TRAINING & QUALIFICATIONS PROGRAM OFFICE BROOKHAVEN NATIONAL LABORATORY	Course Code: OSH151C Control No.: 01 Revision No. 1

LOCKOUT / TAGOUT STUDY GUIDE

Lockout/Tagout

Study Guide

for the

Challenge Exam

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Lockout/Tagout
Authorized Employee Training Study Guide

What is Lockout/Tagout?

In 1989, the Occupational Safety and Health Administration (OSHA) issued a final rule on the "Control of Hazardous Energy (Lockout/Tagout)." Subsequently, this ruling became Part 1910.147 of Title 29 of the Code of Federal Regulations (29 CFR).

This federal regulation, which went into effect on January 2, 1990, helps safeguard employees against the unexpected startup of machines or equipment, as well as from the release of hazardous energy while performing service or maintenance.

29 CFR 1910.147 identifies practices and procedures that must be followed to shut down and lockout or tagout machines and equipment. This regulation also specifies that employees receive training in their employer's lockout/tagout program and mandates that periodic inspections be conducted to maintain or enhance an organization's energy-control program.

Training Objective

Upon completion of this course, you will be able to prevent loss of life, personal injury, and damage to equipment by controlling energy in accordance with BNL's Lockout/Tagout Requirements, ES&H Standard 1.5.1.

ES&H Standard 1.5.1, which is part of BNL's Standards Based Management System, details safety requirements for the control of hazardous energy. The Standard also addresses the practices and procedures necessary to disable machinery or equipment and to prevent the release of potentially hazardous energy during maintenance, servicing, or construction.

While a large percentage of applications deal with electrical energy, lockout/tagout (LOTO) applies to the control of ALL sources of energy. Seven different sources of energy are defined in this course.

Training Restrictions

Completion of this training course alone does not qualify you to lockout and/or tagout equipment. In addition to this course, your work supervisor must instruct you on job-specific requirements and procedures that you need to follow. When confident of your practical skills and job knowledge, your organization will authorize you to lock and tag equipment unsupervised.

Why Lockout/Tagout?

Accident statistics and analysis has shown that failure to control energy causes approximately 10% of all serious incidents. Each year, there are approximately 200 LOTO-related incidents reported at DOE Government-Owned/Contractor-Operated (GOCO) sites, like BNL.

The root cause for many of these incidents was lack of training in de-energizing machinery or equipment, failure to consult schematics or drawings, or inappropriate or inadequate lockout/tagout procedures.

In addition, OSHA research found that the number of accidents lowered after workers received LOTO training, but that incidents began to increase starting about 15 months after training. As a result, OSHA requires retraining in LOTO programs annually. OSHA also requires retraining

whenever there is a change in job assignment, machines, equipment, processes or procedures, or whenever inspection reveals inadequacies in knowledge or use of energy-control procedures.

When Should You Lock or Tag Out?

You must apply lockout/tagout whenever you are performing service, maintenance, or construction around any machine where you could be injured by:

- Unexpected start-up of the equipment
- Release of stored energy

LOTO tags should not be used to control the normal use of machines or equipment. Instead, yellow caution tags, such as those shown here, should be used for administrative control.

Front 

Back

Typical situations that are likely to require application of lockout/tagout include:

- Removing or bypassing a guard or other safety device
- Placing any part of your body where it could be injured by moving machinery
- Working on or near exposed electrical conductors

What You Need To Do:
Remove energy flowing to a device AND release or secure stored energy within the device in order to bring it to a "zero energy state" prior to working on the affected equipment.

Sources of Energy

While a large percentage of applications deal with electrical energy, lockout/tagout (LOTO) applies to the control of ALL sources of energy. Seven different sources of energy are discussed in this study guide.

They are:

- Mechanical
- Electromagnetic
- Electrical
- Chemical
- Thermal
- Hydraulic
- Pneumatic

1. Mechanical

Mechanical energy is defined as movement or the potential for movement. This can be either:

- Kinetic energy: due to motion of an object
- Potential energy: stored in an object that isn't moving

Kinetic Energy: Avoid exposure to rotating equipment, especially after machine guards have been removed. Inspect the system to make sure all parts have stopped moving before going near them.

Potential Energy

From basic physics, any weight (pounds) raised to a height (feet) will store potential energy, which we measure in foot-pounds, abbreviated as ft-lbs. For instance, a 5-pound brick sitting stationary on the ground is not a source of potential energy, but it represents a great deal of energy (250 ft-lbs) if raised to a height of 50 feet.

A spring under tension or compression may store a tremendous amount of potential energy. Be sure to block any spring-driven mechanical motion or relieve tension stored in springs.

Always be aware of anything that has the possibility for generating an uncontrolled release of potential energy. Be sure to block or brace parts that could fall because of gravity.

2. Electromagnetic

Electrically powered devices produce magnetic, radio frequency, and laser energy. Interlocks and/or barriers are the usual controls utilized to prevent exposures beyond acceptable limits.

When maintenance or service work is to be performed on such devices that produce energy levels beyond acceptable limits, the procedures used to control electrical energy are used to control exposure to these strong energy sources.

Special care must be taken when re-energizing electrically powered equipment capable of producing fields that could be harmful to personnel.

3. Electrical

Electrical energy could be supplied by wires to a device from one or more power sources, or it may be stored within a device by batteries or charged capacitors.

Check schematics to determine if you have located ALL power sources and controls. Be sure that your schematic reflects the latest modifications and updates. Isolate ALL energy sources, including secondary power supplies as well as the main supply.

If the source of power is through a flexible line cord and plug, under your exclusive control, and will remain in your sight, then LOTO is not necessary.

If working with capacitors, make certain that they have been isolated from the energy source and have been discharged and are shorted before working on them. Consider the time constant if working on a Resistor-Capacitor (RC) circuit.

Warning - If not shorted or grounded properly, capacitors may recharge through dielectric absorption.* If there is a possibility that stored energy will re-accumulate, the capacitor must be monitored to make sure its energy stays below hazardous levels.

Inductors are electrical components that store energy as current. Small inductors normally discharge rapidly, except in the case of supercooled inductors. Consult operating specifications before working on supercooled inductors.

4. Chemical

Avoid exposure to large quantities of chemicals and fumes, such as caustics or acids, especially when opening vats or tanks, or when disassembling chemical transfer lines. Since splashes can occur during transfer of chemicals, always use the proper procedures as well as personal protective equipment.

Many chemicals present a stored-energy hazard. For instance, if a flammable liquid such as gasoline is spilled, its vapor can ignite violently, creating physical hazards from the heat and explosion pressure.

Hydrogen, used for many purposes around BNL, can create an explosion hazard when mixed with the oxygen in air. When purging hydrogen lines, make sure there are no ignition sources in the area.

5. Thermal

Exposure to temperatures above 113°F or below 39°F requires personal protective equipment and/or proper handling techniques.

Examples of heat hazards include:

- Heating elements in soldering irons or heat guns
- Open flames used in oxyacetylene burning and welding operations
- Burners used in laboratories

Also be aware that:

- Some flames are colorless and are hard to see, such as those from an alcohol burner
- Black (not red-hot) heating elements cause most burn injuries.

Hazards from cryogenic fluids*, such as liquid nitrogen, helium, oxygen, air, methane, and hydrogen, include:

- Cold injuries resembling burns
- Acute respiratory problems
- Sudden expansion due to phase changes from a liquid to a gas
- Oxygen deficient/enriched atmosphere
- Fire and/or explosion

In addition, insulated tanks that retain their extreme heat or cold must be brought to room temperature prior to working on them. If this cannot be done, then personal protective equipment such as gloves must be used.

*(a definition is provided on the last page of this study guide)

6. Hydraulic

Most hydraulic systems operate at high pressures. In fact, some are so high that a leak could drive fluid through a person's skin and into the bloodstream.

Before working on hydraulic systems:
- Block components that could move from loss of pressure.
- Relieve trapped pressure in the system.

Before working on other fluid filled systems:
- Drain process piping system and close valves to prevent the flow of hazardous materials.
- If a line must be blocked where there is no valve, use a blank flange.
- Purge reactor tanks and process lines.

7. Pneumatic

Pressurized gas systems may contain tremendous energy. Compressed air at full line pressure of up to 100 psig is often used to operate pneumatic tools and certain control instruments. At this pressure, air can penetrate the skin, creating air bubbles in a person's bloodstream that can cause an obstruction of a blood vessel, called an embolism.

The hazard posed by pressurized systems is so great that if there is a chance that skin will be exposed to the air stream, the pressure must be restricted to a maximum of 30 psig using restricting nozzles.

Stored Energy

All forms of stored energy, whether mechanical, electrical, hydraulic, or otherwise, must be released or secured in order to bring a device to a "zero energy state" before servicing or maintenance work can be started.

Multiple Energy Sources

Complex equipment, such as accelerators and their related detectors, have multiple sources and types of energy.

There are several large physics machines here at BNL, notably within the C-AD and NSLS that have within their systems every source of energy that was just discussed.

BNL's Lockout/Tagout Requirements

BNL defines two classes of personnel who may come in contact with equipment that is normally connected to an energy source. These two classes are:

Affected Employees
- Anyone whose normal job is to operate or use a machine or other equipment on which servicing, maintenance, or construction is performed under lockout or tagout, or who works in an area where these activities are performed.

Authorized Employees
- Anyone who has received formal training in LOTO and is authorized to implement lockout or tagout on machines or equipment in order to perform servicing, maintenance, or construction.

Affected Employee

An "Affected Employee" must be able to recognize when the energy-control procedure is being implemented and to identify locks and/or tags used in the Laboratory's LOTO Program. Affected Employees must understand the purpose of the procedure and realize that if they remove or attempt to bypass locks or tags, or attempt to start-up or use equipment that has been locked and/or tagged out, they may injure or kill the person performing maintenance on the equipment.

Anyone who attempts to defeat the LOTO energy-control procedure will be subject to disciplinary action.

Authorized Employee

An "Authorized Employee" is trained to recognize hazardous energy sources, the type and magnitude of the energy available in their workplace, and the methods and means necessary to isolate and control those energy sources. This trained person is then permitted to implement LOTO whenever exposure to hazardous energy sources could lead to serious injury, harm, or death.

BNL further defines two classes of "Authorized Employees:"

- Knowledgeable Employee
- Responsible Employee

It is recommended that line supervisors are trained to the "Responsible Employee" level and act in that capacity.

Knowledgeable Employee

A "Knowledgeable Employee" is a person whose name is carried on an organizational list signifying that he or she has:

- Received formal training in lockout/tagout work, and
- Documented "hands-on experience" in safety-related technical aspects of the equipment.

All first-line supervisors of Knowledgeable/Authorized employees must, at a minimum, be qualified at the same level.

"Knowledgeable Employees" are authorized to lockout and tagout systems and equipment primarily for their own safety when performing servicing and maintenance activities.

These employees are **not** permitted to implement "group lock" or "operations lock" systems. They are, however, authorized to add their own locks and tags in "group/operations lock" situations, provided that their lock and tag is not the first applied or the last one to be removed.

Responsible Employee

A "Responsible Employee" has his or her name carried on an organizational list as having:

- Received training in lockout and tagout work, and
- Documented "hands-on experience" in safety-related technical aspects of the equipment, and
- Received additional training to exercise group and system-level judgments.

"Responsible Employees" are only authorized to lockout and tagout equipment for which they have their organization's approval.

Group Lock/Operations Lock

- Group Lock/Operations Lock systems shall only be implemented by a "Responsible Employee" who is responsible for the employees working under his or her protection.
- These systems are used to protect personnel in complicated situations or when shift changes or personnel transfers reduce the effectiveness of one worker/one lock.
  - Group Lock - One person takes responsibility for other employees working in the same trade or work group.

- Operations Lock - Multiple energy sources to a complex device are secured with individual locks whose keys in turn are secured in a lockable box.

- For their own protection, each "Authorized Employee" working on such a project is also advised to affix a personal lockout/tagout device to the group/operations lockout when he or she begins work and remove that device when he or she stops working on the equipment.

BNL's LOTO Lock

Lock: Silver colored MASTER padlock with red colored plastic band

- BNL Stock Number I-65054
- One key issued to user, with the lock's second key controlled by the user organization's LOTO coordinator or destroyed
- Padlock must be traceable to the person using it
- Name/ID number on lock or individual LOTO Tag must be applied with lock

BNL's LOTO Tag

Front Back

Tag: Red HOLD-DANGER DO NOT OPERATE two-part tag with matching serial numbers on both tag parts

- BNL Stock Number I-81045
- Detach separable stub and return for data entry in LOTO Log no later than the end of the shift that issued the tag

OSHA requires the tag to be fastened by a non-reusable attachment capable of withstanding a 50-pound pull.

- Use a nylon cable tie (BNL Stock Number A-59842)
- If taping tag in place use OSHA warning tape or duct tape (BNL Stock Number K-72102 or I-45734)

BNL's LOTO Label

Label: Red HOLD – DANGER

- BNL Stock Number S-33780
- 1.5 inch high x 3 inch wide self-sticking label with a space for recording the Tag Serial Number
- This label is used in conjunction with regular LOTO Tag

LOTO Energy-Control Procedure

A six-step OSHA required procedure described below must be followed when performing either mechanical or electrical work.

Whenever the work does not involve direct exposure to electrical conductors, electrical measurements are not necessary and create additional hazards.

In these cases, when mechanical service work will be done, the disconnect switch is locked in the OFF position and verification of isolation is accomplished by attempting to operate the equipment by it's normal operating control, usually a start-stop switch.

The procedure for implementing LOTO for electrical work on equipment powered through a fused disconnect switch will be described later in the course.

BNL's Energy-Control Procedure

BNL has implemented the following six-step process in order to meet OSHA requirements for service or maintenance of machines and equipment.

Step 1 - Preparation for Shutdown - Notification of Affected Workers
Step 2 - Machine or Equipment Shutdown - Operating controls turned OFF
Step 3 - Machine or Equipment Isolation - Energy sources isolated
Step 4 - LOTO Devices Applied - To all energy isolating devices
Step 5 - Control of Stored Energy - Relieved, restrained or controlled to prevent re-accumulation
Step 6 - Verification of Isolation - Check that isolation and energy control have been accomplished

Preparation for Shutdown

Communication is extremely important in LOTO. In the work planning process, all personnel coming under the category of "Affected Employees" are to be identified. The "Authorized Employee" must notify all these identified "Affected Employees" before LOTO is applied.

All lockouts and tagouts are required to be documented in a bound Logbook.

Before starting work, the "Authorized Employee" must physically locate all energy-isolating devices using schematics or prints as necessary. Before turning off any equipment in order to lock or tag it out, the "Authorized Employee" must know the types and amounts of energy that power it, the hazards of that energy, and how the energy should be controlled.

Equipment Shutdown

Verify that a piece of equipment's normal operating control (typically, an on/off switch) causes it to operate. Once confirmed, shut the system down with its normal operating control. Follow whatever procedure is specified for the equipment so that you shutdown the correct device and don't endanger anyone during the shutdown.

Equipment Isolation

Equipment Isolation can be hazardous; be sure to wear safety glasses.

- De-energize ALL power sources and safely disconnect all appropriate mechanical linkages. Be sure to isolate ALL energy sources – both primary and secondary power supplies.
- BE CAUTIOUS! Many electrical disconnect switches are not rated to be opened while under load, which could cause an arc. For the same reason, do not remove cartridge-style fuses from energized circuits.

Application of LOTO Devices

If the equipment can be locked out, do so with a BNL dedicated red-banded Master padlock and, where appropriate, attach a red HOLD tag. These locks and tags are only to be used for LOTO – no other use is permitted. After lock is applied, the user keeps the key in his/her immediate possession (pockets the key).

- If more than one employee is working on the equipment, then more than one lock/tag should be attached. One worker - one lock/tag
- If your lock cannot be placed directly on the energy control, use a lockout device.* Also more than one employee can lock out a single energy-isolating device by using a multiple lock adapter.

*(a definition is provided on the last page of this study guide)

- For big jobs, a lockout box can be used to maintain control over a large number of keys.
- If a group lock is used, then the Responsible Person who applied the lock must ensure that it is properly tagged.
- Cord/plug-connected electrical equipment is made safe by unplugging the equipment cord. If the plug is within sight and under your exclusive control, the use of LOTO is not required.
- If you are working on equipment installed before January 2, 1990, a provision to attach a lock was not a requirement and you may not be able to attach a lock.
- If the equipment cannot be locked out, it must be tagged out with a red LOTO tag as well as disabling and labeling a supplemental device to render the system safe. Examples of supplemental devices include the removal of an isolating circuit element, blocking a controlling switch, removing a valve handle, inserting a blank flange, or operating the next upstream disconnecting device. The idea is to bring the tagout to the same level of safety as lockout.
- Place each LOTO tag at the same location or as close as possible to the energy-control device. Secure the tag using a non-reusable nylon cable tie with an unlocking strength of not less than 50 pounds. Make sure the tag is filled out legibly and correctly.

Control of Stored Energy

All potentially hazardous stored or residual energies must be relieved or otherwise rendered safe prior to working on the equipment or system.

If there is any chance of re-accumulation of energy, it must be prevented by shorting or grounding electrical components, leaving vent or drain valves open on pressurized hydraulic or pneumatic systems, etc.

Verification of Isolation

After locking and tagging out equipment, but before beginning work, the "Authorized Employee," trained in the use of the appropriate test equipment, must verify that the equipment has been isolated and de-energized.

Use Personal Protective Equipment that your organization requires. Always wear safety glasses when working on or near energized conductors and when verifying electrical isolation.

Verify that the locked-out equipment is inoperative. After checking that there is no danger to personnel, press all start buttons or try to operate the equipment using its normal controls.

When operating rotary or toggle switches, be sure to return them to the OFF position to ensure that the machine does not re-start when power is restored.

Pressure or Vacuum

Use the appropriate gauge for the material and medium being tested as well as the appropriate range and scale.

- When testing for vacuum, use an appropriate gauge with a scale marked in vacuum units.
- For low-pressure systems, it may be necessary to loosen flange bolts and slightly separate a flange joint to verify that all pressure is relieved. This should be done only if there is no danger of exposure to a hazard. A better method is to open test fittings or drain valves to assure that the pressure is relieved. Drain valves should be left open to prevent re-accumulation of pressure.

Temperature
Many systems that are maintained at the Lab may operate at extremely high or low temperatures. They must be allowed to return to room temperature before work on them can begin.

- If the systems or devices have temperature-measuring instruments installed, use them.
- If there is no installed instrumentation, you may use various devices to find the temperature. Some temperature measuring devices are:
  - Pyrometric sticks--These are crayon-like sticks that can be rubbed on a surface. The stick's wax-like material will melt if the temperature is within 5° of the specified stick temperature.
  - Thermometers--A contact-type, fast-response thermometer is a quick and easy way to measure temperature.
  - Pyrometers--A point-and-shoot method for high temperature objects.
  - Infrared heat detectors--A point-and-shoot method useful within a wide temperature range.

Electricity
If the circuit being tested has a voltage greater than 50 Volts, along with greater than 10 milliamperes of available current or capable of instantaneously releasing 10 Joules or more of energy, you may need to follow working-hot procedures.

Remember the following conversion equivalents: (10 Joules = 10 watt-seconds = about 7 ft.-lbs.)

When testing line-powered electrical circuits, use only voltage measuring devices that are "listed" by a nationally recognized testing laboratory, such as UL (Underwriters Laboratory).

Application of LOTO Process

A more involved application of the six-step OSHA required procedure just described must be followed when performing electrical work on electrically powered equipment.

The following pages describe the process that must be followed for electrically powered equipment at BNL in the range of 120-volts to 600-volts that are wired through fused disconnect switches.

In circumstances where access to electrical conductors is needed, it is necessary to verify isolation by measuring for voltage on the load side of the fused disconnect switch. Most disconnect switches, however, will not permit the door to be opened when a locking device is applied to the switch lever.

For these situations, the following procedure is used:

Step 1 - Preparation for Shutdown
Use Personal Protective Equipment that your organization requires.

- At a minimum, ALWAYS wear safety glasses when working on or near potentially energized conductors and when verifying electrical isolation.
- Notify all "Affected Employees" of the planned shutdown of the equipment and application of LOTO devices.

Step 2 - Shutdown of Equipment

Follow whatever procedure is specified for the equipment so that you shutdown the correct device and don't endanger anyone during the shutdown.

- First, verify that a piece of equipment's normal operating control (typically, an on/off or start/stop switch) causes it to operate.
- Once confirmed, shut the system down with its normal operating control.

Step 3 - Equipment Isolation

Isolate the equipment by moving the equipment's disconnect switch to the OFF position.

- When turning a disconnect OFF, keep your face away from the cover of the box and wear safety glasses.
- Arc explosions have occurred, resulting in the cover being blown off or open, and a fireball burning the worker.
- Protect yourself by not standing directly in front of the box and turn your face away from the box when actuating the switch lever.

Step 4 - Application of LOTO Devices

Remember, this is a special (and hazardous) procedure.

Open the cover of the box cautiously; always assume that all electrical components are energized until proven otherwise. Safety glasses are required for arc-flash protection.

- CAUTION: Visually check that all contacts have opened. Disconnects are mechanical devices and have been known to fail. Look at the switch blades to ensure all have pulled out.
- ASSUME NOTHING: Check to make sure that the disconnect switch is not wired backwards, with the line connected to the load side and the load connected to the line side. This configuration has been found in older buildings at BNL.
- Identify the voltage range of the circuit to be tested and use a meter appropriate for that range. If your organization specifies the meter to be used, comply with that directive.
- If your meter has a selector switch, set it to the appropriate scale (Volts - AC or DC).
- Hang the meter in a position that will enable you to read the meter and make the necessary contact connections without excessive reaching or stretching.
- Find the location of the grounding terminal(s) in the box. Place and hold the black (negative) probe on the grounding terminal in the box first, when making measurements.
- Ensure the meter is working by testing it on a known energized source, preferably in the voltage range of the circuit being checked. This can be done by touching the red (positive) probe to a line side terminal if exposed - (if covered, you will need to use a nearby wall outlet). Make sure that:
  - The test is done at the same range switch setting that would be used to test the circuit and then DO NOT change the switch setting.
  - The voltage displayed during the test is correct
- Test for voltage on each wire terminal of the load side by touching the red (positive) probe to each terminal. The meter should register approximately zero volts. For multi-phase circuits, use both the red and black probes to ensure that phase-to-phase readings on the load side also register zero volts.
- Test the same meter again on the same known energized source used earlier. This step verifies that the zero reading witnessed previously was correct and not due to a malfunctioning meter.
- Close the door of the disconnect switch. Complete the application of lockout/tagout devices specified in the procedure by applying your lockout padlock to the switch lever, securing it in the OFF position. A tagout tag is generally applied with the padlock to provide documented information regarding who, when, and why the lockout was applied.

Step 5 - Control of Stored Energy

All sources of energy that may be stored in the equipment to be worked on must be relieved or blocked to prevent injury to workers.

- Discharge and short-circuit energy-storage capacitors
- Relieve stored mechanical energy or block movement
- Relieve stored hydraulic or pneumatic pressure
- Dissipate stored chemical or thermal energy

Step 6 - Verification of Isolation

- Verify that the device is inoperative. After checking that there is no danger to personnel, press all start buttons or try to operate the equipment using its normal controls.
- When operating rotary or toggle switches, be sure to return them to the OFF position to ensure that the machine does not re-start when power is restored.

Performing the Work

Carefully perform required work. Look ahead while working and avoid doing anything that could re-activate the equipment you are working on. Be alert to actions that could bypass the lockout when installing new piping or wiring.

Release from Lockout/Tagout

Before lockout/tagout devices are removed and energy is restored, the "Authorized Employee" must inspect the area for hazards.

- Ensure that the machine or equipment is operationally intact.
- Remove all tools and make sure all guards are in place.
- Check the work area and other areas. If the equipment being energized may introduce additional hazard into another work area, make sure that all potentially affected personnel are clear prior to startup.
- Notify everyone who works in the area that lockout/tagout is being removed.
- Follow a checklist of required steps to re-energize the system.
- Safe work procedures suggest an operational check of an entire system, even if the equipment placed under LOTO was only a part of it.
- On a complex job, it may be necessary to conduct a head count to make sure everyone is clear of the equipment.
- The LOTO tag and/or lock can only be removed by the individual(s) who attached it (them).
- The last lock and tag is removed by the "Authorized Employee" who first attached it.
- Locks and tags are to be returned to the issuer and entries closed out in LOTO logbook.

Release from Lockout/Tagout BY SOMEONE ELSE

When the worker who applied a lock isn't available to remove it, the lock can be removed in an emergency situation or when work is completed on a different shift by following the emergency lock/tag removal procedure.

- Verify that the "Authorized Employee" who applied the device is not at the facility. Try to contact the absent employee by paging and attempting to reach the employee at home.
- A committee of three (one line supervisor and two “Authorized Employees” familiar with the equipment) must determine if removal is safe.
- Remove the lock and/or tag. If a key is not available from the organization’s LOTO Coordinator, the lock may be cut off.
- The removal must be documented in the organization’s LOTO Logbook.

Communication is Important!

If a LOTO is removed by SOMEONE OTHER THAN the person who applied it:

- Notify the employee that their lockout device was removed before he/she resumes work.
- Notify that person's supervisor that the employee's lock or tag was removed. If possible, do so before the start of that supervisor's shift.
- Also, place a written notice at the employee's workstation and verbally notify the employee's coworkers.

Accountable Key Systems

Accountable key systems or "Kirk" key systems are mechanical arrangements engineered to provide a level of protection equivalent to lockout/tagout. If the system is being serviced in a way that cannot provide that level of protection, then lockout/tagout must also be used.

- LOTO must be implemented whenever more than one employee is working on the device.
- Affected employees must remain clear of any system with the Kirk key removed.
- Organization-specific training is required for accountable key systems.

Special Situations

Be alert for new types of lockout or tagout devices when outside contractors are performing service or maintenance at your worksite.

If you must temporarily reactivate equipment you are working on:

- Remove unnecessary tools from the work area and make sure everyone is clear of the equipment.
- Remove lockout/tagout devices following instructions under "Release From Lockout/Tagout" and re-energize the system.
- As soon as the energy is no longer needed, isolate the equipment and reapply lockout/tagout, in accordance with BNL's energy-control Procedure and Verification of Isolation.

For further information of special situations, refer to the work rule examples listed in Appendix A of ES&H Standard 1.5.1, Lockout/Tagout Requirements.

Definitions

Lockout device
A special device used to prevent the operation of an energy-control point that gets secured in place with a padlock or multiple lock adapter.

Examples are:
- Covers for valve handwheels
- Blocking devices for 1/4 turn valves
- Motion restricting devices for toggle switches and circuit breakers
- Covers for cord plugs

Dielectric absorption
The persistence of electric charge in dielectric materials used in capacitors even after discharge of the capacitor.

This lingering electric charge can cause voltage to re-appear across the terminals of a previously discharged capacitor.

Placing a direct short across capacitor terminals after discharging will prevent any voltage buildup.

Cryogenic fluids
Fluids that are primarily the liquid form of the so-called permanent gases, such as helium, hydrogen, neon, nitrogen, oxygen and air, and characterized by their extremely low temperatures.

These cryogenic liquids typically absorb heat at their boiling points, which range between -100^{o}C and -270^{o}C.

The extremely low temperatures and boiling characteristics of these cryogens create thermal and pressure hazards to personnel.