar equipment in a single location presents opportunities for errors leading to property damage, injury, and death.

- Electricians LOTOed pump 7's starter and circuit breaker.

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Look-alike Equipment

Similar equipment in a single location presents opportunities for errors leading to property damage, injury, and death.

- Pump 6's motor bore an outdated label identifying it as pump 7.
- This motor had previously been used to run pump 7, but had been serviced, and then reinstalled to serve pump 6, but he "LCW-7" label was never removed.

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Look-alike Equipment

Similar equipment in a single location presents opportunities for errors leading to property damage, injury, and death.

- Based on the erroneous label, an electrician disconnected the wires and conduit on Pump 6.

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Look-alike Equipment

Similar equipment in a single location presents opportunities for errors leading to property damage, injury, and death.

- Without correct LOTO in place, automatic or manual controls could have caused Starter 6 to energize the wires on which the electrician was working.

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Look-alike Equipment

Similar equipment in a single location presents opportunities for errors leading to property damage, injury, and death.

- If the control system or an operator had tried to start Pump 6, the electrician would have been exposed to electric shock and arc-flash hazards, which could have resulted in INJURY or DEATH.

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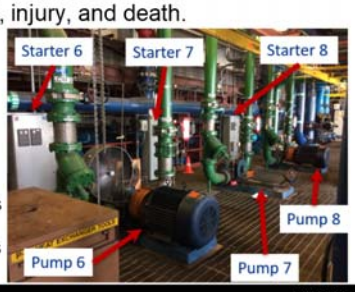
Look-alike Equipment

Similar equipment in a single location presents opportunities for errors leading to property damage, injury, and death.

- The erroneous label, vague documentation, overconfidence in some and inexperience in others, perceived time pressure, and a congested work area are just a few of the factors that helped lead into this near miss.
- There were also offers of help and signs that something wasn't right, which in retrospect, could have helped avoid this incident.



Look-alike Equipment

Strategies to mitigate the look-alike equipment error precursor:

- Permanent labeling (NOT on the replaceable equipment, like motors)
- Work Planning, referencing plans or maps when possible
- Coordinate with equipment SMEs
- Temporary barricades and signs
- Questioning Attitude (S.T.A.R.)

Written LOTO Procedures Required When

4. The isolation and locking out will not completely de-energize and deactivate the equipment.
5. Equipment cannot be isolated from the source and locked out during servicing or maintenance.
6. A single device will not achieve LOTO.
7. A lockout device is not under the exclusive control of the authorized employee.

* #5- May need more than one device or disconnect points to achieve LOTO.

#6- Self explanatory

#7- Self explanatory

#8- If it creates hazards for others the written procedure must take care of these hazards.

*

#9- Self explanatory. This could be a motor that can also be controlled by a control system such as Johnson Controls. This actually occurred at ANL- APS where a motor activated under LOTO by a Johnson Control.

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Written LOTO Procedures Required When

8. Servicing or maintenance of equipment creates hazards for others.
9. There are documented incidents associated with this equipment where it activated or re-energized while under LOTO.
10. Any energy isolating devices are remotely operated. (This is specific to Fermilab)

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* Have the students open their booklets to the blank written LOTO procedure page (FESHM 5120 page 23) and discuss these items.

Minimum Requirements

Specific statement of intended use
Specific steps for shutting down: isolating, blocking, securing
Specific steps for placement, removal, _transfer of locks
Specific steps for testing the effectiveness (verification)

Remember that written procedures are generated by ???
Ans: The knowledgeable employee and approved by line management at the Department Head level or higher.

Note for instructor: Ask the students if they can state the 6 steps of the general LOTO procedure. Then click on the lower left corner and it will take you to Slide 37 for the answer. Once on Slide 37 click inside the lower left arrow and it will return you to Slide 49 where you can continue the instruction.

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Written LOTO Procedures

Written LOTO Procedures are drafted by Knowledgeable Employee(s) and must include:

- A statement of specific use
- Approval by Dept. head or higher
- Specific LOTO steps
- Specific steps for verification
- Specific steps for return to service

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Written LOTO Procedures

- Written LOTO procedures replace General LOTO procedures.
- Written LOTO procedures may add to, modify or even skip General LOTO procedure steps.
- You CANNOT use the General LOTO procedure if a written procedure exists.

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Written LOTO Procedures

This training alone does not qualify you to perform a Written LOTO. You must also be trained on each specific Written LOTO before you can perform it.

Is Alternative Removal of Locks and Tags Allowed?

Temporary Removal of Locks/Tags for Testing or Positioning

- Follow the *Five Steps for Return to Service* when a lock or tag shall be temporarily removed from an energy isolating device so that the machine, equipment or system may be energized to test or position it.
- When finished, return the equipment to a safe de-energized state by using the General or written lockout procedure (whichever applies).

* When a lock or tag shall be temporarily removed from an energy isolating device so that the machine, equipment or system may be energized to test or position it follow the 5 steps for return to service.

Note to Instructor: Ask the students if they remember the steps. Give them sometime then click on the green arrow on lower left inferior corner. It will take you to the slide. Then when in that slide (#43) click on the green arrow again and it will return you to the last slide you were viewing.

When done, return the equipment to a safe de-energized state by using the General or written lockout procedure whichever applies.

Removing an absent person's LOTO locks or tags

- Removing LOTO locks or tags placed by another person is an extreme measure that is not to be done for convenience.
- These three conditions must be met before removing another person's LOTO locks or tags:
  - Absence: It is difficult or impossible for the person to promptly return to the Fermilab site
  - Urgency: The locked-out equipment must be used before the person can return
  - Necessity: Alternatives to removing the person's locks or tags have been evaluated, and do not meet laboratory mission needs

* Locate means physically or by phone.

Approval from D/S/C SSO.

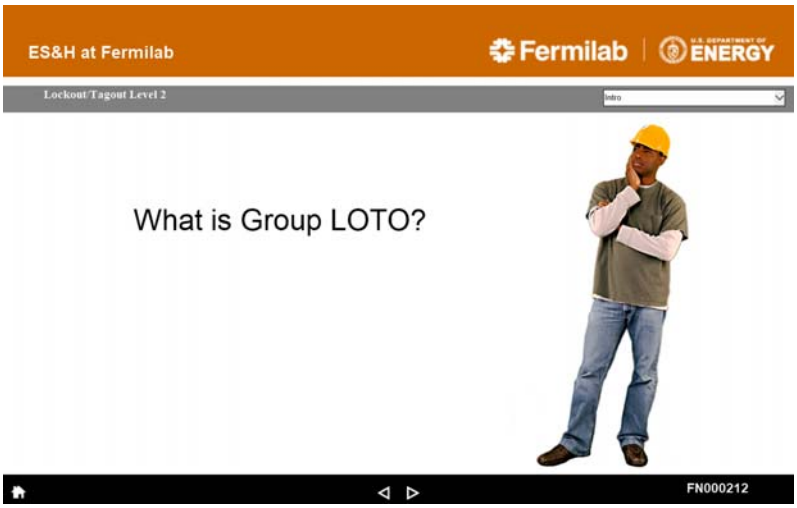
Note to Instructor: The rest of the slide is self explanatory.

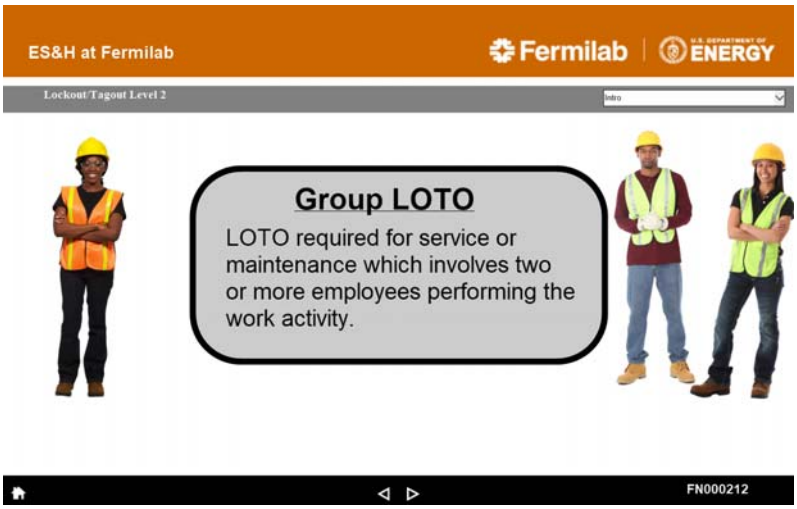
To remove a lock and/or tags when the *employee is absent but can communicate by telephone, E-mail, or text message*, supervisors should:

1. Notify the Division Safety Officer and obtain his/her verbal permission and guidance.
2. Solicit verbal permission from the absent employee to remove his/her LOTO devices.
3. Discuss any special conditions known by absent employee.
4. Have another Authorized Employee follow the *Five Steps for Return to Service.*
5. Document the alternative removal and keep it on file.

To remove a lock and/or tags when the *employee is absent and not available*, supervisors should:

1. Notify the Division Safety Officer and obtain his or her verbal permission and guidance.
2. Make every reasonable effort to locate the Authorized Employee.
3. Get written approval from the D/S Head.
4. Have another Authorized Employee inspect the equipment to be sure the work was completed & follow the *Five Steps for Return to Service.*
5. Inform the original Authorized Employee before he/she resumes work activities.
6. Keep a copy of the written approval on file.





* 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.

Two Types of Group LOTO

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. They are Type A and Type B.

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Two Types of Group LOTO

Type A

(Simple)

Type B

(Complex)

Mnemonic: "B" stands for "Box"

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Fermilab | U.S. DEPARTMENT OF ENERGY
Lockout/Tagout Level 2
Intro

Two Types of Group LOTO

Both types of group lockout involve a designated Lead Authorized Employee who performs or coordinates one or more LOTO activities. The lead authorized employee is responsible for coordinating workforces and ensuring continuity of protection when more than one crew, craft or department is involved.

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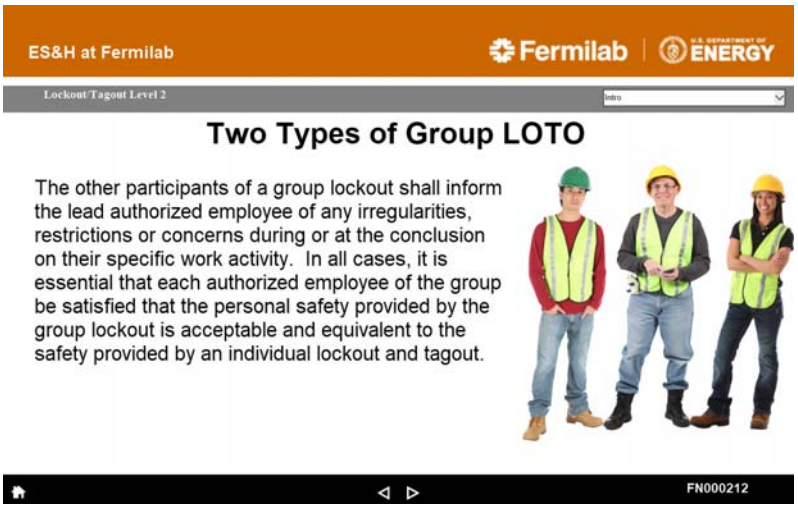
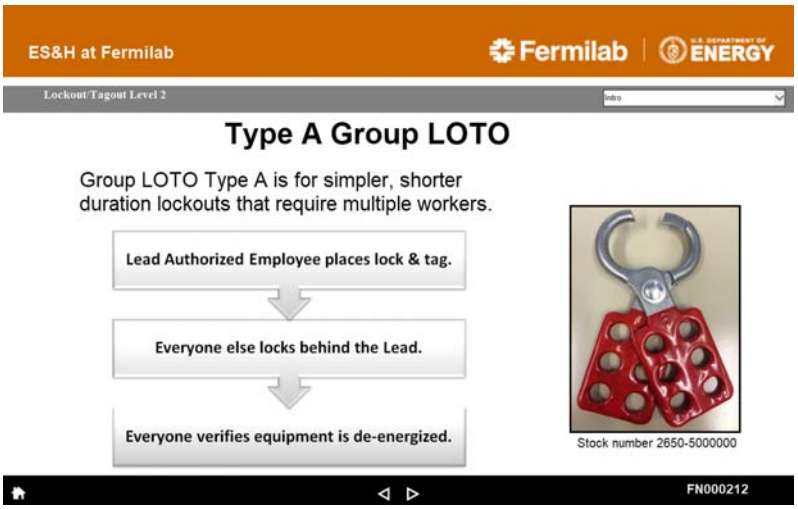


* Type A- For simpler, shorter duration lockouts that requires multiple workers.

The Lead Authorized Employee performs LOTO.

Each Authorized Employee places their lock/tag on each energy isolating device.

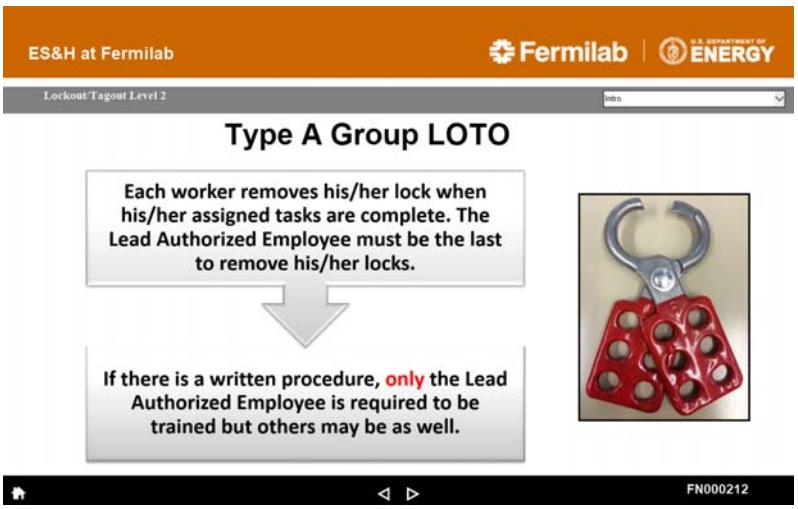
Each employee verifies that the equipment is de-energized.



* Each worker removes their locks/tags upon completion of the assignment.

The Lead Authorized Employee must be the last to remove his or her locks. Why? (She or he is responsible for performing the “Return to Service” steps.)

Only the Lead Authorized Employee needs to be trained in an applicable written procedure.



Why must the Lead Authorized Employee be the last to remove his or her locks?

Click here for the answer

Because he or she is responsible for performing the "Return to Service" steps.

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Lockout/Tagout Level 2
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Type A Group Lockout

In a Type A group LOTO the Lead Authorized Employee performs the notify, prepare and shut down steps.

Energy Isolating Device(s)

Lead Authorized Employee

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Intro

Type A Group Lockout

The Lead is then joined by the other Authorized Employees who observe as the Lead performs the isolate, lock and tag, and verify steps.

Energy Isolating Device(s)

Lead Authorized Employee

Authorized Employees

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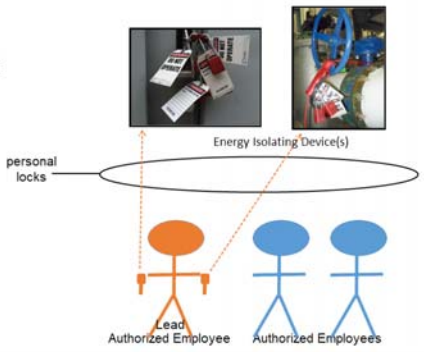
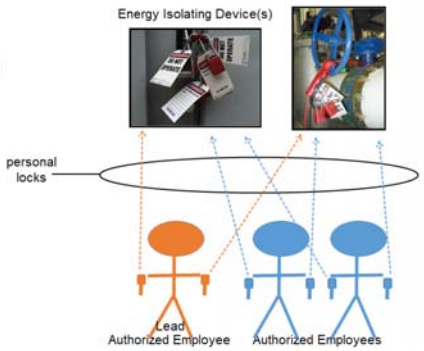
Type A Group Lockout

The Lead places his or her locks and tags first.



Type A Group Lockout

Then the others place their locks and tags.



Type B Group LOTO

Lead Authorized Employee performs LOTO. This is most often done with multiple locks.

All keys go into the lockbox.

The Lead Authorized Employee places a lock and tag on the lockbox.

Each of the other workers place a personal LOTO lock on the lockbox.

Type B Group LOTO is more complex and has longer LOTOs.

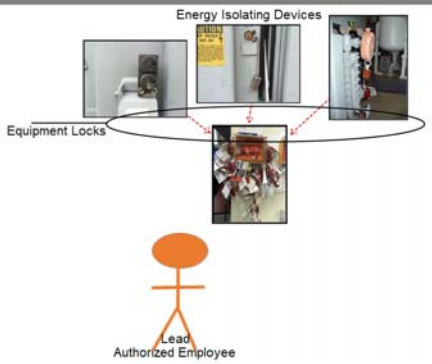
Type B Group Lockout

In a Type B Group Loto the Lead Authorized Employee performs all 6 steps listed below at each energy isolating device using equipment lockout devices.

1. notify
2. prepare
3. shut down
4. isolate
5. lock and tag
6. verify

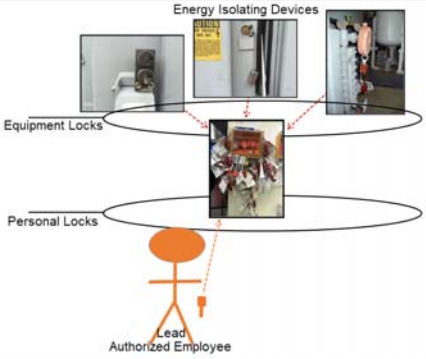
Type B Group Lockout

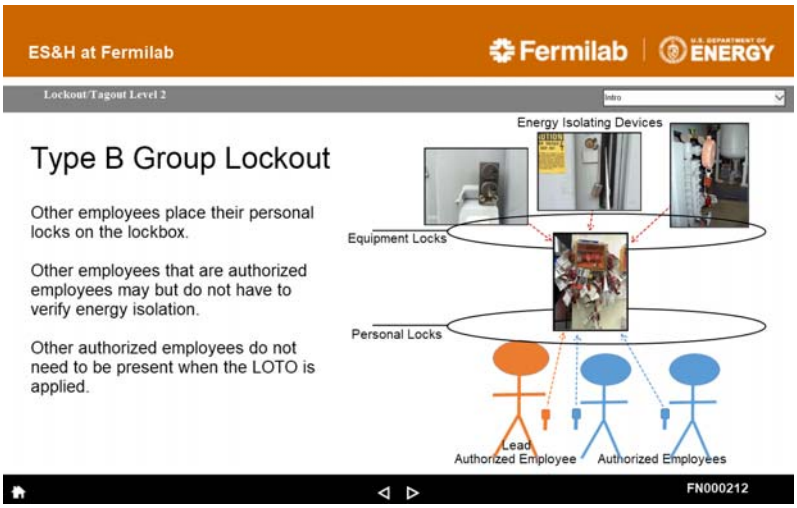
The keys from these devices are placed in a group lockout box.



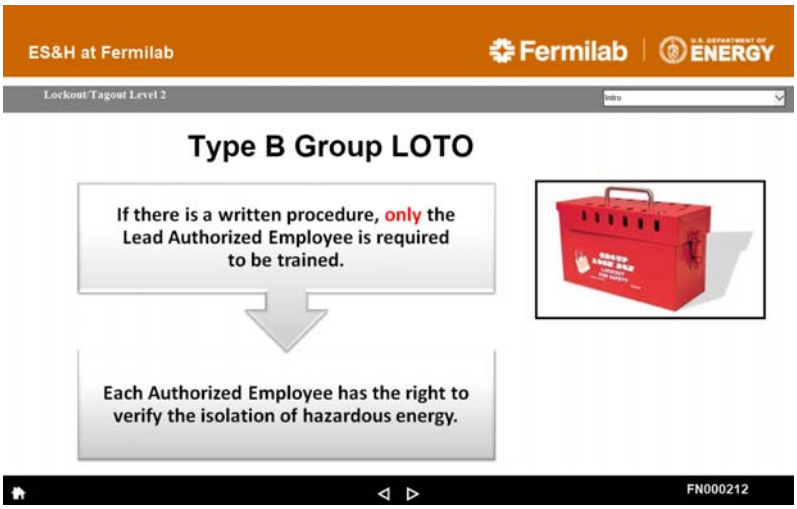
Type B Group Lockout

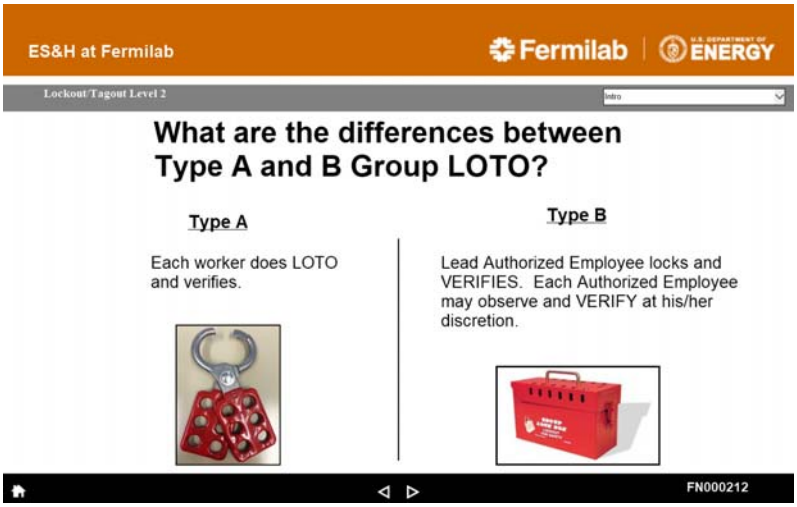
The Lead places a personal lockout device on the group box.

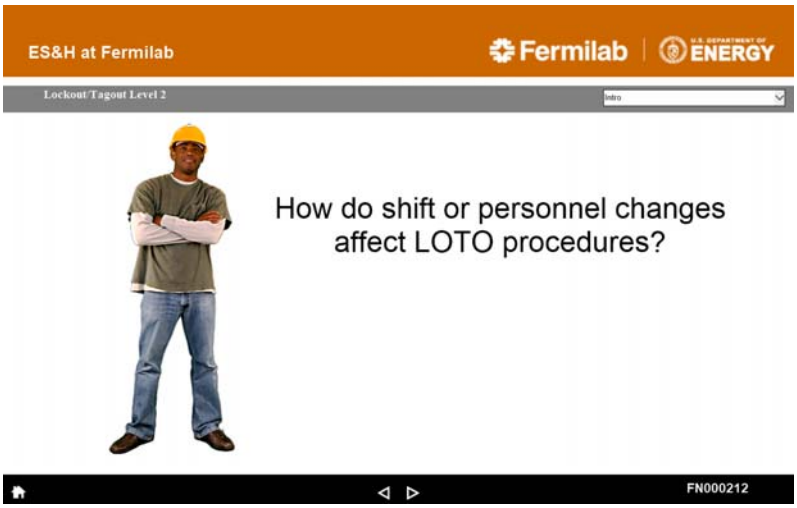




* Type B- Meant to accommodate complex lockout/tagout activities.
The lead authorized employee performs or directs the performance of the LOTO activity.
The associated key(s) are then captured in the job lockbox.
Authorized Employee places his lock/tag to lockbox.
An additional lock/tag by Lead to retain control of the captured key(s).
Authorized employee may do their own verification of de-energization if they so choose and/or walk with the lead authorized employee witnessing the placement of locks and the VERIFICATION of de-energization.





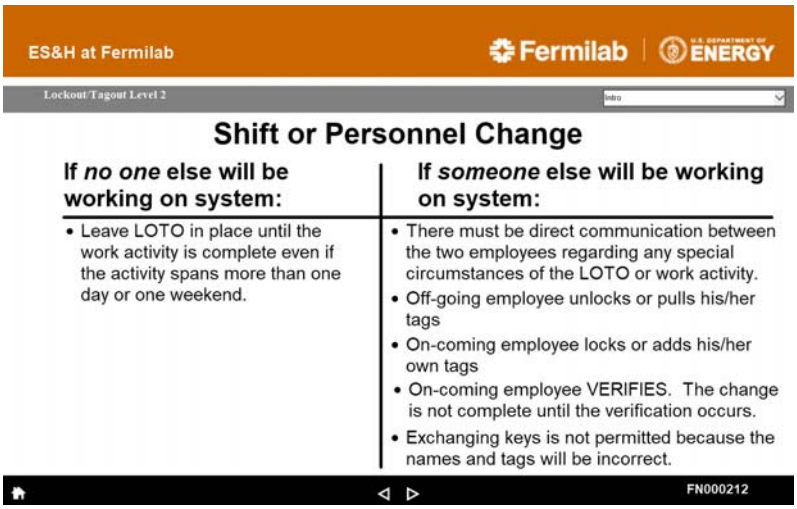


* Normally, authorized employees may leave their LOTO devices in place until the work activity is complete – even if the activity spans more than one day or a weekend.

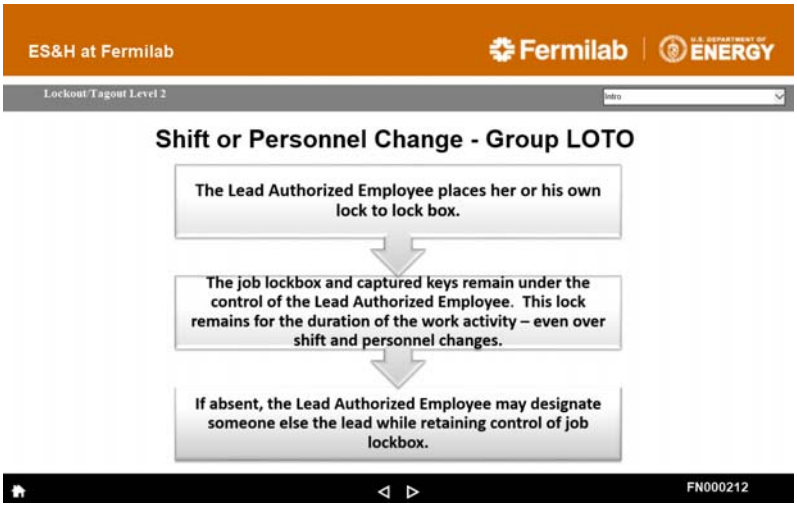
There must be direct communication between the two employees regarding any special circumstances of the LOTO or work activity. You replace the off-going employee locks with your own locks.

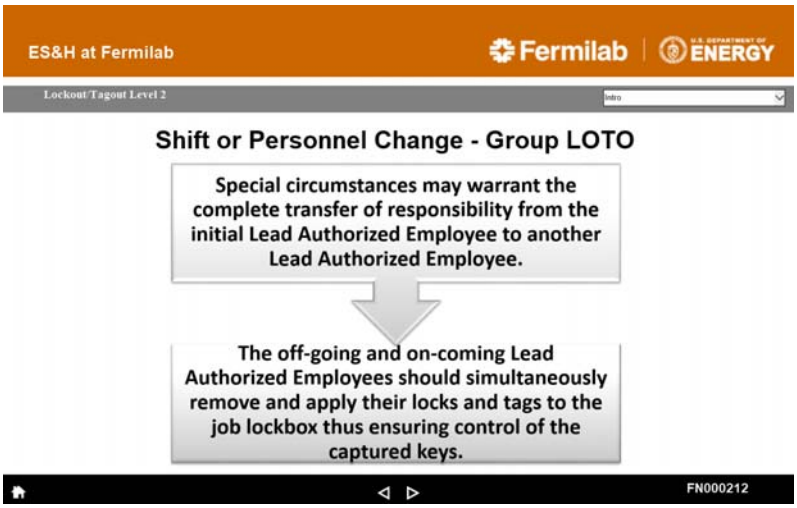
The change is not complete until on-coming employee VERIFIES. That is the most important message you can take with you from this course and the one that someday may save your LIFE.

Merely exchanging keys is not permitted. If only the keys are exchanged, the name on the tags will be incorrect.



* The job lockbox and captured keys remain under the singular control of the lead authorized employee when the lead authorized employee places his lock on the lock box. This lock remains for the duration of the work activity – even over shift and personnel changes.





* Group LOTO

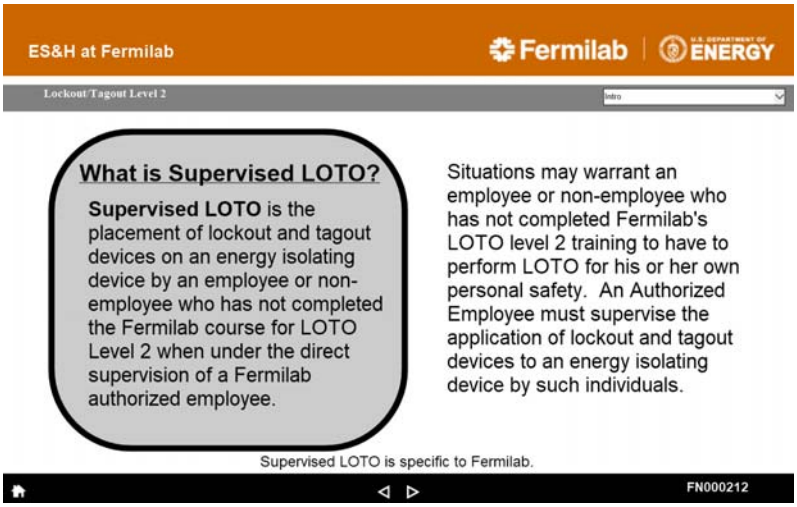
Special circumstances may warrant the complete transfer of responsibility from the initial lead authorized employee to another lead authorized employee.

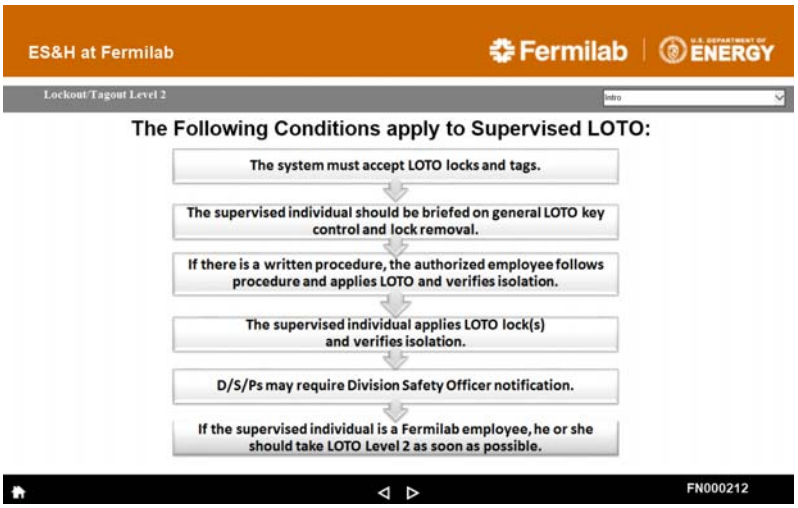
The off-going and on-coming leads would simultaneously remove and apply their respective locks and tags to the job lockbox, thus insuring control of the captured keys.

* How is supervised LOTO defined? Simply… 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.

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.

An authorized employee may supervise the application of lockout and tagout devices to an energy isolating device by such individuals.





* Conditions apply
Under Supervised LOTO the untrained person cannot be using tagout only. Also the briefing must include many of the points we have discussed today especially with regard to lock key control and lockout and tagout device removal.

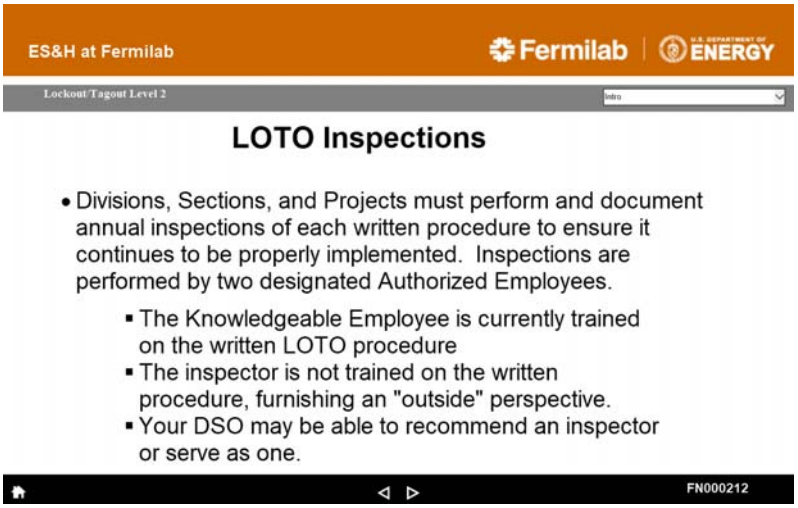
* All authorized personnel's LOTO training must be periodically reviewed and refreshed. Why? To refresh yourself on general LOTO requirements that you don't use as part of your job, and to be made aware of revisions to the LOTO procedures.

General LOTO training, this course, must be retaken every two years. The initial session must be classroom-based training. After that, you must pass the challenge exam every two years. You will be notified online when it is coming due.

If you fail the online exam twice, you must suffer through a classroom session again.

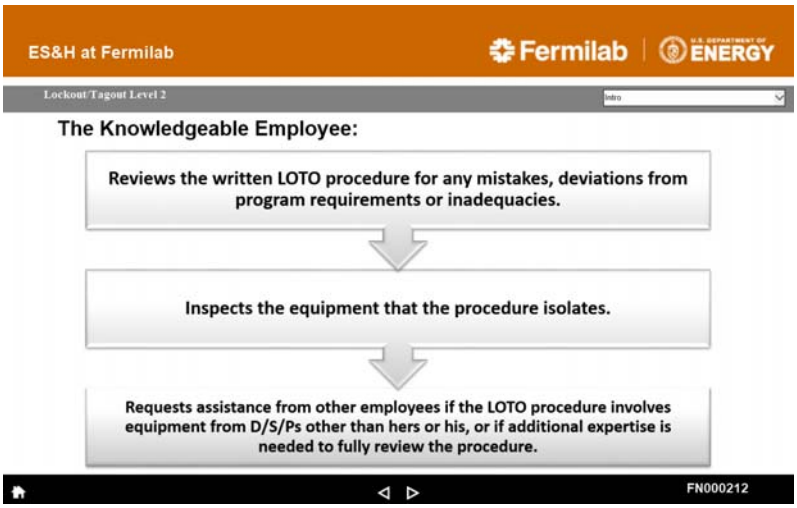
The same training course page where you find the link to the online test also has a link to the course training materials. We recommend that you review the training materials before you take the online exam the first time, especially if the revision date on the training materials is more recent than your last exam.

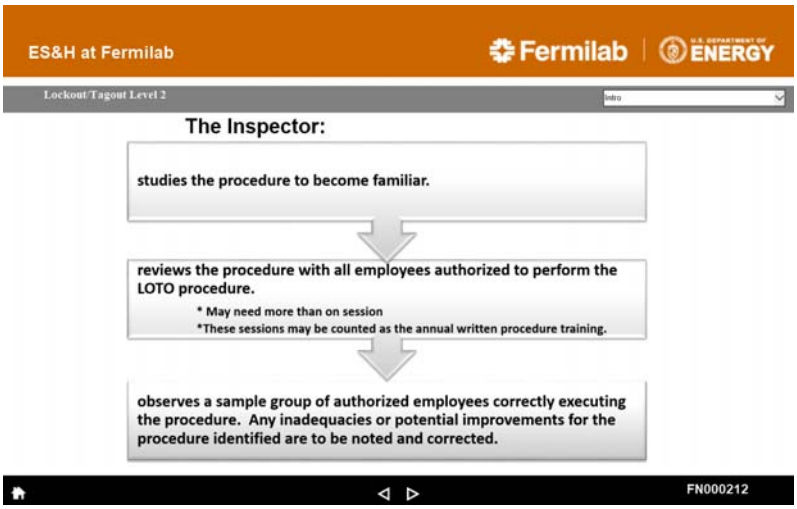
You must be trained in a written LOTO procedure in order to use it, and that training expires in one year from the date of training.



* Divisions, Sections, and Centers must perform and document annual inspections to assure that each Written LOTO Procedure continues to be implemented properly. This is a three-step process that begins with a review of the written procedure by a Knowledgeable Employee. This is an opportunity to capture changes that occur because of added, removed, and updated equipment and changes to interfaces with other employees and systems.

The inspection is conducted by person who has received LOTO 2 training, but is not authorized on the specific written procedure. This requirement puts a set of "outside eyeballs" on the procedure to capture any ambiguities or deficiencies that those familiar with the procedure might overlook.





* The inspectior should review the Written LOTO Procedure with all employees authorized to perform the procedure. More than one training session may be needed if all the authorized employees are not available at once, such as if some work off shifts. It is intended that these inspection reviews also be used to meet the Authorized Employee's annual training requirements.

As a final check, the Inspector observes a sample group of the Authorized Employees implementing the Written Procedure. Any inadequacies or potential improvements for the procedure identified are to be noted and corrected.

Note to Instructor: The periodic training for a particular written procedure may need to be performed in more than one meeting. It can be performed by one authorized employee observing another one go through the process of locking out the equipment while following the written procedure. Or, by one authorized employee using the written procedure while a group of authorized employees observe. In both cases an attendance document must be generated.

This may serve as an occasion for training new employees in the use of the written procedure.

LOTO Inspections

- Operation schedules may result in the inspection of one or more written procedures expiring.
- The expired LOTO procedure must be inspected before it can be performed again.
- The first application of the LOTO after re-training the authorized employees may be the inspector's sample observation.

What is Fermilab's LOTO procedure for Sub-Contractors?

* All subcontractors must be able to demonstrate that their personnel working where LOTO is used are trained.

Sub-Contractors

All sub-contractors must be able to prove that all their personnel performing LOTO have been trained.

LOTO training is done differently for two types of sub-contractors

- **Fixed-priced** sub-contractors have contracts with a well defined scope, schedule and cost, such as constructing a building.
- **Time & Material (T&M)** sub-contractors are under a contract to perform work that is too urgent or too small in scope for a bidding process to be practical.

* Subcontractors must have a LOTO program in place if they perform work in which energization or energy release may cause injury. Many subcontractors perform construction, which is governed by OSHA 1926, not 1910 like Fermilab employees, so their compliance methods may legitimately differ.
OSHA requires that Fermilab and our subcontractors inform each other of our LOTO programs and what we must do to comply with each other's programs. Our standard subcontractor training program informs our subcontractors about Fermilab's LOTO program.
Fermilab will communicate the same information about the subcontractor's LOTO program to those who will be affected by the subcontractor's work.
In the absence of proof that a lock or tag is not a LOTO lock or tag, treat it with the same respect as a Fermilab LOTO lock or tag. Subcontractors may use a different color LOTO lock or a different tag format.

Fixed Price Sub-Contractors

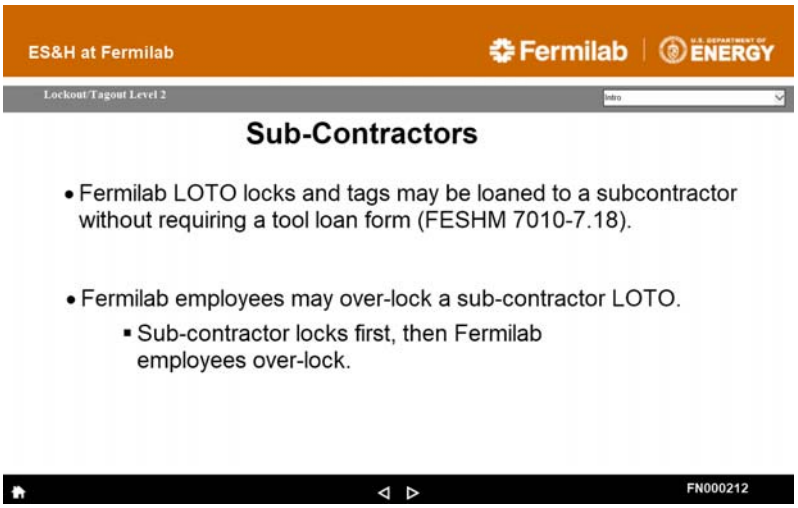
- Fixed price sub-contractors are required to have their own LOTO program if they perform activities which may cause injury from energy release.
- Fixed price sub-contractors learn about our LOTO program through subcontractor orientation.
- Fixed price sub-contractors submit their program to their Fermilab project manager for approval by ES&H.
- Fermilab informs affected employees about and how to comply with the subcontractor's LOTO program.

* Two subcontractors follow our program in accordance with their contract. Those are the Time and Material subcontractors that work HVAC systems and electrical distribution systems.

Employees of these two subcontractors attend LOTO 2 training if scheduled during the timeframe when the subcontractor needs the training. Always remember that the primary responsibility for training is the subcontractors. FNAL is a client.

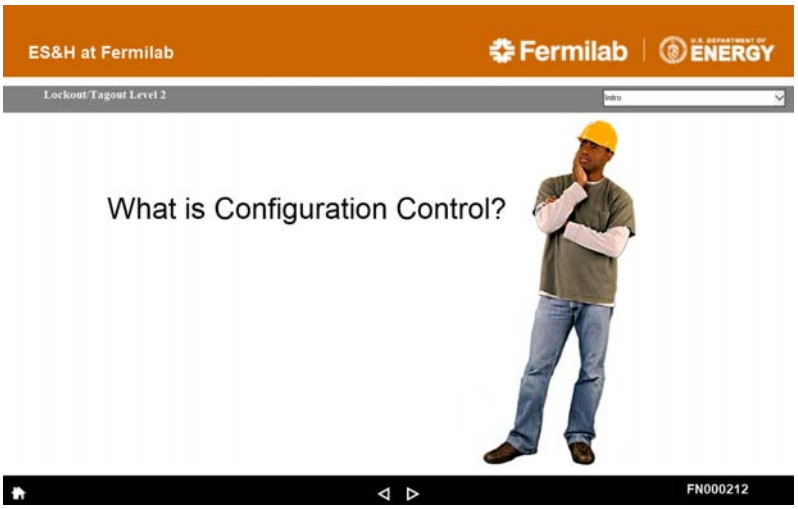
T&M Sub-Contractors

- must follow Fermilab's LOTO program
- include electrical, pipefitting, ironwork and HVAC
- receive LOTO II training at no cost to them



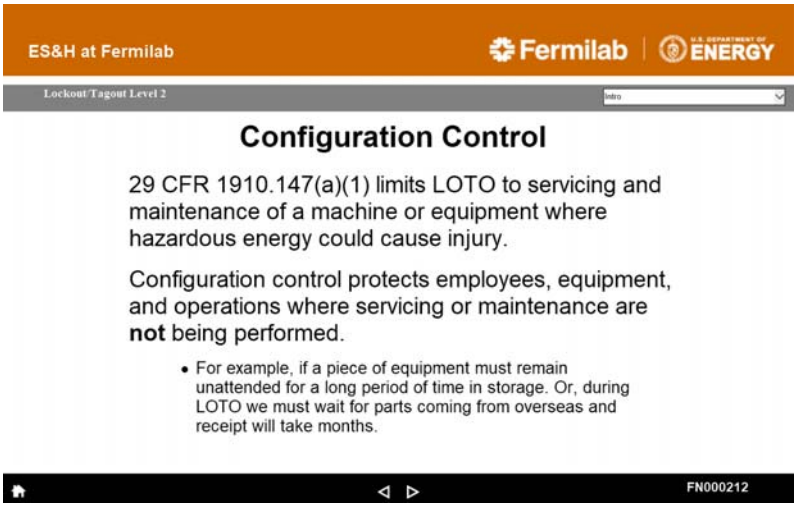
* Fermilab locks and tags may be loaned to subcontractors without the need to fill out the tool loan form found in FESHM 7010.

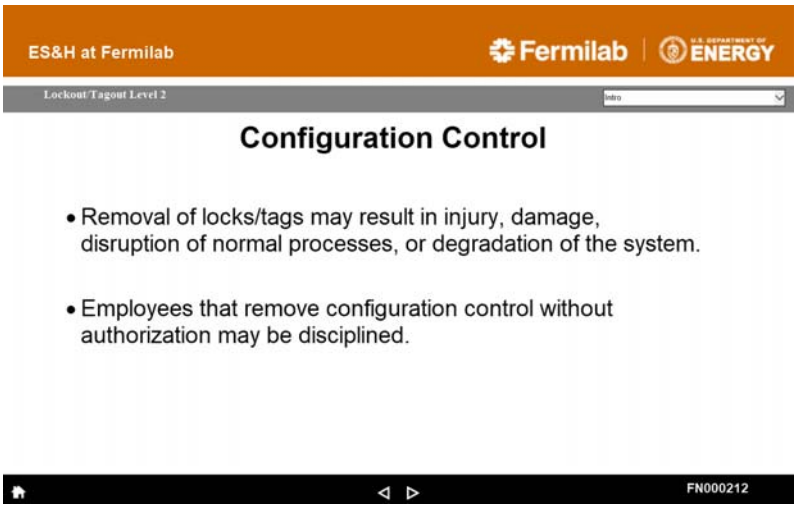
Over locking is a way of maintaining control over the job. The sub-contractor locks first, then the Fermilab task manager or construction coordinator may over-lock.



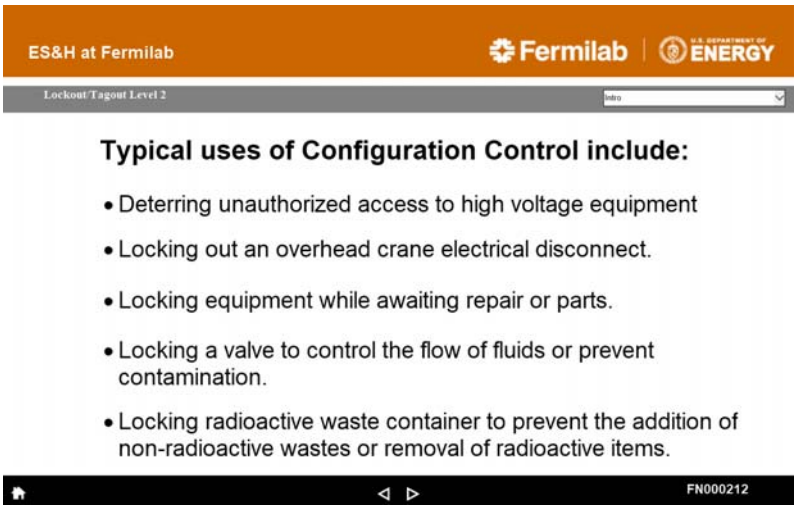
* This program is used when we need to exercise some sort of configuration or administrative control.

For example, if a piece of equipment must remain unattended for a long period of time such as in storage. Or, during LOTO we must wait for parts coming from overseas and receipt will take months. Also, if we are custodians of a building fixed crane and we want only trained and authorized personnel using the crane. How about a sump pump or exhaust fan that must remain in the ON mode.





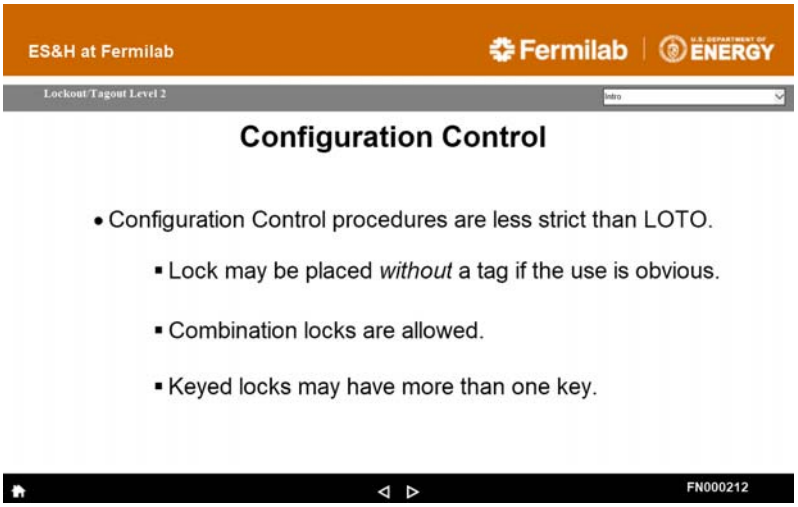
* Keep in mind that removal of the configuration control lock may result in injury, damage or disruption of normal processes. Removal of a configuration control without proper authorization may result in discipline.



* Other examples of configuration control are:

Ask the students for other examples they may use these locks.

- 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



* Example for bullet point 1

Locking high voltage switchgear
Locking magnet power supply doors

A combination lock is allowed.
Locks may have more than one key where in LOTO only one key can exist.

* Unsafe to who? Individuals or may cause damage to the equipment.

Divisions, Sections, and Centers may impose more stringent requirements. Make a real effort to find out the conditions for removal if you plan to cut an administrative lock found in other jurisdictions.

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Lockout/Tagout Level 2

Configuration Control - Removal

- The removal of the lock should be done by the person or group who applied it.
- Lock removal by another authorized or qualified person is allowed if there is assurance that removal will not create an unsafe condition.
- D/S/Ps may impose more stringent requirements. Make sure to find out the conditions for removal if you plan to remove a configuration control lock found in other jurisdictions.

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Lockout/Tagout Level 2

Configuration Control Locks

- Can use any shape or color of lock **EXCEPT RED.**
- Yellow, manila or red tags are allowed. However, they must not contain the words "*DO NOT OPERATE*".
- RED locks and "*DANGER: DO NOT OPERATE" tags* are used exclusively for LOTO.

Padlock stock # 1208-500700

Combination stock # 1208-501000

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Lockout/Tagout Level 2

Configuration Control Tags

ASSE / ANSI Z535.5 (2011 edition)

DANGER: "indicates an imminently hazardous situation which, if not avoided, **will** result in death or serious injury. This signal word is to be limited to the most extreme situations."

2650-41200

WARNING: "indicates a potentially hazardous situation which, if not avoided, **could** result in death or serious injury."

2650-401300

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Configuration Control Tags Cont.

ASSE / ANSI Z535.5 (2011 edition)

CAUTION: "indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices."

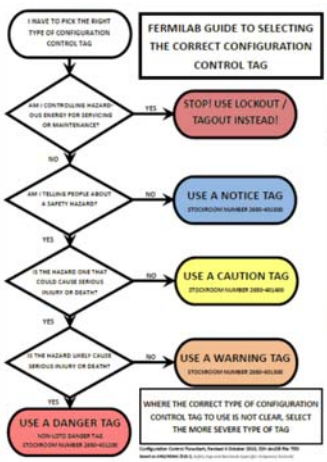
2650-401400

NOTICE: "is appropriate for property-damage-only hazards.

2650-401500

(Caution without the safety alert triangle is now obsolete)

Config ... ection



Click to enlarge image

Close large image

* Self-explanatory

Configuration Controls & Sub-Contractor LOTO

- As noted before, most subcontractors are eligible to use their LOTO system in place of Fermilab's.
- Sub-contractor LOTO may use other lock and tag colors and wording that are different from Fermilab's.
- If you have any doubt, treat it as lockout!

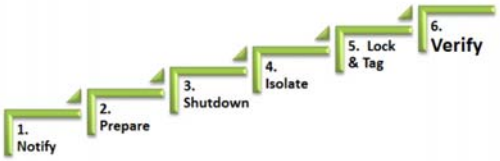
Summary

Summary

- You will become an Authorized Employee for two years upon successful completion of this training.
- Red locks and danger tags mean LOTO in place. LOTO is ***not*** to be violated. You will not be faulted for investigating any locks and tags before removing them.

Summary

Remember the six steps to lock out.



Summary

Remember the *Five Steps to Return to Service*.

1. Check equipment
2. Check work area
3. Verify that controls are in neutral, OFF or in a safe state
4. Remove Locks and Tags, and energize if appropriate
5. Notify affected employees

Summary

- Written LOTO procedures are required under special circumstances. They must be written by Knowledgeable Employees and must receive Dept. Head approval (or higher).
- The temporary removal of LOTO locks and/or tags is allowed if you follow the *Five Steps for Return to Service* and restore the lockout/tagout conditions following the procedure.

Summary

There are two types of Group LOTO.

Type A - each worker does LOTO and verifies.

Type B - the Lead Authorized Employee locks and VERIFIES. Each Authorized Employee may observe and VERIFY at his/her discretion.

Summary

- Be sure to follow proper procedures during shift changes that involve LOTO or Group LOTO.
- Training is required in order to perform General LOTO. Additional training is required to be able to perform each Written LOTO.
- Inspections and audits of written LOTO procedures are required.

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Lockout/Tagout Level 2
Intro

Summary

Supervised LOTO is allowed when an employee or visiting/guest scientist needs to perform LOTO and training is unavailable. An Authorized Employee must supervise the application of the LOTO.

ES&H at Fermilab
Fermilab | U.S. DEPARTMENT OF ENERGY
Lockout/Tagout Level 2
Intro

Summary

- Fixed price sub-contractors are required to have their own LOTO program if they perform activities which may cause injury from energy release.
- Time & Material sub-contractors are an exception. They ***must*** follow Fermilab's LOTO procedures.

Summary

- The Configuration Control program is used to exercise administrative control. It is less strict than LOTO.
- The hazards or damage against which configuration control protects may be as severe as LOTO hazards.

This concludes LOTO 2 training. Upon passing the test you will be qualified to perform General LOTO for 2 years.

You will receive TRAIN credit upon successful completion of the LOTO test. Click here to take the LOTO 2 test.

Don't forget what you learned today.
It might save your life!