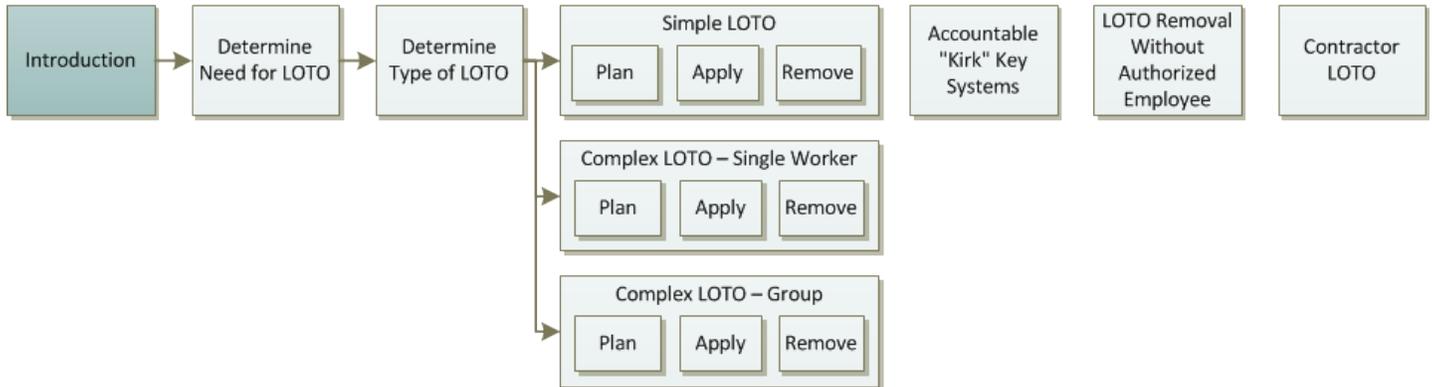


SUBJECT AREA CONTENT



Lockout/Tagout (LOTO) for Installation, Demolition, or Service and Maintenance

Subject Area
Effective Date: Jan 11, 2016 (Rev 8.0)
Periodic Review Due: Jan 11, 2019



Introduction

Lockout/tagout (LOTO) is necessary for the protection of personnel from unexpected energization or startup of machinery and equipment, or the release of hazardous energy during installation, demolition, or service and maintenance activities. Hazardous energy includes mechanical (rotational, gravitational), electrical, chemical, pressure or vacuum (hydraulic, pneumatic), ionizing and non-ionizing radiation, thermal and other energies that may cause harm.

This subject area applies to the installation, demolition, or servicing and maintenance of fixed, permanently installed equipment, temporarily installed equipment, and portable equipment. Construction activities are covered under this subject area (installation and demolition). Only employees authorized by the Department/Division may perform lockout/tagout, in accordance with this program.

This subject area does not cover the following

- All applications of locks and/or tags other than for installation, demolition, or servicing and maintenance activities are not covered in this subject area. See your department/division procedures for more information regarding these other applications.

Red "Hold/Danger" , Yellow "Caution" , or "Do Not Operate" tags are not to be used during installation, demolition, service and maintenance.

Yellow tags are not to be used with LOTO red-banded locks for lockout/tagout applications.

If a yellow informational caution tag is in place on the equipment, do not remove this tag. You may apply a LOTO red-banded lock and LOTO red-and-white striped tag for control of hazardous energy during installation, demolition, or service and maintenance.

- Installations that are considered electric utility transmission and distribution (these installations are covered in Utility Work Procedures).
Note: When a structure has been de-energized by Facilities & Operations Directorate's approved High Voltage Switching Procedures, service and maintenance of equipment fed by the high voltage distribution equipment will still require lockout/tagout, i.e., the high-voltage equipment must be locked-out/tagged-out in order to perform service and maintenance on the equipment that is fed from it.
- Minor tool changes and adjustments, other minor servicing, and normal production operations if they are routine, repetitive, and integral to the use of the equipment for production. The work must be performed using alternative measures that provide effective protection.
- Cord and plug-connected electrical equipment that is unplugged and the plug is within sight and under the exclusive control of the Employees performing the service and maintenance.

Responsibilities

Line supervisors are responsible for ensuring that all Authorized and Affected BNL Employees are trained appropriately to the hazard level to which they will be exposed. All line supervisors of employees who perform lockout/tagout must also be qualified at the Authorized Employee level for lockout and tagout work. Supervisors should have knowledge on the specific hazards involved at the system level and equipment level for the systems/equipment they oversee so they can identify the hazards, and choose the correct workers to implement the correct lockout/tagout.

Project Managers or their delegates are responsible for ensuring that all Authorized and Affected Contractors are trained appropriately to the hazard level to which they will be exposed.

The **Department Chair/Division Manager** is responsible for ensuring consistent implementation of this procedure for BNL and non-BNL workers.

Each **Department/Division** must conduct periodic inspections (audits) at least annually, of at least one lockout/tagout in progress and written instruction in detail (see the exhibit [Criteria for LOTO Inspections \(Audits\)](#)).

All BNL and non-BNL employees are responsible for recognizing the importance of not tampering with locked/tagged equipment and must not attempt to start, energize, or use that machine or equipment.

Cross-references

BNL uses the work planning and control processes to properly manage all work, as described in the [Work Planning and Control for Experiments and Operations](#) Subject Area. Lockout/tagout is an integral part of work planning.

Violations of the lockout/tagout procedures fall under the purview of the [Disciplinary Actions](#) Subject Area.

Standards of Performance

Managers shall analyze work for hazards, authorize work to proceed, and ensure that work is performed within established controls.

Managers shall ensure that work is planned to prevent pollution, minimize waste, and conserve resources, and that work is conducted in a cost-effective manner that eliminates or minimizes environmental impact.

All staff and users shall identify, evaluate, and control hazards in order to ensure that work is conducted safely and in a manner that protects the environment and the public.

All staff and guests shall promptly report accidents, incidents, injuries, ESS&H deficiencies, emergencies, and off-normal events in accordance with procedures.

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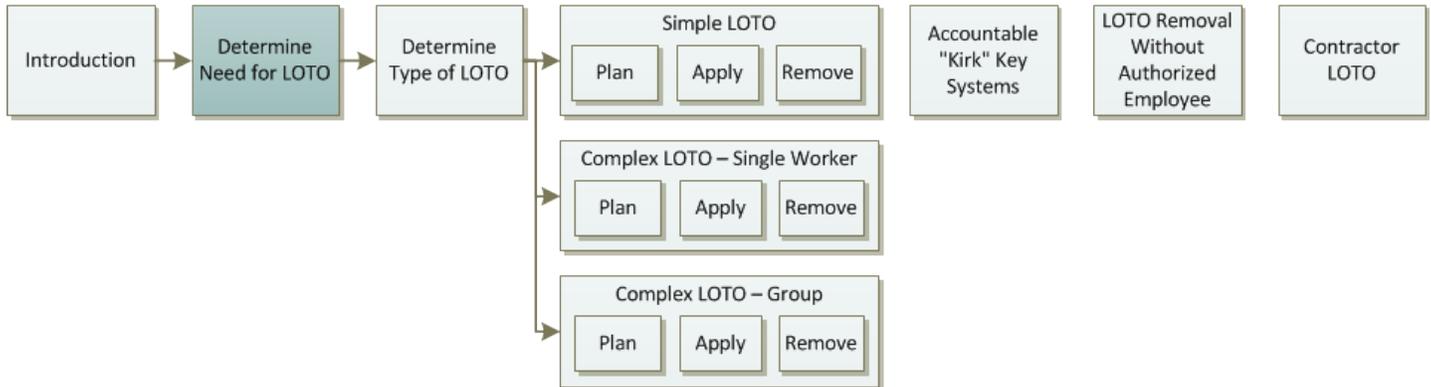
Questions/Comments

SUBJECT AREA PROCEDURE CONTENT



Lockout/Tagout (LOTO) for Installation, Demolition, or Service and Maintenance

Subject Area
Effective Date: **Jan 11, 2016** (Rev 8.0)
Periodic Review Due: **Jan 11, 2019**



For personnel who plan installations, demolitions, or servicing and maintenance activities for equipment, machinery or systems.

Determine Need for LOTO

1. Review the work that is being planned to determine which energy sources are present and whether they are potentially hazardous. If there are hazardous energy sources, they require lockout/tagout during installation, demolition, or servicing and maintenance activities.

Consider all tasks involved with the work, such as setup, installation, removal, adjusting, cleaning, troubleshooting, and programming. Examples of tasks that routinely require lockout/tagout include:

- Entry into a machine's point of operation or any associated danger zone
- Repair of electrical circuits
- Cleaning, repairing and maintaining machinery with moving parts
- Cleaning jammed mechanisms
- Removing or bypassing a guard or other safety device
- Work on piping or lines carrying hazardous materials, materials under pressure, or materials at dangerous temperatures (hot or cold)
- Working under heavy equipment or machinery with all or part of it raised and/or capable of falling.

2. Evaluate the potential hazard associated with each energy source within the work boundary (electrical, mechanical, thermal, pneumatic, hydraulic, radiation, chemical, etc.)

If the hazard is electrical, note that a [Testing, Troubleshooting, and Voltage Measuring \(TTVM\) Electrical Work Permit](#) or equivalent permit, approved by the supervisor or LOTO SME, will be needed to verify the absence of hazardous energy when applying lockout/tagout.

3. Identify hazards that might arise from the interaction of the release of energy and the work environment.

The following situations provide examples of possible interactions:

- Work on water lines over electrical components or electrical systems in wet locations creating a shock or arc flash hazard;
- Work on compressed air in an area where inadvertent activation might generate toxic or radioactive dusts or aerosols creating contamination or personal exposure;
- Repair work on overhead water or air lines from a ladder that may cause a worker to fall or drop tools if startled by the impact of the air or water or the elevated noise level from release of compressed air;
- Work on low pressure inert gas line in confined space creates asphyxiation hazard;
- Maintenance that must be done under machinery or equipment that may fall on a worker;
- Work near live steam or pressure relief valves subject to thermal and pneumatic hazards;
- Servicing of equipment in an area with magnetic field that may propel ferrous tools toward the magnet.

4. Assess the potential consequences. Evaluate whether the hazards identified in Step 3 could harm workers, given the precautions used on the job. Assume that workers are present when the energy is released. This [table on energy sources](#) provides threshold information useful in making this evaluation. Where a system is designed for lockout/tagout, there is a good possibility that either the manufacturer or BNL has evaluated the hazards and determined that lockout/tagout is necessary.

Refer to the [Supplemental Information on Thresholds for Various Forms of Energy](#).

5. If the potential for exposure exists, [determine type of LOTO](#) needed to ensure full protection of workers. *Whenever an energy source has the potential to harm workers, lockout/tagout is required*, unless de-energizing the source introduces additional or increased hazards or is infeasible due to equipment design or operational limitations. Such cases require job-specific procedures, such as energized electrical work permits and

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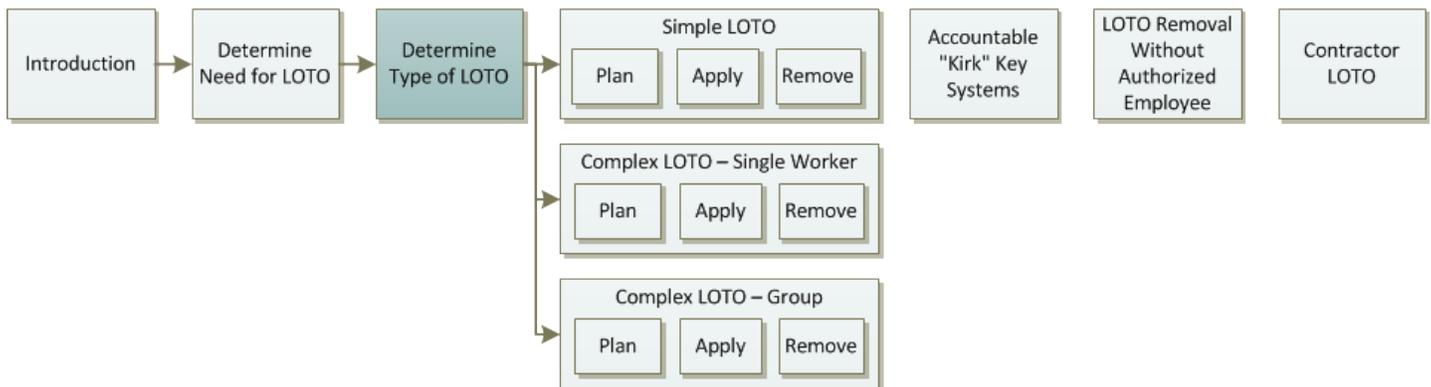
Questions/Comments

SUBJECT AREA PROCEDURE CONTENT



Lockout/Tagout (LOTO) for Installation, Demolition, or Service and Maintenance

Subject Area
Effective Date: **Jan 11, 2016** ([Rev 8.0](#))
Periodic Review Due: **Jan 11, 2019**



For Authorized Employees and personnel who plan installations, demolitions, or servicing and maintenance activities for equipment, machinery or systems.

Determine Type of LOTO

1. Determine if any of the following conditions exist:

1. More than 1 source of hazardous energy;
2. More than 1 isolation point;
3. More than 1 craft applying LOTO;
4. More than 1 work location;
5. Both BNL and non-BNL workers applying LOTO;
6. More than 1 crew applying LOTO;
7. More than 1 disconnecting means;
8. A particular sequence that is out of the ordinary is required for safe shutdown or startup of the equipment;
9. Piece of equipment involved cannot be locked.

Note: It may not be possible to attach a lock for equipment installed before January 2, 1990. If the equipment cannot be locked, it must be tagged out and additional measures must be taken to assure equivalent safety when compared to applying a lock.

2. If none of these conditions exists, follow the [Simple LOTO](#) process.

Note: EMII - Electrical Material and Installation Inspection Program: Where a "Simple LOTO" is in place and an inspection is required, local inspectors or the Chief Electrical Inspector may choose to follow the [Simple LOTO](#) process even if they are not identified as members of the BNL craft or crew that applied the initial simple LOTO.

3. If at least one of these conditions exists, and the lockout/tagout is for the [protection of a single worker](#) follow the [Complex LOTO - Single Worker](#) process.

Note: EMII - Electrical Material and Installation Inspection Program: Where a "Complex LOTO - Single Worker" is in place and an inspection is

required, the LOTO becomes a [Complex LOTO - Group](#) process and additional work planning is required.

- If at least one of these conditions exists, and the lockout/tagout is for the [protection of multiple workers](#), follow the [Complex LOTO - Group](#) process.

Note: EMII - Electrical Material and Installation Inspection Program: Where a "Complex LOTO - Group" is in place and an inspection is required, BNL approved local inspectors and the Chief Electrical Inspector must follow the [Complex LOTO - Group](#) process.

- Or, if your department/division uses Accountable ("Kirk") Key Systems, follow the [Accountable \("Kirk"\) Key Systems](#) process.

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Questions/Comments

SUBJECT AREA PROCEDURE CONTENT

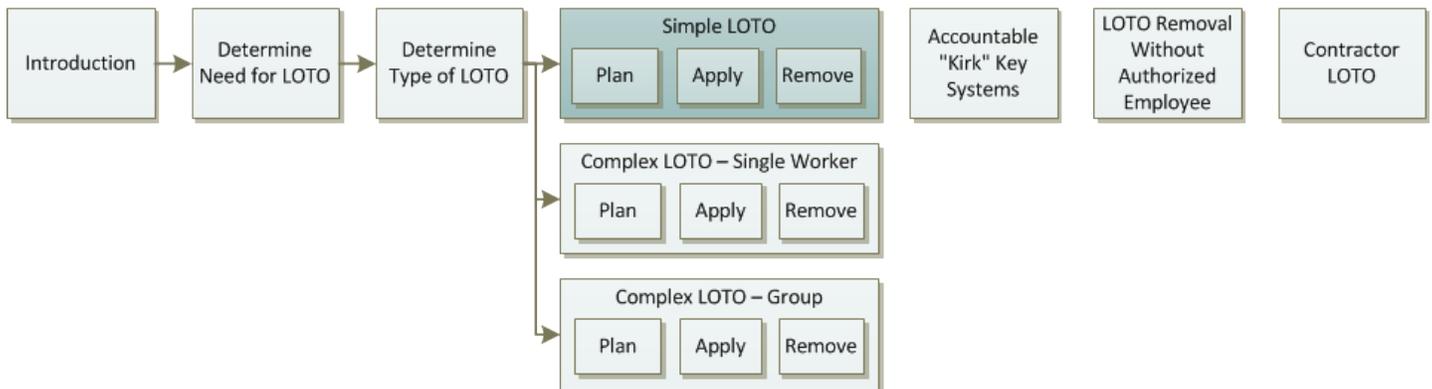


Lockout/Tagout (LOTO) for Installation, Demolition, or Service and

Maintenance Subject Area

Effective Date: Jan 11, 2016 (Rev 8.0)

Periodic Review Due: Jan 11, 2019



For Authorized Employees (including contractors) who perform lockout/tagout and their supervisors.

Simple LOTO

Lockout/tagout (LOTO) is necessary for the protection of personnel from unexpected energization or startup of machinery and equipment, or the release of hazardous energy during installation, demolition, or service and maintenance activities. Hazardous energy includes mechanical (rotational, gravitational), electrical, chemical, pressure or vacuum (hydraulic, pneumatic), ionizing and non-ionizing radiation, thermal and other energies that may cause harm.

EMII - Electrical Material and Installation Inspection Program: Where a "Simple LOTO" is in place and an inspection is required, local inspectors or the Chief Electrical Inspector may choose to follow the [Simple LOTO](#) process even if they are not identified as members of the BNL craft, crew, or contractor that applied the initial simple LOTO.

Planning Simple LOTO

Each Department/Division must conduct periodic inspections (audits) at least annually, of at least one lockout/tagout in progress (see the exhibit [Criteria for LOTO Inspections \(Audits\)](#)).

- Supervisor assigns work task to Authorized Employee(s) and verifies all employees working on the equipment under a lockout/tagout are trained and authorized by their Department.
- Authorized Employee assesses the type, magnitude and hazards of the energy source to be controlled. Use up-to-date drawings, diagrams and identification tags and confirm locations of disconnecting device.

3. Authorized Employee must visually inspect the equipment.

Look-alike equipment: If the equipment that will be de-energized exists in a work area with other energized equipment that is similar in size, shape, or construction that it could be mistaken for the equipment that is to be locked out, the Authorized Employee must take steps to prevent access to the wrong equipment, such as

- Safety signs or tags to identify the equipment to be serviced;
- Barricades around the equipment to be serviced;
- Attendants at the equipment being serviced.

4. Authorized Employee confirms that there is only a single point for complete hazardous energy isolation.

Note: Consider backfeeds, especially when connecting temporary power in situations when equipment is taken out of service for repair or maintenance. If backfeeds are possible, it is likely that there is more than one isolation point.

If there is more than one isolation point, a complex lockout/tagout will need to be implemented. Work is paused, and the [type of lockout/tagout reevaluated](#).

5. Authorized Employee determines or confirms method of controlling the hazardous energy, depending on the type of hazardous energy and where it is located.

6. Authorized Employee identifies and obtains the appropriate lockout/tagout device.

Locks, tags, chains, wedges, key blocks, adapter pins, self-locking fasteners, or other hardware must be supplied by the Department/Division for BNL employees and by their employer for non-BNL employees; workers cannot bring their own lockout/tagout hardware.

7. Authorized Employee verifies that they possess the BNL authorized LOTO padlock and that it is personally identifiable.



BNL Authorized LOTO Padlock: Silver colored padlock with red band, which is Master Lock Model 31 (BNL Stock #I65064).

In addition, the padlock must be identifiable in one of the following three ways:

- Indicates the name and phone number of the Authorized Employee; or
- Indicates an inventory number that can be traced through an electronic database to the Authorized Employee; or
- Attach a tag (two-sided, red-and-white-striped, BNL Stock Tag #S81043) to the lock that indicates the name and phone number of the Authorized Employee. This tag must be secured to withstand a pull-strength of not less than 50 pounds.

Note: The use of existing Master Lock Model 3 locks is allowable as long as the organization keeps track of them and understands the risks associated with duplicate keys. As of May 8, 2013, only BNL authorized LOTO padlocks may be purchased for these lockout/tagout applications.



LOTO Padlock for Contractors: Contractors use a lock similar in appearance to the BNL padlock, i.e., a silver lock with a red band. The lock must be identifiable in one of the following two ways:

- Indicates the name of the Authorized Employee and the company name and phone number; or
- Has an associated tag that is similar in appearance to the BNL red-and-white-striped tag and meets ANSI Z535.5, indicating the name of the Authorized Employee, company name and phone number. This tag can be one-sided. It must be secured to withstand a pull-strength of not less than 50 pounds.

Applying Simple LOTO [^back to top](#)

1. Authorized Employee notifies all Affected Employees of the upcoming work/shutdown.
2. Authorized Employee ensures it is safe to shut down the equipment.
3. Authorized Employee or an equipment operator shuts down the equipment.
4. Authorized Employee sets up the work boundaries determined through the work planning process.
5. Authorized Employee positively isolates hazardous energy source, ensures isolation point corresponds to equipment on which lockout/tagout is being performed, and verifies that the appropriate isolation device is being used.



For electrical, visually check (if possible) that all contacts have opened. Also, check to make sure that the disconnect switch is not wired backwards (line voltage supplied through the load terminals), a condition occasionally found in older buildings at BNL.

6. In cases when the lockout/tagout device is applied to a switch lever, it may be necessary for the Authorized Employee to verify the absence of **voltage** now since disconnect switches will not permit the door to be opened after the lockout/tagout device is applied.
7. Authorized Employee applies personally identifiable lock to energy isolating device.



BNL Authorized LOTO Padlock: Silver colored padlock with red band, which is Master Lock Model 31 (BNL Stock #I65064).

In addition, the padlock must be identifiable in one of the following three ways:

- Indicates the name and phone number of the Authorized Employee; or
- Indicates an inventory number that can be traced through an electronic database to the Authorized Employee; or
- Attach a tag (two-sided, red-and-white-striped, BNL Stock Tag #S81043) to the lock that indicates the name and phone number of the Authorized Employee. This tag must be secured to withstand a pull-strength of not less than 50 pounds.

Note: The use of existing Master Lock Model 3 locks is allowable as long as the organization keeps track of them and understands the risks associated with duplicate keys. As of May 8, 2013, only BNL authorized LOTO padlocks may be purchased for these lockout/tagout applications.



LOTO Padlock for Contractors: Contractors use a lock similar in appearance to the BNL padlock, i.e., a silver lock with a red band. The lock must be identifiable in one of the following two ways:

- Indicates the name of the Authorized Employee and the company name and phone number; or
- Has an associated tag that is similar in appearance to the BNL red-and-white-striped tag and meets ANSI Z535.5, indicating the name of the Authorized Employee, company name and phone number. This tag can be one-sided. It must be secured to withstand a pull-strength of not less than 50 pounds.

- Authorized Employee "challenges" the lock's effectiveness by trying to move the energy isolating device to the energized position. If the lock is found to be ineffective, the Authorized Employee must pause and re-evaluate along with the supervisor.
- Authorized Employee attempts to restart the equipment. The Authorized employee must physically try to restart the equipment using the normal controls.
- Authorized Employee returns the controls to the "off" or "neutral" condition.
- Authorized Employee verifies the absence of **hazardous energy**.

For example:

- **Pressurized systems:** depressurize/drain and confirm.
- **Electrical:** Obtain a [Testing, Troubleshooting, and Voltage Measuring \(TTVM\) Electrical Work Permit](#) or supervisor-approved equivalent permit; then using a properly-rated and listed voltmeter per the [Requirement for Meters Used at BNL](#), first test an energized source within the range of the circuit being verified, then, while not changing the switch setting, measure between ground and each phase conductor, then measure between the neutral and each phase conductor, then measure each phase-to-phase combination. Finally test the meter again on an energized source to verify the meter was not malfunctioning. If the source is DC, test all combinations of positive, negative, and ground conductors.

Note: A similar procedure is applied for equipment isolated by opening a panel-mounted circuit breaker or by "racking out" a large cubicle circuit breaker. For these cases, perform the zero voltage check, (TTVM Electrical Work Permit still needed), at the line terminals of the equipment supplied by the circuit breaker.

- Relieve, or otherwise render safe, all potentially **stored or residual energies** before working on the equipment or system:
 - Dissipate or restrain stored or residual energy (i.e., capacitors, springs, elevated machine members, rotating flywheels, hydraulic systems, and air, gas, steam, or water pressure) by grounding, repositioning, blocking, and/or bleeding down. Acceptable methods of dissipation include leaving vent or drain valves open on pressurized hydraulic or pneumatic systems.
 - Where possibility of induced voltages or stored electrical energy exists, ground the phase conductors or circuits parts before touching. Where the conductors or circuits parts could come into contact with energized parts, apply ground connecting devices rated for the available fault duty.
 - Verify the isolation of residual energy continually until the installation, demolition, servicing or maintenance is completed, or until the possibility of re-accumulation of stored energy to a hazardous level no longer exists.
- Authorized Employee conducts work on the equipment.



Always confirm your lockout/tagout and retest absence of energy if conditions change, or when the job location is left unattended.

- If during the course of the work, it is determined that the time needed for work on the equipment goes beyond the shift of the Authorized Employee and **new worker(s) will be replacing the initial worker(s)**, then the Authorized Employee pauses and the supervisor re-evaluates the type of lockout/tagout and a **verbal turnover of the job** is conducted if it is determined that the lockout/tagout can remain simple.

The verbal turnover includes:

- A discussion of the need to complete all applicable lockout/tagout steps (lockout/tagout removal and installation);
- A review of the initial scope of work and any changes;
- Status of work – including safety precautions to be taken.

If a verbal turnover is not feasible, then the Simple LOTO is no longer applicable, Complex LOTO must be followed, and a [Complex Lockout/Tagout Instruction](#) is developed.

- If the time needed for work on the equipment goes beyond the shift of the Authorized Employee but **the same Authorized Employee will continue work the next day or later**, then a tag is required. The Authorized Employee fills out all information on the tag, applies it to the lock, and records it in the logbook of the organization that owns the equipment.



BNL Authorized LOTO Tag is two-sided, red-and-white-striped, BNL Stock Tag #S81043. It must be secured to withstand a pull-strength of not less than 50 pounds.

Simple LOTO tags in place for more than one shift must include the following information:

- Unique tag number;
- An instruction such as: Do Not Start, Do Not Open, Do Not Close, Do Not Energize, Do Not Operate;
- Equipment ID (for example, component name and number); *sufficient information to uniquely identify the equipment;*
- Location (for example, building number, description of location, manhole number, etc.); *sufficient information to identify the location of the LOTO;*
- Printed name, life number, department and phone extension of the Authorized Employee;
- Signature of the Authorized Employee and date the LOTO was applied;
- Reason for the LOTO.

LOTO Tag for Contractors used for Simple LOTO for more than one shift: Tag is similar in appearance to the BNL red-and-white-striped tag and meets ANSI Z535.5, and is completely filled out including the name of the Authorized Employee, company

name and phone number. This tag can be one-sided. It must be secured to withstand a pull-strength of not less than 50 pounds.

Removing Simple LOTO [^back to top](#)

This includes removing simple lockout/tagout temporarily for testing or positioning purposes.

1. Authorized Employee inspects the work area to ensure nonessential items, such as tools, have been removed, guards and covers are installed properly, grounded equipment is removed, and the equipment is ready to be safely operated.
2. Authorized Employee notifies Affected Employees and others in the area that the lockout/tagout devices will be removed and the equipment may start.
3. Authorized Employee verifies that the operating controls for the equipment are off or in the neutral position.
4. Authorized Employee checks area to ensure all employees are safely positioned or removed from the area.
5. Authorized Employee removes the lockout/tagout devices.
6. Equipment operator or an Authorized Employee restarts the equipment.
7. If applicable, Authorized Employee notifies operators that the equipment is ready for use.
8. If the lockout/tagout was removed temporarily for testing or positioning purposes, the Authorized Employee reinstalls the lockout/tagout immediately after completion of testing or positioning.
9. If the tag was logged during application of LOTO [see Step15 of Applying Simple LOTO], the Authorized Employee closes out the tag in the same logbook.

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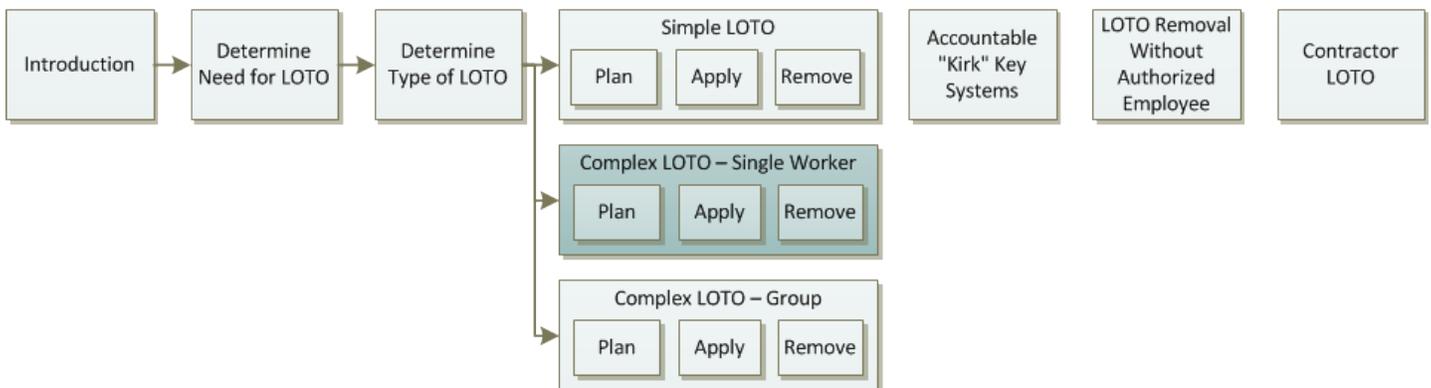
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SUBJECT AREA PROCEDURE CONTENT



Lockout/Tagout (LOTO) for Installation, Demolition, or Service and Maintenance

Subject Area
Effective Date: **Jan 11, 2016** ([Rev 8.0](#))
Periodic Review Due: **Jan 11, 2019**



For Authorized Employees (including contractors) who perform lockout/tagout and their supervisors.

Complex LOTO - Single Worker

Lockout/tagout (LOTO) is necessary for the protection of personnel from unexpected energization or startup of machinery and equipment, or the release of hazardous energy during installation, demolition, or service and maintenance activities. Hazardous energy includes mechanical (rotational, gravitational), electrical, chemical, pressure or vacuum (hydraulic, pneumatic), ionizing and non-ionizing radiation, thermal and other energies that may cause harm.

If equipment cannot be locked out, a tag only situation exists and the following steps must also be conducted:

- Supervisor verifies that the worker involved is trained and understands the limitations of the tag only process.
- Supervisor assures that the procedure clearly establishes responsibilities and accountabilities for the person who might be exposed to hazardous energy.
- Authorized Employee securely attaches tags to energy isolating device where the lock would normally be secured so that they cannot be inadvertently or accidentally detached during use.
- Authorized Employee applies additional measures to assure full protection to reduce the likelihood of inadvertent energization, such as the removal of an isolating circuit element, blocking of a controlling switch, opening of an extra disconnecting device, or the removal of a valve handle to reduce the likelihood of inadvertent energization.

EMII - Electrical Material and Installation Inspection Program: Where a "Complex LOTO - Single Worker" is in place and an inspection is required, the LOTO becomes a [Complex LOTO - Group](#) process and additional work planning is required.

Planning Complex LOTO for Single Worker [^back to top](#)

Each Department/Division must conduct periodic inspections (audits) at least annually, of at least one lockout/tagout in progress and written instruction in detail (see the exhibit [Criteria for LOTO Inspections \(Audits\)](#)).

1. **Written instructions** are required and must be available at the work site.
 - If there are established written lockout/tagout instructions for the equipment, then the Authorized Employee verifies, and if necessary modifies, the existing instructions.
 - If not, the Authorized Employee develops a [Complex Lockout/Tagout Instruction](#) to be used to ensure the process protects them from all hazardous energy during the work, since the work sequence is complicated (multiple isolation points) and requires a greater level of rigor in planning.
 - This form may be printed and completed by hand or used as a Word file template. If the format is modified, the written instructions must clearly and specifically outline the scope, purpose, authorization, rules, and techniques to be used for the control of hazardous energy including:
 - Statement of the intended use of the instruction;
 - Steps for shutting down, isolating, blocking, and securing the equipment to control the hazardous energy;
 - Steps for testing to verify absence of hazardous energy;
 - Steps for the placement, removal, and transfer of lock and tag;
 - Responsibility for locks and tags;
 - Requirements for testing to determine and verify the effectiveness of the locks and tags and other hazardous energy control measures;
 - Requirement for assuring the equipment is in a safe operating condition prior to removing lockout/tagout;
 - The written instructions may also include task work steps.
2. Supervisor assigns work task to Authorized Employee and verifies all employees working on the equipment under a lockout/tagout are trained and authorized by their Department.
3. Authorized Employee assesses the type, magnitude and hazards of all energy sources to be controlled. Use up-to-date drawings, diagrams and identification tags and confirm locations of disconnecting devices.

Note: Consider backfeeds, especially when connecting temporary power in situations when equipment is taken out of service for repair or maintenance. If backfeeds are possible, it is likely that there is more than one isolation point since power could be coming back from the load as well as the source.
4. Authorized Employee determines or confirms method of controlling the hazardous energy, depending on the type of hazardous energy and where it is located.
5. Authorized Employee must visually inspect the equipment prior to applying lockout/tagout.

Look-alike equipment: If the equipment that will be deenergized exists in a work area with other energized equipment that is similar in size, shape, or construction that it could be mistaken for the equipment that is to be locked out, the Authorized Employee must take steps to prevent access to the wrong equipment, such as

 - Safety signs or tags to identify the equipment to be serviced;
 - Barricades around the equipment to be serviced;
 - Attendants at the equipment being serviced.
6. Authorized Employee identifies and obtains the appropriate lockout/tagout device.

Locks, tags, chains, wedges, key blocks, adapter pins, self-locking fasteners, or other hardware must be supplied by the Department/Division for BNL employees and by their employer for non-BNL employees; workers cannot use lockout/tagout hardware that has not been approved by the Department/Division or employer for non-BNL employees.
7. Authorized Employee verifies that they possess the BNL authorized LOTO padlock and that it is personally identifiable.



BNL Authorized LOTO Padlock: Silver colored padlock with red band, which is Master Lock Model 31 (BNL Stock #165064).

In addition, the padlock must be identifiable in one of the following three ways:

- Indicates the name and phone number of the Authorized Employee; or
- Indicates an inventory number that can be traced through an electronic database to the Authorized Employee; or
- Attach a tag (two-sided, red-and-white-striped, BNL Stock Tag #S81043) to the lock. This tag must be secured to withstand a pull-strength of not less than 50 pounds.

Note: The use of existing Master Lock Model 3 locks is allowable as long as the organization keeps track of them and understands the risks associated with duplicate keys. All new purchases of padlocks for installation, demolition, or service and maintenance lockout/tagout must be Master Lock Model 31.



LOTO Padlock for Contractors: Contractors use a lock similar in appearance to the BNL padlock, i.e., a silver lock with a red band. The lock must be identifiable in one of the following two ways:

- Indicates the name of the Authorized Employee and the company name and phone number; or
- Has an associated tag that is similar in appearance to the BNL red-and-white-striped tag and meets ANSI Z535.5. This tag can be one-sided. It must be secured to withstand a pull-strength of not less than 50 pounds.

Applying Complex LOTO for Single Worker [^back to top](#)

1. Authorized Employee uses the written instructions and confirms the type, magnitude, and hazards of all energy sources to be controlled.
2. Authorized Employee notifies all Affected Employees of the upcoming work/shutdown.
3. Authorized Employee ensures it is safe to shut down the equipment.
4. Authorized Employee or an equipment operator shuts down the equipment.
5. Authorized Employee sets up the work boundaries determined through the work planning process.
6. Authorized Employee positively isolates all hazardous energy sources, ensures isolation points on the written instructions correspond to equipment on which lockout/tagout is being performed, and that the appropriate isolation device is being used.



For electrical, visually check (if possible) that all contacts have opened. Also, check to make sure that the disconnect switch is not wired backwards (line voltage supplied through the load terminals), a condition occasionally found in older buildings at BNL.

7. In cases when the lockout/tagout device is applied to a switch lever, it may be necessary for the Authorized Employee to verify the absence of **voltage** now since disconnect switches will not permit the door to be opened after the lockout/tagout device is applied.
8. Authorized Employee applies personally identifiable locks to energy isolating devices, fills out all information on the tags and applies it to the locks.



BNL Authorized LOTO Padlock: Silver colored padlock with red band, which is Master Lock Model 31 (BNL Stock #I65064).



BNL Authorized LOTO Tag: two-sided, red-and-white-striped, BNL Stock Tag #S81043. This tag must be secured to withstand a pull-strength of not less than 50 pounds.

Tags used for Single Worker Complex LOTO must include the following information:

- Unique tag number;
- An instruction such as: Do Not Start, Do Not Open, Do Not Close, Do Not Energize, Do Not Operate;
- Equipment ID (for example, component name and number); *Sufficient information to uniquely identify the equipment;*
- Location (for example, building number, description of location, manhole number, etc.) *Sufficient information to identify the location of the LOTO;*
- Printed name, life number, department and phone extension of the Authorized Employee;
- Signature of the Authorized Employee and date the LOTO was applied;
- Reason for the LOTO.



LOTO Padlock for Contractors: Contractors use a lock similar in appearance to the BNL padlock, i.e., a silver lock with a red band.

LOTO Tag for Contractors used for Complex LOTO - Single Worker: Tag is similar in appearance to the BNL red-and-white-striped tag and meets ANSI Z535.5, and is completely filled out including the name of the Authorized Employee, company name and phone number. This tag can be one-sided. It must be secured to withstand a pull-strength of not less than 50 pounds.

9. Authorized Employee "challenges" the locks' effectiveness by trying to move the energy isolating devices to the energized position. If the lock is found to be ineffective, the Authorized Employee must pause and re-evaluate along with the supervisor.
10. Authorized Employee attempts to restart the equipment. The Authorized Employee must physically try to restart the equipment using the normal controls, and for electrical perform verification of absence of electrical hazardous energy.
11. Authorized Employee returns the controls to the "off" or "neutral" condition.
12. Authorized Employee verifies the absence of **hazardous energy**.
For example:
 - **Pressurized systems:** depressurize/drain and confirm.
 - **Electrical:** Obtain a [Testing, Troubleshooting, and Voltage Measuring \(TTVM\) Electrical Work Permit](#) or equivalent permit, approved by the supervisor or LOTO SME; then using a properly-rated and listed voltmeter per the [Requirement for Meters Used at BNL](#), first test an energized source within the range of the circuit being verified, then, while not changing the switch setting, measure between ground and each phase conductor, then measure between the neutral and each phase conductor, then measure each phase-to-phase combination. Finally test the meter again on an energized source to verify the meter was not malfunctioning. If the source is DC, test all combinations of positive, negative, and ground conductors.

Note: A similar procedure is applied for equipment isolated by opening a panel-mounted circuit breaker or by "racking out" a large cubicle circuit breaker. For these cases, perform the zero voltage check, (TTVM Electrical Work Permit still needed), at the line terminals of the equipment supplied by the circuit breaker.

13. Relieve, or otherwise render safe, all potentially **stored or residual energies** before working on the equipment or system:
 - Dissipate or restrain stored or residual energy (i.e., capacitors, springs, elevated machine members, rotating flywheels, hydraulic systems, and air, gas, steam, or water pressure) by grounding, repositioning, blocking, and/or bleeding down. Acceptable methods of dissipation include leaving vent or drain valves open on pressurized hydraulic or pneumatic systems.
 - Where possibility of induced voltages or stored electrical energy exists, ground the phase conductors or circuits parts before touching. Where the conductors or circuits parts could come into contact with energized parts, apply ground connecting devices rated for the available fault duty.
 - Verify the isolation of residual energy continually until the installation, demolition, servicing or maintenance is completed, or until the possibility of re-accumulation of stored energy to a hazardous level no longer exists.
14. Authorized Employee conducts work on the equipment.



Always confirm your lockout/tagout and retest absence of energy if conditions change, or when the job location is left unattended.

15. If during the course of the work, it is determined that the time needed for work on the equipment goes beyond the shift of the Authorized Employee and a **new worker will be replacing the initial worker**, then the Authorized Employee pauses and the lockout/tagout becomes [Complex - Group](#).
16. If the time needed for work on the equipment goes beyond the shift of the Authorized Employee but **the same Authorized Employee will continue the work**, he/she records their tags in the logbook of the organization that owns the equipment.

Removing Complex LOTO for Single Worker [^back to top](#)

This includes removing the lockout/tagout temporarily for testing or positioning purposes.

1. Authorized Employee inspects the work area to ensure nonessential items, such as tools, have been removed, guards and covers are installed properly, grounded equipment is removed, and the equipment is ready to be safely operated.
2. Authorized Employee notifies Affected Employees and others in the area that the lockout/tagout devices will be removed and the equipment may start.
3. Authorized Employee verifies that the operating controls for the equipment are off or in the neutral position.
4. Authorized Employee checks area to ensure all employees are safely positioned or removed from the area.
5. Authorized Employee removes the lockout/tagout devices.
6. Equipment operator or an Authorized Employee restarts the equipment.
7. If applicable, Authorized Employee notifies operators that the equipment is ready for use.
8. If the lockout/tagout was removed temporarily for testing or positioning purposes, the Authorized Employee reinstalls the lockout/tagout immediately after completion of testing or positioning.
9. Employee designated by the Department retains the individual written lockout/tagout instructions so that they are available when audits are performed.
10. If the tag was logged during application of LOTO [see Step16 of Applying Complex LOTO for Single Worker], the Authorized Employee closes out the tag in the same logbook.

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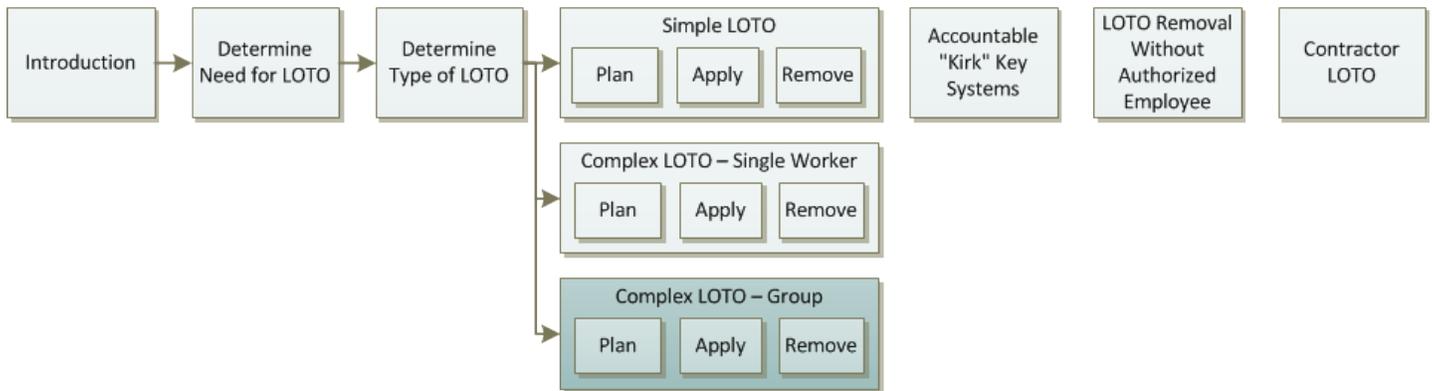
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SUBJECT AREA PROCEDURE CONTENT



Lockout/Tagout (LOTO) for Installation, Demolition, or Service and Maintenance

Subject Area
Effective Date: **Jan 11, 2016** ([Rev 8.0](#))
Periodic Review Due: **Jan 11, 2019**



For Authorized Employees (including contractors) who perform lockout/tagout and their supervisors.

Complex LOTO - Group

Lockout/tagout (LOTO) is necessary for the protection of personnel from unexpected energization or startup of machinery and equipment, or the release of hazardous energy during installation, demolition, or service and maintenance activities. Hazardous energy includes mechanical (rotational, gravitational), electrical, chemical, pressure or vacuum (hydraulic, pneumatic), ionizing and non-ionizing radiation, thermal and other energies that may cause harm.

A Group lockout/tagout involves more than one [crew, craft](#), department, or other group. Overall lockout/tagout control is designated to one Primary Authorized Employee. The duty of the Primary Authorized Employee is to coordinate workforces and ensure continuity of lockout/tagout protection for all involved (both authorized and affected employees). The Primary Authorized Employee must be the first to apply a lock and the last to remove a lock from the equipment or lockbox. He or she must ensure application of locks or tags in a way that ensures no equipment can be re-energized without his/her personal lock or tag being removed and they must verify that all sources of hazardous energy are controlled before work begins.

A Group lockout/tagout may also be deemed appropriate when additional oversight is desired, such as when managing contractor-performed work.

If equipment cannot be locked out, a tag only situation exists and the following steps must also be conducted:

- Supervisor verifies that the worker involved is trained and understands the limitations of the tag only process.
- Supervisor assures that the procedure clearly establishes responsibilities and accountabilities for the person who might be exposed to hazardous energy.
- Authorized Employee securely attaches tags to energy isolating device where the lock would normally be secured so that they cannot be inadvertently or accidentally detached during use.
- Authorized Employee applies additional measures to assure full protection to reduce the likelihood of inadvertent energization, such as the removal of an isolating circuit element, blocking of a controlling switch, opening of an extra disconnecting device, or the removal of a valve handle to reduce the likelihood of inadvertent energization.

EMII - Electrical Material and Installation Inspection Program: Where a "Complex LOTO - Group" is in place and an inspection is required, local inspectors and the Chief Electrical Inspector must follow the [Complex LOTO - Group](#) process.

Planning Complex LOTO for Group [^back to top](#)

Each Department/Division must conduct periodic inspections (audits) at least annually, of at least one lockout/tagout in progress and written instruction in detail (see the exhibit [Criteria for LOTO Inspections \(Audits\)](#)).

1. A Primary Authorized Employee is designated by the department doing the work.
2. **Written Instructions** are required and must be available at the work site.
 - If there are established written lockout/tagout instructions for the equipment, then the Authorized Employee verifies, and if necessary modifies, the existing instructions.
 - If not, the Primary Authorized Employee with the work planning team, develops a [Complex Lockout/Tagout Instruction](#) to be used by the Authorized Employees to ensure the process protects all workers (including any new workers arriving after the job has begun) from all hazardous energy during the work.
 - This form may be printed and completed by hand or used as a Word file template. If the format is modified, the written instructions must clearly and specifically outline the scope, purpose, authorization, rules, and techniques to be used for the control of hazardous energy including:
 - Statement of the intended use of the instruction;
 - Steps for shutting down, isolating, blocking, and securing the equipment to control the hazardous energy;
 - Steps for testing to verify absence of hazardous energy;
 - Steps for the placement, removal, and transfer of locks and tags;
 - Responsibility for locks and tags;
 - Requirements for testing to determine and verify the effectiveness of the locks and tags and other hazardous energy control

- measures;
- Requirement for assuring the equipment is in a safe operating condition prior to removing lockout/tagout.
- The written instructions may also include task work steps.

- Supervisor assigns work task to Authorized Employee(s) and verifies all employees working on the equipment under a lockout/tagout are trained and authorized by their Department.
- Primary Authorized Employee assesses the type, magnitude and hazards of all energy sources to be controlled. Use up-to-date drawings, diagrams and identification tags and confirm locations of disconnecting devices.
Note: Consider backfeeds, especially when connecting temporary power in situations when equipment is taken out of service for repair or maintenance. If backfeeds are possible, it is likely that there is more than one isolation point since power could be coming back from the load as well as the source.
- Primary Authorized Employee determines type of lockout/tagout application – lock box or hasp (also known as a multi-lock tree). 
- Authorized Employees must visually inspect the equipment prior to applying lockout/tagout.
Look-alike equipment: If the equipment that will be de-energized exists in a work area with other energized equipment that is similar in size, shape, or construction that it could be mistaken for the equipment that is to be locked out, the Authorized Employee must take steps to prevent access to the wrong equipment, such as
 - Safety signs or tags to identify the equipment to be serviced;
 - Barricades around the equipment to be serviced;
 - Attendants at the equipment being serviced.
- Authorized Employee identifies and obtains the appropriate lockout/tagout devices.
Locks, tags, chains, wedges, key blocks, adapter pins, self-locking fasteners, or other hardware must be supplied by the Department/Division for BNL employees and by their employer for non-BNL employees; workers cannot use lockout/tagout hardware that has not been approved by the Department/Division or employer for non-BNL employees.
- Primary Authorized Employee convenes meeting of all Authorized Employees working on the lockout/tagout to inform them of energy, hazards, and review the written instructions. If the written instructions cannot be reviewed at this meeting, they must be discussed with the worker(s) prior to starting the lockout/tagout.
- Authorized Employees verify that they possess the BNL authorized LOTO padlock and that it is personally identifiable.



BNL Authorized LOTO Padlock: Silver colored padlock with red band, which is Master Lock Model 31 (BNL Stock #I65064).

In addition, the padlock must be identifiable in one of the following three ways:

- Indicates the name and phone number of the Authorized Employee; or
- Indicates an inventory number that can be traced through an electronic database to the Authorized Employee; or
- Attach a tag (two-sided, red-and-white-striped, BNL Stock Tag #S81043) to the lock that indicates the name and phone number of the Authorized Employee. This tag must be secured to withstand a pull-strength of not less than 50 pounds.

Note: The use of existing Master Lock Model 3 locks is allowable as long as the organization keeps track of them and understands the risks associated with duplicate keys. All new purchases of padlocks for installation, demolition, or service and maintenance lockout/tagout must be Master Lock Model 31.



LOTO Padlock for Contractors: Contractors use a lock similar in appearance to the BNL padlock, i.e., a silver lock with a red band. The lock must be identifiable in one of the following two ways:

- Indicates the name of the Authorized Employee and the company name and phone number; or
- Has an associated tag that is similar in appearance to the BNL red-and-white-striped tag and meets ANSI Z535.5, indicating the name of the Authorized Employee, company name and phone number. This tag can be one-sided. It must be secured to withstand a pull-strength of not less than 50 pounds.

Applying Complex LOTO for Group [^back to top](#)

- Authorized Employees use the written instructions and confirm the type, magnitude, and hazards of all energy sources to be controlled.
- Primary Authorized Employee notifies all Affected Employees of the upcoming work/shutdown.
- Primary Authorized Employee ensures it is safe to shut down the equipment.
- Authorized Employee or an equipment operator shuts down the equipment.
- Authorized Employee sets up the work boundaries determined through the work planning process.
- Authorized Employee positively isolates all hazardous energy sources, ensures isolation points on the written instructions correspond to equipment on which lockout/tagout is being performed, and verifies that the appropriate isolation device is being used.



For electrical, visually check (if possible) that all contacts have opened. Also, check to make sure that the disconnect switch is not wired backwards (line voltage supplied through the load terminals), a condition occasionally found in older buildings at BNL.

- In cases when the lockout/tagout device is applied to a switch lever, it may be necessary for the Authorized Employee to verify the absence of **voltage** now since disconnect switches will not permit the door to be opened after the lockout/tagout device is applied.
- Primary Authorized or Authorized Employee applies locks to **energy isolating devices**, fills out all information on the tags and applies it to the locks.



BNL Authorized LOTO Padlock: Silver colored padlock with red band, which is Master Lock Model 31 (BNL Stock #I65064).



BNL Authorized LOTO Tag: two-sided, red-and-white-striped, BNL Stock Tag #S81043. It must be secured to withstand a pull-strength of not less than 50 pounds.

Tags applied to energy isolation devices during this step must include the following information:

- Unique tag number;
- An instruction such as: Do Not Start, Do Not Open, Do Not Close, Do Not Energize, Do Not Operate;
- Equipment ID (for example, component name and number); *sufficient information to uniquely identify the equipment*;
- Location (for example, building number, description of location, manhole number, etc.); *sufficient information to identify the location of the LOTO*;
- Printed name, life number, department and phone extension of the Authorized Employee;
- Signature of the Authorized Employee and date the LOTO was applied;
- Reason for the LOTO.



LOTO Padlock for Contractors: Contractors use a lock similar in appearance to the BNL padlock, i.e., a silver lock with a red band.

LOTO Tag for Contractors: Tags applied to energy isolation devices during this step must be similar in appearance to the BNL red-and-white-striped tag, meet ANSI Z535.5, and be completely filled out including the name of the Authorized Employee, company name and phone number. This tag can be one-sided. It must be secured to withstand a pull-strength of not less than 50 pounds.

9. Authorized Employee "challenges" the locks' effectiveness by trying to move the energy isolating devices to the energized position. If the lock is found to be ineffective, the Authorized Employee must pause and re-evaluate along with the supervisor.
10. Authorized Employee attempts to restart the equipment. The Authorized Employee must physically try to restart the equipment using the normal controls, and for electrical perform verification of absence of electrical hazardous energy.
11. Authorized Employee returns the controls to the "off" or "neutral" condition.
12. Authorized Employee verifies the absence of **hazardous energy**.
For example:
 - **Pressurized systems:** depressurize/drain and confirm.
 - **Electrical:** Obtain a [Testing, Troubleshooting, and Voltage Measuring \(TTVM\) Electrical Work Permit](#) or equivalent permit, approved by the supervisor or LOTO SME; then using a properly-rated and listed voltmeter per the [Requirement for Meters Used at BNL](#), first test an energized source within the range of the circuit being verified, then, while not changing the switch setting, measure between ground and each phase conductor, then measure between the neutral and each phase conductor, then measure each phase-to-phase combination. Finally test the meter again on an energized source to verify the meter was not malfunctioning. If the source is DC, test all combinations of positive, negative, and ground conductors.

Note: A similar procedure is applied for equipment isolated by opening a panel-mounted circuit breaker or by "racking out" a large cubicle circuit breaker. For these cases, perform the zero voltage check, (TTVM Electrical Work Permit still needed), at the line terminals of the equipment supplied by the circuit breaker.
13. Relieve, or otherwise render safe, all potentially **stored or residual energies** before working on the equipment or system:
 - Dissipate or restrain stored or residual energy (i.e., capacitors, springs, elevated machine members, rotating flywheels, hydraulic systems, and air, gas, steam, or water pressure) by grounding, repositioning, blocking, and/or bleeding down. Acceptable methods of dissipation include leaving vent or drain valves open on pressurized hydraulic or pneumatic systems.
 - Where possibility of induced voltages or stored electrical energy exists, ground the phase conductors or circuit's parts before touching. Where the conductors or circuit's parts could come into contact with energized parts, apply ground connecting devices rated for the available fault duty.
 - Verify the isolation of residual energy continually until the installation, demolition, servicing or maintenance is completed, or until the possibility of re-accumulation of stored energy to a hazardous level no longer exists.
14. Primary Authorized Employee verifies the instructions have been correctly executed and all sources of hazardous energy have been controlled.
15. Primary Authorized Employee applies lock.
 - If lock box:
 - Primary Authorized Employee applies lock and tag to lock box.
 - If hasp:
 - Primary Authorized Employee applies lock and tag to hasp attached to the energy isolating device(s) of the equipment.

Primary Authorized Employee must be the first to apply a lock and the last to remove a lock from the lockbox or hasp.

Primary Authorized Employee tags must include the following information:

- Unique tag number;
- An instruction, such as: Do Not Start, Do Not Open, Do Not Close, Do Not Energize, Do Not Operate;
- Equipment ID (for example, component name and number); *sufficient information to uniquely identify the equipment*;
- Location (for example, building number, description of location, manhole number, etc.); *sufficient information to identify the location of the active LOTO*;

- Printed name, life number, department and phone extension of the Authorized Employee;
- Signature of the Authorized Employee and date the LOTO was applied;
- Reason for the LOTO.

16. All Authorized Employees performing work on the equipment ensure that each step of the procedure has been completed and then apply their **personally identifiable lock** to the lock box or hasp device.



BNL Authorized LOTO Padlock: Silver colored padlock with red band, which is Master Lock Model 31 (BNL Stock #I65064).

In addition, the padlock must be identifiable in one of the following three ways:

- Indicates the name and phone number of the Authorized Employee; or
- Indicates an inventory number that can be traced through an electronic database to the Authorized Employee; or
- Attach a tag (two-sided, red-and-white-striped, BNL Stock Tag #S81043) to the lock that indicates the name and phone number of the Authorized Employee. This tag must be secured to withstand a pull-strength of not less than 50 pounds.

Note: The use of existing Master Lock Model 3 locks is allowable as long as the organization keeps track of them and understands the risks associated with duplicate keys. All new purchases of padlocks for installation, demolition, or service and maintenance lockout/tagout must be Master Lock Model 31.



LOTO Padlock for Contractors: Contractors use a lock similar in appearance to the BNL padlock, i.e., a silver lock with a red band. The lock must be identifiable in one of the following two ways:

- Indicates the name of the Authorized Employee and the company name and phone number; or
- Has an associated tag that is similar in appearance to the BNL red-and-white-striped tag and meets ANSI Z535.5, and is completely filled out including the name of the Authorized Employee, company name and phone number. This tag can be one-sided. It must be secured to withstand a pull-strength of not less than 50 pounds.

17. Authorized Employee conducts work on the equipment.



Always confirm your lockout/tagout and retest absence of energy if conditions change, or when the job location is left unattended.

18. If the time needed for work on the equipment goes beyond the shift, the Primary Authorized Employee records their tag in the logbook of the organization that owns the equipment.

Removing Complex LOTO for Group [^ back to top](#)

This includes removing the lockout/tagout temporarily for testing or positioning purposes.

1. Primary Authorized Employee briefs the Authorized Employees on the procedure to restore equipment to service.
2. Primary Authorized Employee inspects the work area to ensure nonessential items, such as tools, have been removed, guards and covers are installed properly, grounded equipment is removed, and the equipment is ready to be safely operated.
3. Primary Authorized Employee notifies Affected Employees and others in the area that the lockout/tagout devices will be removed and the equipment may start.
4. Each Authorized Employee removes their lock and tag from the lock box or hasp.
5. Primary Authorized Employee verifies that the operating controls for the equipment are off or in the neutral position.
6. Primary Authorized Employee checks area to ensure all employees are safely positioned or removed from the area.
7. Primary Authorized Employee ensures it is safe to restart the equipment and then removes his/her lock and tag from the lock box or hasp.
8. Primary Authorized Employee designates an Authorized Employee to prepare the equipment for restart by turning on the energy isolating device and testing as necessary.
9. Equipment operator or an Authorized Employee restarts the equipment.
10. If applicable, Primary Authorized Employee notifies operators that the equipment is ready for use
11. If the lockout/tagout was removed temporarily for testing or positioning purposes, the Primary Authorized Employee ensures that the lockout/tagout is reinstalled immediately after completion of testing or positioning.
12. If the tag was logged during application of LOTO [see Step18 of Applying Complex LOTO for Group], the Primary Authorized Employee closes out the tag in the same logbook.
13. Employee designated by Department retains the individual lockout/tagout written instructions so that they are available when audits are performed.

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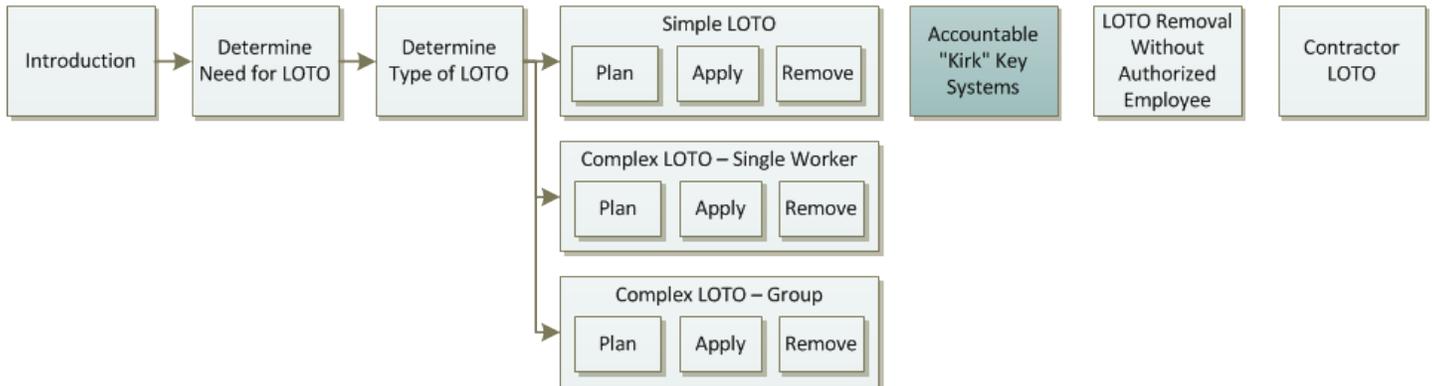
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SUBJECT AREA PROCEDURE CONTENT



Lockout/Tagout (LOTO) for Installation, Demolition, or Service and

Maintenance Subject Area
Effective Date: **Jan 11, 2016** ([Rev 8.0](#))
Periodic Review Due: **Jan 11, 2019**



For personnel who plan installations, demolitions, or servicing and maintenance activities for equipment, machinery or systems in Departments/Divisions that use Accountable "Kirk" Key Systems on machines or equipment that could cause injury by the unexpected start-up, energization, or release of stored energy, and

People who are familiar with operations of the specific equipment controlled by the Accountable Key System.

Accountable ("Kirk") Key Systems

Departments/Divisions who use Accountable Key Systems must designate employees to conduct inspections.



Do not use Programmable Logic Controllers (PLCs)! Accountable Key Systems used for lockout/tagout are to positively de-energize all energy sources to the equipment being controlled. PLCs cannot be used as effective lockout/tagout.



Use only Key Systems that are approved by the Department/Division Management.

Accountable Key Systems are an acceptable alternative method to lockout/tagout. If not properly designed, reviewed and implemented, Accountable Key Systems may fail to provide the required level of safety. This failure is most likely to happen when more than one Employee is involved in service or maintenance, more than one repair activity is taking place around the same equipment, or along the energization chain of such a system, or when equipment is remotely activated or computer-controlled.

Therefore, Accountable Key Systems must be approved by the Department/Division to provide at least an equal amount of protection when compared to lockout/tagout procedures. If it is not approved, the system must not be considered equivalent to lockout/tagout for employee protection while they perform service or maintenance on the equipment.

All Affected Employees must be trained to recognize the hazards and to remain clear of any system whose key is activated because maintenance may be in progress.

1. **Design** an Accountable Key System (to be used for the isolation of hazardous energy during service or maintenance), where energy isolation does not depend on control circuitry. If possible, design the system to enable the last accountable key to be secured in a lock box, which can be padlocked with standard BNL lockout/tagout devices.
2. An expert on the specific equipment controlled by the Accountable Key System and a person experienced in the design and operation of Accountable Key Systems **review the design**. Departments/Divisions that do not have an Accountable Key System expert can contact their Departmental ESH Representative who will then contact the Laboratory Electrical Safety Officer for assistance.
3. The Accountable Key System design must be kept under **configuration control** (in accordance with the [Engineering Design](#) Subject Area). In addition,
 - Each key must be uniquely identified;
 - Only one key is allowed for operators;

4. The Accountable Key System must be **approved by the Department's/Division's Work Planning and Control / Experimental Safety Review** process.
5. The person who designed the Accountable Key System or a system operator must **test** the integrity of the System by verifying that the locked equipment protects employees from hazardous energy.
6. The **Department/Division approves** that the Accountable Key System provides equivalent protection to standard lockout/tagout processes and may be used for service and maintenance of the system.
7. Use the Accountable Key System to lockout/tagout the equipment as necessary.
8. Employee designated by the Departments/Divisions **conduct periodic inspections** of their Accountable Key Systems at least annually or prior to use.
9. In the event an Accountable Key is lost or damaged and a duplicate key (if available) is used, follow the procedure in the section [LOTO Removal when Authorized Employee is Unavailable](#).

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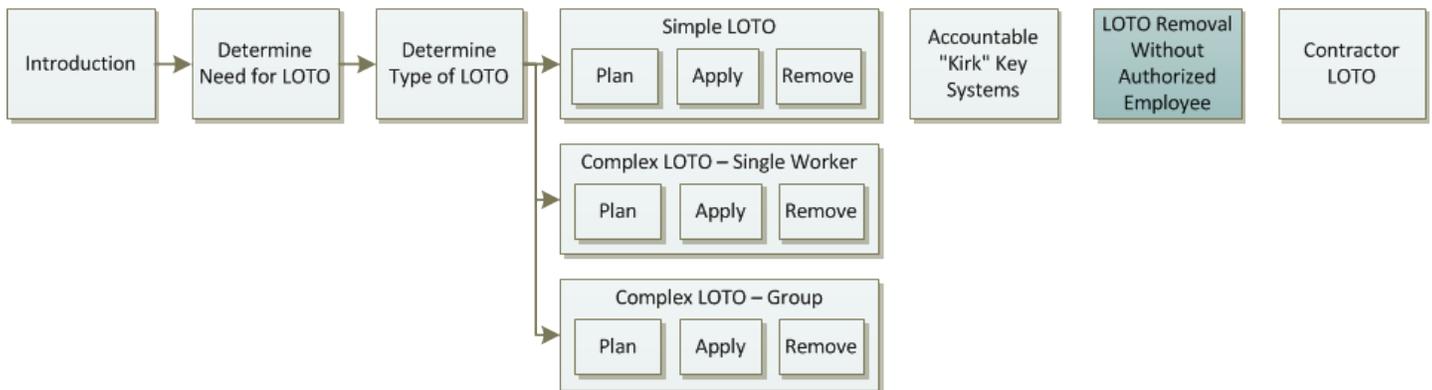
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SUBJECT AREA PROCEDURE CONTENT

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Lockout/Tagout (LOTO) for Installation, Demolition, or Service and Maintenance

Subject Area
Effective Date: **Jan 11, 2016** ([Rev 8.0](#))
Periodic Review Due: **Jan 11, 2019**



For BNL supervisors (or their designees) of Authorized Employees who perform lockout/tagout at BNL; under certain circumstances, it also applies to contractors.

LOTO Removal when Authorized Employee is Unavailable

Every effort must be made to contact the Authorized Employee so they can remove their own lock and tag.

Authorized Employees participating in a lockout/tagout may never transfer their keys to anyone else.

A committee of designated individuals must ensure that the work is complete, the equipment is safe to re-energize, and the Authorized Employee is not in danger from the equipment on return to work.

For Contractors:

A contractor cannot remove a lock applied by a BNL employee.

If a contractor applied a lock but is unavailable to remove it, BNL can remove the lock following the steps in this section.

If a contractor applied a lock and has to remove this lock, they must obtain concurrence from BNL's project manager before they follow the steps in this section.

1. The supervisor must make every reasonable effort to contact the Authorized Employee who applied the lockout/tagout, so that he or she can remove their own lock and tag.
2. If the Authorized Employee is unavailable, a committee of three, consisting of a line supervisor or designee and two Authorized Employees who are familiar with the equipment, determines if removal is safe.
3. Either the Authorized Employee or the Primary Authorized Employee removes the lockout/tagout following the applicable removal procedure (Simple LOTO, Complex LOTO – Single Worker, or Complex LOTO – Group) based on the type of situation. The lock is allowed to be cut off.
4. The employee who removed the lockout/tagout documents the removal in the lockout/tagout logbook.
5. The supervisor must inform the original Authorized Employee that their lockout device was removed and brief that employee on the current status of the equipment. If the Authorized Employee cannot be reached directly and a message is left, the supervisor must receive direct confirmation from the Authorized Employee before he or she can resume work on the equipment.

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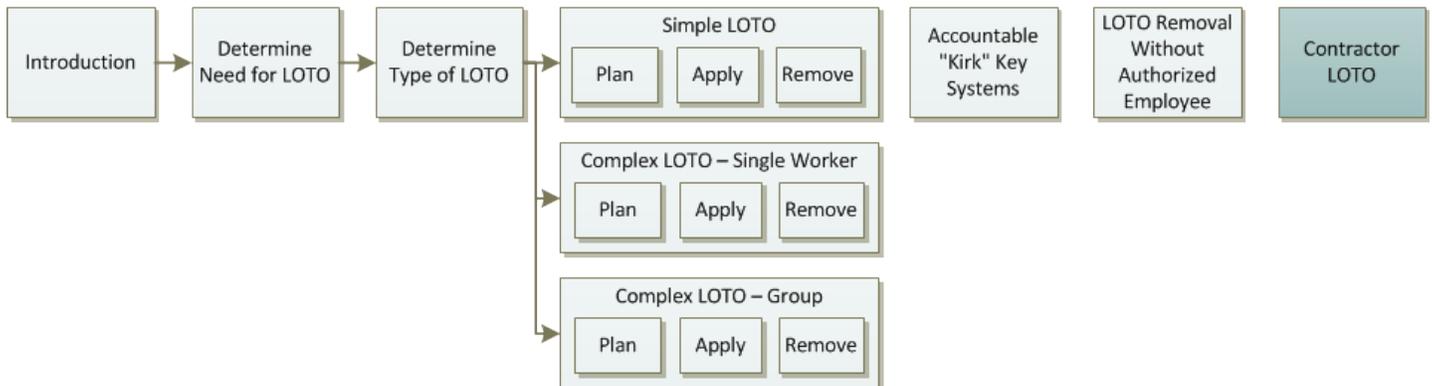
SUBJECT AREA PROCEDURE CONTENT



Lockout/Tagout (LOTO) for Installation, Demolition, or Service and

Maintenance Subject Area
Effective Date: Jan 11, 2016 (Rev 8.0)

Periodic Review Due: Jan 11, 2019



For BNL project managers who are responsible for projects that involve contracted workers as well as contractors and any of their subcontractors working on projects at BNL.

Contractor LOTO

Contractors follow all sections of the Lockout/Tagout Subject Area; below are additional requirements.

Lockout/tagout is necessary for the protection of personnel from unexpected energization or startup of machinery and equipment, or the release of hazardous energy installation, demolition, or service and maintenance activities.

If lockout/tagout will be required on any BNL project, a 10 CFR 851, *Worker Safety and Health Program*, compliant lockout/tagout program must be in place for each contractor. Such a program must include detailed administrative procedures and personnel training as required by 10 CFR 851, OSHA, NFPA 70E *Standard for Electrical Safety in the Workplace*, and BNL. If the contractor does not have such a program, they need to implement one or adopt BNL's program by completing BNL training requirements.

BNL Project Manager Responsibilities

1. Before beginning any work that requires a lockout/tagout, the BNL project manager finds out if the contractor or subcontractor has a 10 CFR 851, *Worker Safety and Health Program*, compliant LOTO program.
2. If the contractor or subcontractor **has a 10 CFR 851, Worker Safety and Health Program, compliant LOTO program**, the BNL Project Manager verifies that the contractor and any subcontractor employee installing and removing lockout/tagout
 1. are authorized by the contractor; as proof of authorization, the contractor submits a written notification to BNL which includes the names of the Authorized Employees),
 2. have identified the type of lockout/tagout being applied (electrical, mechanical, etc.) and
 3. have satisfied [BNL training requirements](#).
3. If the contractor or subcontractor **does not have a 10 CFR 851, Worker Safety and Health Program, compliant LOTO program**, the BNL Project Manager verifies that the contractor and any subcontractor employee installing and removing lockout/tagout successfully completed the required [training and/or requalification](#).

Documented on-the-job training and a successfully completed Job-Performance Measure (JPM) is required to show proficiency and apply LOTO without direct BNL supervision.

Contractors who have not yet successfully completed a JPM may apply locks and tags while receiving on-the-job training, but must not act as Primary Authorized Employee.

Contractor Responsibilities

1. The contractor supervisor will ensure that any crew members working for the contractor, including any of its subcontractors, understand and perform lockout/tagout in accordance with this Subject Area.

Failure to ensure compliance with the Lockout/Tagout Subject Area may result in penalties up to and including termination for cause.

2. For Complex LOTO – Group, the contractor appoints an employee who accepts responsibility for the safety of the contractor's employees (and any subcontractors) working under the Complex LOTO procedure. The contractor also designates an employee responsible to coordinate work between the different crafts or groups and ensures continuity of protection.
3. In situations where BNL is shutting down the equipment (not the contractor):
 1. The BNL primary Authorized Employee locks out/tags out the equipment.
 2. Then the contractor employees attach their locks to the disconnecting devices.
 3. Work on the equipment can now be conducted.
 4. The contractor employees remove their locks first, then the BNL Primary Authorized Employee removes his/her lock and tag.

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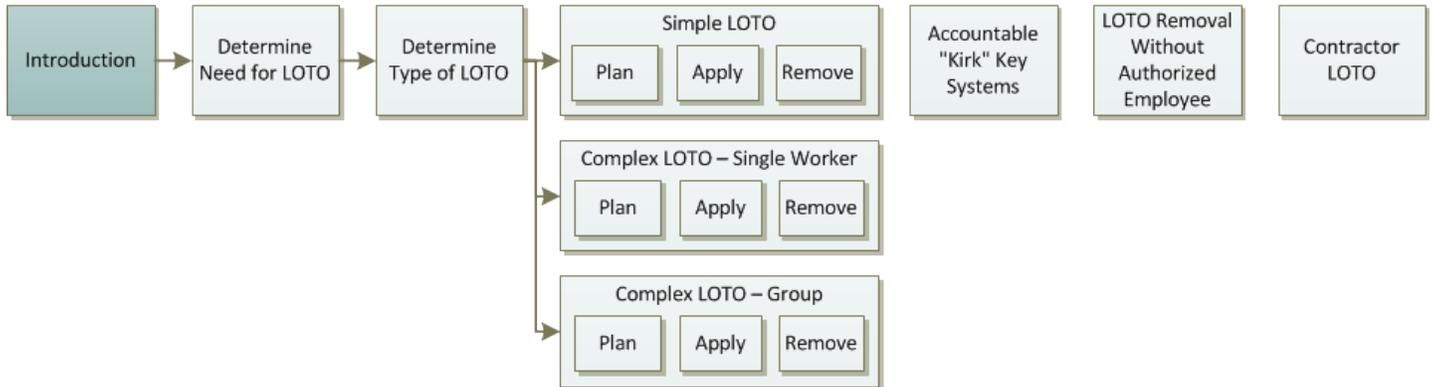
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REQUIREMENTS CONTENT



Lockout/Tagout (LOTO) for Installation, Demolition, or Service and Maintenance

Subject Area
Effective Date: **Jan 11, 2016** ([Rev 8.0](#))
Periodic Review Due: **Jan 11, 2019**



Reporting Obligations

None

External/Internal Requirements

BNL has to abide by all applicable Prime Contract clauses, DOE directives, industry standards, as well as Federal, state, and local laws. BNL develops its policies and procedures based on an evaluation of these external requirements. This Subject Area implements the following requirements:

Requirement Number	Requirement Title
10 CFR 851	Worker Safety and Health Program
29 CFR 1910	Labor/Occupational Safety and Health Standards
29 CFR 1926	Labor/Safety and Health Regulations for Construction
ANSI Z 136.1	Safe Use of Lasers
ANSI Z 535.1	Safety Color Code
BSA Contract No. DE-SC0012704 - Clause C.4	Statement Of Work
BSA Contract No. DE-SC0012704 - Clause H.27 (ACT)	Non-Federal Agreements for Commercializing Technology (Pilot) (ACT)
BSA Contract No. DE-SC0012704 - Clause I.131 (DEAR 970.5223-1)	INTEGRATION OF ENVIRONMENT, SAFETY, AND HEALTH INTO WORK PLANNING AND EXECUTION (DEC 2000)
NFPA 70E (2009)	Electrical Safety Requirements for Employee Workplaces
O 414.1D Admin Chg 1 (May 8, 2013)	Quality Assurance

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TRAINING CONTENT

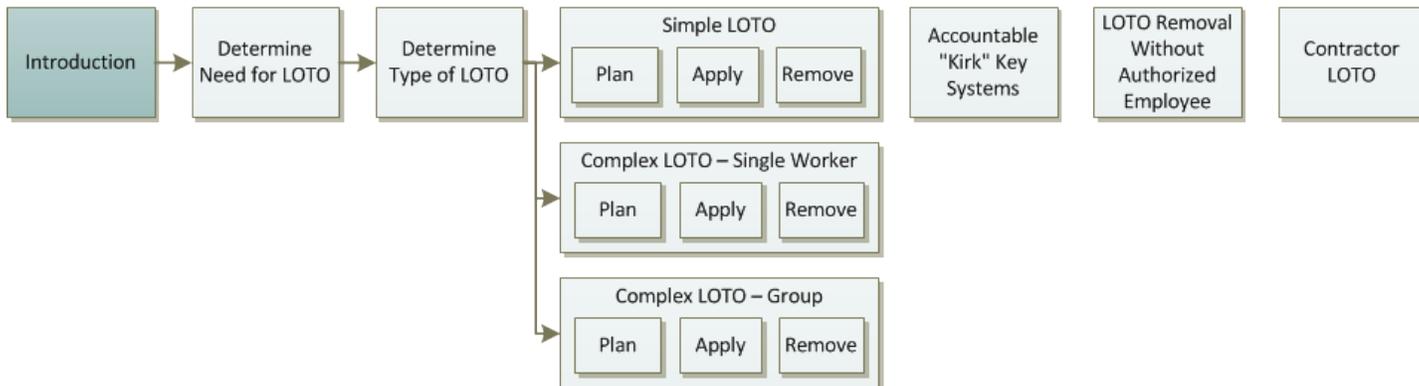


Lockout/Tagout (LOTO) for Installation, Demolition, or Service and

Maintenance Subject Area

Effective Date: Jan 11, 2016 (Rev 8.0)

Periodic Review Due: Jan 11, 2019



Training

This is a list of the minimum LOTO training requirements (organized by role). Contact your supervisor and [departmental Training Coordinator](#) for further details of what training you need.

Affected Employees

JTA: GE-68A LOTO Affected Worker			
Course Title	Course No.	Delivery Method	Requalification Period (months)
Lockout/Tagout - Affected Employee	HP-OSH-151A-W	Web-based	0

Authorized Employees and Primary Authorized Employees

JTA: GE-68B LOTO Authorized Employee			
Course Title	Course No.	Delivery Method	Requalification Period (months)
Lockout/Tagout - Authorized <i>Employees who have never taken BNL LOTO Authorized Employee training must take the classroom course. Employees who are requalifying may take either the classroom or Web-based course.</i>	HP-OSH-151B or HP-OSH-151B-W	Classroom Web-based	12
Documented "hands-on experience" in safety-related technical aspects of the equipment to be locked/tagged out.		On-the-job training by a Facility Authorized LOTO Trainer using Lockout/Tagout Training Tool	As necessary, determined by line supervision
LOTO Job-Performance Measure <i>Employees must have a field evaluation by a Job-Performance Measure Field Evaluator. This evaluation will confirm the LOTO Authorized Candidate's ability to successfully complete the required LOTO steps.</i>	TQ-LOTO-P	BNL LOTO Field Evaluator	12

Documented on-the-job training and/or a successfully completed Job-Performance Measure (JPM) is required to show proficiency and apply LOTO without direct supervision.

BNL staff who have not yet successfully completed a JPM may apply locks and tags while receiving on-the-job training, but must not act as Primary Authorized Employee.

Use the [Lockout/Tagout Training Tool](#) to document all new on-the-job training for BNL staff.

Group LOTO: Workers do not need [TQ-ELECSAF1](#) or [TQ-ADULTCPR](#) to add a lock to a group LOTO, unless they are performing the electrical verification for themselves.

Contractors and Subcontractors with a 10 CFR 851, Worker Safety and Health Program, Compliant LOTO Program

Workers are to be authorized by the contractor; as proof of authorization, the contractor submits a written notification to the BNL Project Manager which includes the names of the LOTO Authorized Employees			
Course Title	Course No.	Delivery Method	Requalification Period (months)
Documented "hands-on experience" in safety-related technical aspects of the equipment to be locked/tagged out, and the differences between the BNL LOTO program and the Contractor LOTO program are discussed		On-the-job training by a Facility Authorized LOTO Trainer using Lockout/Tagout Training Tool	As necessary, determined by line supervision
LOTO Job-Performance Measure <i>Contractors must have a field evaluation by a Job-Performance Measure Field Evaluator. This evaluation will confirm the LOTO Authorized Candidate's ability to successfully complete the required LOTO steps.</i>	TQ-LOTO-P	BNL LOTO Field Evaluator	12

Documented on-the-job training and a successfully completed Job-Performance Measure (JPM) is required to show proficiency and apply LOTO without direct BNL supervision.

Contractors who have not yet successfully completed a JPM may apply locks and tags while receiving on-the-job training, but must not act as Primary Authorized Employee.

Use the [Lockout/Tagout Training Tool](#) to document all new on-the-job training for contractors.

HP-OSH-151B (classroom) or HP-OSH-151B (Web-based) training is not required for contractors with a 10 CFR 851 compliant LOTO Program.

Contractors and Subcontractors without a 10 CFR 851, Worker Safety and Health Program, Compliant LOTO Program

Course Title	Course No.	Delivery Method	Requalification Period (months)
Contractors who have never taken BNL LOTO training take HP-OSH-151B (classroom Lockout/Tagout Authorized) or HP-OSH-151B-W (Web-based Lockout/Tagout Authorized) based on an evaluation by the BNL Facility Authorized LOTO Trainer	HP-OSH-151B or HP-OSH-151B-W	Classroom	12
		Web-based	12
Contractors who have taken BNL LOTO training more than 12 months ago must be requalified and take HP-OSH-151B-W (Web-based Lockout/Tagout Authorized)	HP-OSH-151B-W	Web-based	12
Documented "hands-on experience" in safety-related technical aspects of the equipment to be locked/tagged out, and the differences between the BNL LOTO program and the Contractor LOTO program are discussed		On-the-job training by a Facility Authorized LOTO Trainer using Lockout/Tagout Training Tool	As necessary, determined by line supervision
LOTO Job-Performance Measure <i>Contractors must have a field evaluation by a Job-Performance Measure Field Evaluator. This evaluation will confirm the LOTO Authorized Candidate's ability to successfully complete the required LOTO steps.</i>	TQ-LOTO-P	BNL LOTO Field Evaluator	12

Documented on-the-job training and a successfully completed Job-Performance Measure (JPM) is required to show proficiency and apply LOTO without direct BNL supervision.

Contractors who have not yet successfully completed a JPM may apply locks and tags while receiving on-the-job training, but must not act as Primary Authorized Employee.

Use the [Lockout/Tagout Training Tool](#) to document all new on-the-job training for contractors.

Field Evaluator for Lockout/Tagout Job-Performance Measure and Facility Authorized LOTO Trainer

JTA: GE-68E Job-Performance Measure Field Evaluator and Facility Authorized LOTO Trainer
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Course Title	Course No.	Delivery Method	Requalification Period (months)
Lockout/Tagout Authorized Employee Training	HP-OSH-151B-W	Web-based	12
Lockout/Tagout Train-the-Evaluator	TQ-LOTO-EVAL	Classroom	0

Supervisors of Authorized Employees and Employees providing LOTO oversight (not actively applying LOTO)

JTA: GE-68S LOTO Oversight or Supervisor			
Course Title	Course No.	Delivery Method	Requalification Period (months)
Lockout/Tagout - Authorized	HP-OSH-151B-W	Web-based	12

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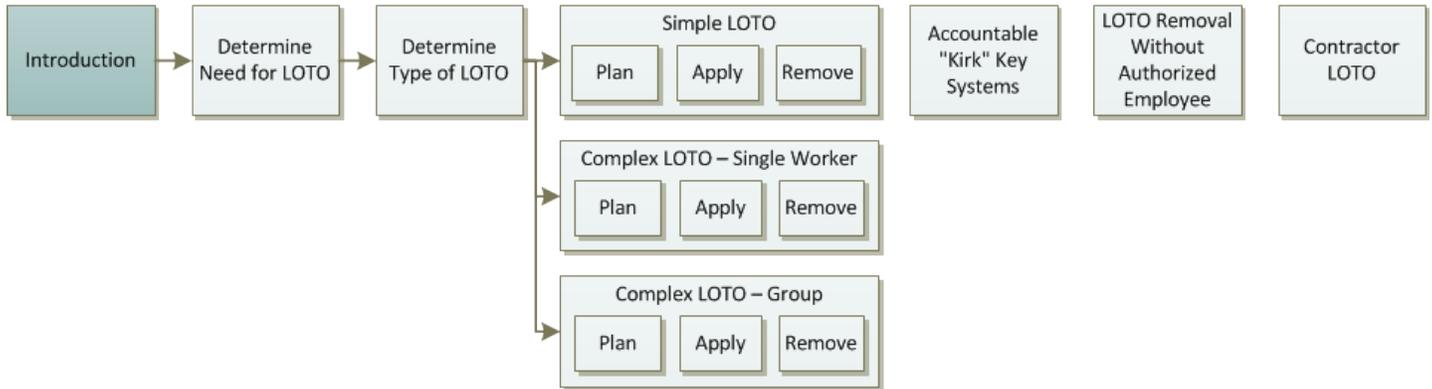
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Lockout/Tagout (LOTO) for Installation, Demolition, or Service and Maintenance

Subject Area
 Effective Date: **Jan 11, 2016** ([Rev 8.0](#))
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Revision History

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Revision Number	Revision Type	Revision Date	Revision Description
8.0	Major	01/11/2016	This was a complete review and the following major changes were made: <ul style="list-style-type: none"> • Wording throughout the document was modified for consistency regarding use of LOTO tags and required information on the tags. • The Complex LOTO Instructions were modified to allow for verbal approval from the Authorized Department Representative to proceed with equipment shutdown and restoration of power when the work is complete.
7.0	Major	01/05/2015	The following three changes were made: <ul style="list-style-type: none"> • The LOTO tag used is changed to a BNL designed two-sided tag for BNL applied LOTOs. <ul style="list-style-type: none"> • Current BNL applied one-sided tags already in place may remain for one year from the date of publication of this subject area change. • Contractors can continue to use an OSHA compliant tag that is similar in appearance. The Contractor tag can be one sided. • LOTO and the EMII (Electrical Material and Installation Inspection) program: <ul style="list-style-type: none"> • Added definition of the EMII program • Where a "Simple LOTO" is in place and an inspection is required, local inspectors or the Chief Electrical Inspector may choose to follow the Simple LOTO process, even if they are not identified as members of the BNL craft, crew or contractor that applied the initial simple LOTO. • Where a "Complex LOTO - Single Worker" is in place and an inspection is required, the LOTO becomes a Complex LOTO - Group process and additional work planning is required. • Where a "Complex LOTO - Group" is in place and an inspection is required, local inspectors and the Chief Electrical Inspector must follow the Complex LOTO - Group process. • Complex Group LOTOs in place for less than one shift do not require tags to be logged.
6.0	Major	09/30/2013	The subject area was completely reviewed, revised, and published in a new layout. The subject area scope was modified to specifically include only service and maintenance activities. The number of LOTO types was reduced to three; 1) Simple LOTO, 2) Complex Single Worker LOTO and 3) Complex Group LOTO. The type of tag was changed to make it specific to service and maintenance LOTO only. Wording was added to clarify that installation and demolition are included as part of the LOTO subject area. Responsibility for assuring contractor training and authorization is assigned to the Project Manager or delegate. A requirement for employees to have a field evaluation by a Job-Performance Measure Field Evaluator was added. Sections were structured to follow the LOTO process as conducted in the field from planning through implementation. A tool (energy source table) was

			included to help determine when LOTO is required. Terminology was changed from "Responsible" to "Primary Authorized" to describe the person responsible for assuring continuous protection for a group of Authorized Employees/Workers. The term "Person In Charge" was removed. The subject area no longer allows the use of UPA devices as part of the zero energy check for electrical LOTO. Definitions were modified and added to better address the general concepts of LOTO and to specifically address "crew" and "craft".
5.4	Minor	11/01/2012	In section 1. Implementing Lockout/Tagout (LOTO), a change was made in step 11 to clarify that the Laboratory Electrical Safety Committee (LESC) approves the use of multiple keys to a single LOTO device. An organizational-level procedure is required to document how multiple keys are controlled (either destruction of additional keys or controlled through administrative procedure).
5.3	Minor	03/30/2012	As part of a corrective action, step 5 in the section Lockout/Tagout--Exposed Electrical Conductors or Parts was revised and the following sentence was added: Consider backfeeds, especially when connecting temporary power in situations when equipment is taken out of service for repair or maintenance.
5.2	Minor	11/29/2010	This was a minor revision to clarify the wording of step 2 in the section Lockout/Tagout for Contractors at BNL.
5.1	Minor	10/21/2010	This was a minor revision to add clarification to the section Lockout/Tagout Contractors During Construction and change the section title to Lockout/Tagout for Contractors at BNL.
5.0	Major	10/15/2010	The subject area was completely reviewed and the following major changes were made: <ul style="list-style-type: none"> • Added the line, "Workers must visually inspect the equipment prior to LOTO," in the section Implementing Lockout/Tagout (LOTO) • Added a step to the section Complex/Group/Operations Lockout/Tagout (LOTO) that requires the Department/Division to ensure that a specific written LOTO plan is developed, documented, and used • Modified the training requirements in the section Lockout/Tagout-Exposed Electrical Conductors or Parts • Added the line, "Only one key is allowed for the operators," in the section Accountable Key System • Added a new section titled Lockout/Tagout Contractors During Construction
4.1	Minor	06/17/2010	This was a minor revision to update all references to the Personal Protective Equipment and Respirators Subject Area to reflect the recent merger of the Respiratory Protection and Personal Protective Equipment Subject Areas. In the sections Lockout/Tagout--No Exposed Electrical Conductors or Parts and Lockout/Tagout--Exposed Electrical Conductors or Parts, reference to the exhibit BNL Handbook on Personal Protective Equipment (PPE) Selection and Use was replaced with the exhibit PPE Descriptions and Design Requirements Standards.
4.0	Major	09/11/2009	The subject area was completely reviewed and revised for clarification and to add a required step. In the Introduction section under Complex Lockout/Tagout Procedure, asterisks were added wherever Authorized Employees/Workers were referenced to indicate the Person in-charge must also be authorized as Responsible Employee/Worker. A new step 3 was added to the section Implementing Lockout/Tagout(LOTO) that requires Authorized Employees/Workers to evaluate if the equipment that will be deenergized exists in a work area with other energized equipment that is similar in size, shape, and construction that might be look-alike equipment and could be mistaken for the equipment that is to be serviced or maintained. If there is look-alike equipment one of the following methods must be used to prevent access to the wrong equipment: 1. Safety signs or tags; 2. Barricades; 3. Attendants. The section Complex/Group/Operations Lockout/Tagout (LOTO) was revised and Person-in-Charge was deleted whenever the lockout/tagout included other employees/workers. The Definitions section was revised and the definition for Responsible Employee/Worker was clarified by adding the statement "Responsible Employees/Workers are Persons-in-Charge but a Person-in-Charge may not be a Responsible Employee/Worker." The definition for Person-in-Charge was revised for clarification by adding the quotation marks: These Employees/Workers must be authorized "as a Person-in-Charge" by their organization to lockout and tagout the equipment. The definition for Responsible Employee/Worker was revised for clarification and specifies that the Responsible Employee/Worker may act as a Person-in-Charge, however, a Person-in-Charge may not act as a Responsible Employee/Worker without written approval from the organization.
3.2	Minor	03/24/2009	The following sentence was deleted from step 8 in the sections Lockout/Tagout--No Exposed Electrical Conductors or Parts and Lockout/Tagout--Exposed Electrical Conductors or Parts: Tags may be secured using duct tape or black-and-yellow striped safety tape only if it is not possible to use the non-reusable nylon cable tie.
3.1	Minor	10/15/2008	In the Introduction section, the reference to five lockout/tagout procedures was changed to four since two procedures were combined during the committee review of the subject area. The following bullets were added to step 1 in the section Complex/Group/Operations Lockout/Tagout (LOTO): • Specific procedural steps for testing to verify the absence of hazardous energy; • Responsibility for locks and tags; Also in step 1, "or other control measures" was changed to "and other control measures" in the last bullet.
3.0	Major	08/25/2008	This revision is the result of an ISM/Safety Improvement Project Plan Corrective Action, Corrective Action C-1.2 – Review and revise SBMS documents. This is one of several corrective actions developed to address a finding that the "Laboratory has not fully established clear, adequate, and consistent requirements and effectively communicated these requirements to enable the implementation of some ES&H and assurance requirements/controls." Corrective Action C-1.2 requires that certain Standards Based Management System Subject Areas "having significant institutional risks be revised using a new process to be developed under another corrective action. A team of subject matter experts, workers and line managers will be created to review and upgrade each of these subject areas." A comprehensive assessment was conducted comparing the various DOE, Federal, and National Consensus Standards for lockout/tagout to the Lockout/Tagout (LOTO) Subject Area, which was rewritten and published in February 2008 after the DOE's Office of Environment, Safety, and Health (ES&H) evaluations (HS-64), within the Office of Health, Safety and Security (HSS), inspected environment, safety, and health (ES&H) program implementation at BNL during July and August 2007. That assessment showed some minor clarification was necessary, and served as a cornerstone for the review process that resulted in this change. This change expands the use of lockout/tagout for the protection of personnel to tasks other than servicing and

			<p>maintenance. In essence, a red lock and a red tag are required when protecting people. This revision also acknowledges the differences between OSHA and the NFPA 70E for lockout/tagout, especially for complex, group, and operations lockout/tagout situations. This revision considers that people conducting lockout/tagout at BNL may not all be BNL employees, and uses the term "employee/worker" to ensure all personnel working at BNL are protected from hazardous energy.</p> <p>Training will be revised within three months of the publication of this subject area.</p>
2.1	Minor	07/11/2008	<p>The following changes were made to the Introduction section: • Under the Simple lockout/tagout procedure, the words "that can cause injury" were added to the first bullet; • Adding Conduct of Operations lockout/tagout to the existing LOTO procedures allowed at BNL; • Changed Accountable Key System to a LOTO procedure for clarification (increasing the total number of LOTO procedures from three to five). In the section Implementing Lockout/Tagout (LOTO), "within one shift" was added in step 11 to clarify the timeframe and other minor changes were made for clarification. The following changes were made to the section Simple Lockout/Tagout (LOTO): • Under the Required Procedure, verify was replaced with confirm to be consistent with the new terms and definitions; • Step 2 was revised to align with OSHA requirements. In the sections Complex Lockout/Tagout (LOTO) and Lockout/Tagout--No Exposed Electrical Conductors or Parts, under the Required Procedure, verify was replaced with confirm to be consistent with the new terms and definitions and other minor changes were made for clarification. Step 7 in the section Complex Lockout/Tagout (LOTO) was deleted from the procedure, modified, and moved to the Guidelines section as the following guidance: Each Authorized Employee working on the task should attach their individual lock. The following changes were made to the section Lockout/Tagout--Exposed Electrical Conductors or Parts: • Under the Required Procedure, verify was replaced with confirm to be consistent with the new terms and definitions; • The second bulleted item in step 11 was revised to add "and is in an electrically safe condition" for clarification and PPE requirements were corrected. The following step was added to the section Removing Lockout/Tagout: Responsible Employees must determine the exposure status of individual group members prior to release from lockout/tagout. Minor changes were made for clarification to the sections Removing Lockout/Tagout Devices When the Authorized Employee is Not Available and Transferring Lockout/Tagout Devices. The Sample Complex Lockout/Tagout Plan (formerly titled Sample Complex Lockout Procedure) was revised for clarity. The Sample Simple Lockout/Tagout Plan was formerly titled Sample Simple Lockout Procedure. Definitions for the terms "confirm" and "verify" were added to the Definitions section.</p>
2.0	Major	02/29/2008	<p>The subject area was completely reviewed and revised to simplify and clarify the process. There are no new requirements. The following changes were made to the Introduction section: • Describing when LOTO is not required to clarify OSHA exceptions; • Defining the three LOTO procedures allowed at BNL—Simple, Complex, and Operations; • Moving the DOE-STD-1030-96 Guide to Good Practices for Lockouts and Tagouts from Requirements to References. The following six sections were added to the subject area: • The new sections Simple Lockout/Tagout (LOTO) and Complex Lockout/Tagout (LOTO) incorporate the requirements from the existing section Implementing Lockout/Tagout (LOTO) for clarification; • The new sections Lockout/Tagout--No Exposed Electrical Conductors or Parts and Lockout/Tagout--Exposed Electrical Conductors or Parts to divide the former section Applying Lockout/Tagout Devices into non-electrical and electrical procedures to simplify the process for non-electrical personnel; • The new section Lockout/Tagout Conduct of Operations, to incorporate the requirements of DOE O 5480.19; • The new section Accountable Key Systems replaces the exhibit Accountable Key Systems. The following changes were made to the section Implementing Lockout/Tagout (LOTO): • Defining when LOTO is required in the Applicability statement; • In the Required Procedure, adding conduct of operations and if an energy isolating device is capable of being locked, the Authorized Employee performing service or maintenance must use a lock; • Clarifying the Supervisors' responsibilities for training personnel in the first step; • Including requirements for specific written plans. The section Removing Lockout/Tagout was renumbered and temporary release of lockout/tagout was moved from the Required Procedure to the first step. The section Removing Lockout/Tagout Devices When an Authorized Employee is Not Available was renumbered and further defines the requirements from OSHA in the Required Procedure. The section Transferring Lockout/Tagout Devices remains unchanged. The exhibit Accountable Key Systems was deleted. The exhibit Criteria for LOTO Inspections (Audits) was added. The exhibit Examples of Lockout/Tagout (LOTO) was revised. The exhibit Sample - Specific Lockout/Tagout Procedure was deleted and replaced by the exhibit Samples of Lockout/Tagout Plans, which contains a renamed and updated Sample Simple Lockout/Tagout Plan and a new Sample Complex Lockout/Tagout Plan. The definitions for Accountable Key System, Authorized Employee/ Worker, Group Lock/Operations Lock, Lockout/Tagout (LOTO), and Supervisor were revised. The terms Knowledgeable Employee, Research Workers, and Utility Workers were deleted from the Definitions section.</p>
1.2	Minor	02/12/2007	<p>A minor correction was made to change Effective Worker to Affected Worker in the section Implementing Lockout/Tagout (LOTO).</p>
1.1	Minor	01/31/2007	<p>References to ES&H Standard 1.5.0, Electrical Safety were replaced by the Electrical Safety Subject Area.</p>
1.0	Major	09/29/2006	<p>The Lockout/Tagout (LOTO) Subject Area provides procedures to safeguard employees from the unexpected energization or startup of machinery or equipment, or the release of hazardous energy during service or maintenance activities. This subject area replaces ESH Standard 1.5.1 Lockout/Tagout Requirements and does not add or change any requirements from the standard.</p>

NOTE: The dates for "Major Revisions" match the Subject Area Effective Date. Major and/or Minor revisions may not always match with the "Last Modified Date", since this date could reflect changes to links or spelling. Records of changes are maintained in the SBMS documentation for each subject area.

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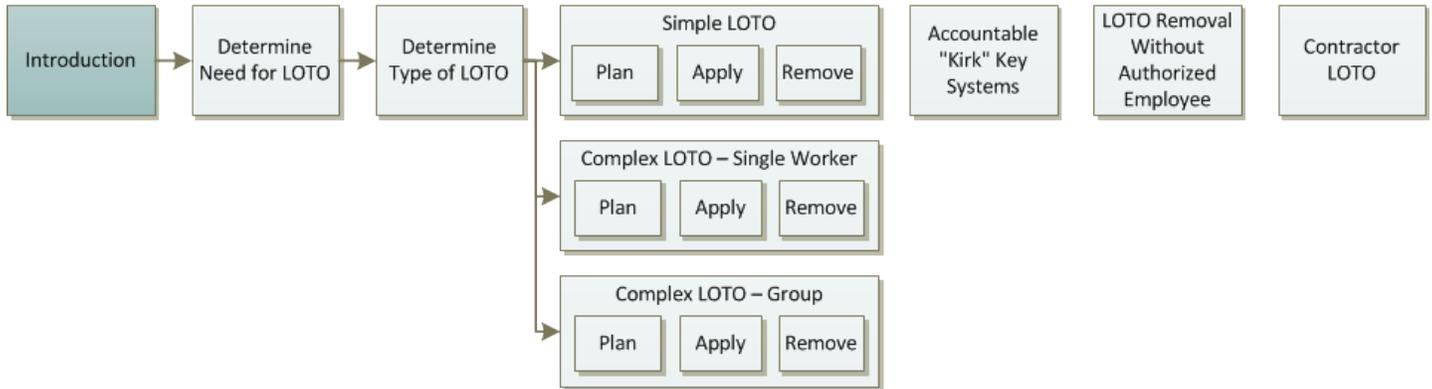
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DEFINITION CONTENT



Lockout/Tagout (LOTO) for Installation, Demolition, or Service and Maintenance

Subject Area
 Effective Date: **Jan 11, 2016** (Rev 8.0)
 Periodic Review Due: **Jan 11, 2019**



Definitions

Term	Definition
Accountable Key System (e.g., Captive or Kirk Key)	A system where a key is physically removed from one position and inserted and captured in another lock to enable a system or to provide personnel access to controlled areas. This system is typically used to control active energy sources, personnel access, and energy discharge systems. To be used as a form of LOTO, these systems require design review, periodic testing, and formal review by the appropriate Department Electrical Subject Matter Expert and a person experienced in the design and operation of accountable key systems.
Affected Employee	An employee who is required to use machines or equipment on which servicing is performed under the lockout/tagout standard or who performs other job responsibilities in an area where such servicing is performed.
Authorized Employee	An employee who has satisfied all LOTO training requirements and has demonstrated proficiency in applying LOTO without direct BNL supervision. An Authorized Employee can perform simple and complex lockout/tagout for their own protection.
Complex LOTO - Group	<p>Lockout/tagout for protection of personnel from unexpected energization or startup of machinery and equipment, or the release of hazardous energy during installation, demolition, or service or maintenance activities, where one or more of the following conditions exist and the LOTO is for the protection of others:</p> <ul style="list-style-type: none"> • More than 1 source of hazardous energy • More than 1 isolation point • More than 1 craft applying LOTO • More than 1 work location • Both BNL and non-BNL workers are applying LOTO • More than 1 crew is applying LOTO • More than 1 disconnecting means • A particular sequence that is out of the ordinary, is required for LOTO • Piece of equipment involved cannot be locked <p>During a Group Complex LOTO, more than one Authorized Employee is performing work on equipment or a system; including one Primary Authorized Employee.</p>

Complex LOTO - Single Worker	<p>Lockout/tagout for protection of personnel from unexpected energization or startup of machinery and equipment, or the release of hazardous energy during installation, demolition, or service or maintenance activities, where one or more of the following conditions exist and the LOTO is for individual protection:</p> <ul style="list-style-type: none"> • More than 1 source of hazardous energy • More than 1 isolation point • More than 1 work location • More than 1 disconnecting means • A particular sequence that is out of the ordinary, is required for LOTO • Piece of equipment involved cannot be locked <p>During a Single Worker Complex LOTO, only one Authorized Employee is performing work on equipment or a system.</p>
Craft	Discrete trade – e.g. electrician, fire alarm electrician, tower line electrician, plumber, technician.
Crew	Teams normally assigned to work together.
de-energized	Free from any kinetic energy due to mechanical motion, electric energy, and potential energy due to the stored energy of position (e.g., gas in a pressure vessel, water in a pressurized cooling system, stored charge in a capacitor).
Designee	Individual that is designated in writing, by the Department Chair/Division Manager, or their supervisor.
electrical hazard	A dangerous condition such that contact or equipment failure can result in electric shock, arc flash burn, thermal burn, or blast.
EMII - Electrical Material and Installation Inspection	A program that covers the review and approval of the materials and installation of the electrical distribution for facilities and hard-wired equipment at BNL.
Employee	Generic term for any person doing work at BNL or in places under BNL's jurisdiction.
energized	Connected to an energy source or containing residual, stored or potential energy.
energy	Kinetic energy due to mechanical motion and/or potential energy due to the stored energy of position (e.g., gas in a pressure vessel, water in a pressurized cooling system, steam lines, electrons in a capacitor).
energy isolating device	A mechanical device that physically prevents the transmission or release of energy, including but not limited to the following: A manually operated electrical circuit breaker; a disconnect switch; a manually operated switch by which the conductors of a circuit can be disconnected from all ungrounded supply conductors, and, in addition, no pole can be operated independently; a line valve; a block; and any similar device used to block or isolate energy. Push buttons, selector switches and other control circuit type devices are not energy isolating devices.
energy source	Any source of electrical, mechanical, hydraulic, pneumatic, chemical, thermal, or other energy.
exposed (as applied to live parts)	Capable of being inadvertently touched or approached nearer than a safe distance by a person. It is applied to parts that are not suitably guarded, isolated, or insulated.
Facility Authorized LOTO Trainer	A person authorized by their organization to perform training in preparation for a formal Job-Performance Measure (JPM) on LOTO Authorized Candidates. Examples of persons acting in a Facility Authorized LOTO Trainer capacity include supervisors, technical leads, and foremen.
hazardous energy	Hazardous energy is energy or combinations thereof that when released has the potential to harm workers.
lock box	A lockable box used to store lockout keys for complex systems.
lockout	The placement of a lockout device on an energy isolating device, in accordance with an established procedure, ensuring that the energy isolating device and the equipment being controlled cannot be operated until the lockout device is removed.
lockout device	A device that utilizes a positive means such as a lock, to hold an energy isolating device in a safe position and prevent the energizing of a machine or equipment. Included are blank flanges and bolted slip blinds.
LOTO Authorized Candidate	A person who is in the process of becoming a LOTO Authorized Employee at BNL.
LOTO Field Evaluator	A person authorized by their organization to perform a Job-Performance Measure (JPM) evaluation on LOTO Authorized Candidates.
other employees	Employees who may be impacted by the LOTO work being performed, but who is not associated with the work being performed. These employees are expected to comply with all requirements not to disturb locks and tags.
Primary Authorized Employee	An Authorized Employee who is designated by their department/division to coordinate complex-group lockout/tagout procedures. The Primary Authorized Employee coordinates workforces and ensures continuity of lockout/tagout protection for all involved (both Authorized and Affected Employees). They are the first to apply their lock and the last to remove their lock from a group lockout/tagout.

servicing and/or maintenance	Workplace activities such as constructing, installing, setting up, adjusting, inspecting, modifying, and maintaining and/or servicing machines or equipment. These activities include lubrication, cleaning or unjamming of machines or equipment and making adjustments or tool changes, where the employee may be exposed to the <i>unexpected</i> energization or startup of the equipment or release of hazardous energy.
Simple LOTO	Lockout/tagout for protection of personnel from unexpected energization or startup of machinery and equipment, or the release of hazardous energy during installation, demolition, or service or maintenance activities, where all of the following conditions exist: <ul style="list-style-type: none"> • 1 source of hazardous energy • 1 isolation point • 1 craft applying LOTO • 1 work location • Either BNL workers or non-BNL workers are applying LOTO (not both) • 1 crew is applying LOTO • 1 disconnecting means • The LOTO sequence is not out of the ordinary • Piece of equipment involved can be locked
tagout	The placement of a tagout device on an energy isolating device, in accordance with an established procedure, to indicate that the energy isolating device and the equipment being controlled may not be operated until the tagout device is removed.
tagout device	A prominent warning device, such as a tag and a means of attachment, which can be securely fastened to an energy isolating device in accordance with an established procedure, to indicate that the energy isolating device and the equipment being controlled may not be operated until the tagout device is removed. (BNL Stock No. S81043)
verify	Verify means the establishing of actual facts. The Authorized Employee establishes that the correct action was performed. They witness the testing performed by someone else or they perform the testing themselves.

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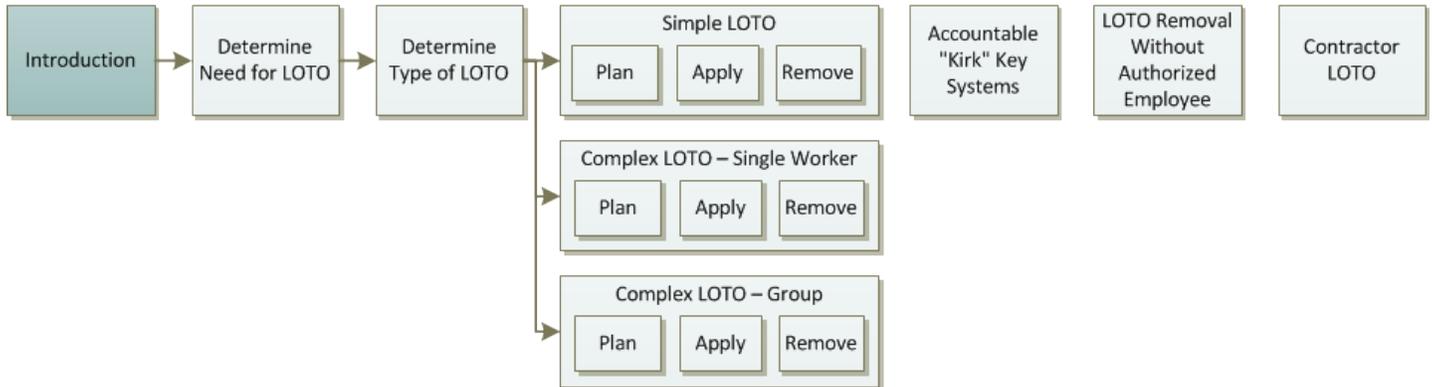
Questions/Comments

LESSONS LEARNED CONTENT



Lockout/Tagout (LOTO) for Installation, Demolition, or Service and Maintenance

Subject Area
 Effective Date: **Jan 11, 2016** (Rev 8.0)
 Periodic Review Due: **Jan 11, 2019**



Lessons Learned

BNL's Lessons Learned Program supports ongoing learning by collecting and sharing work experiences and good practices. This allows us to better understand risks and hazards and develop strategies to control them. Many managers share selected Lessons Learned with their staff at daily briefings and morning meetings to update everyone's knowledge and skills. The Program draws information from BNL, the DOE complex, and private industry. For more, [see the BNL Lessons Learned Program website](#).

Here is a selection of recent Lessons Learned related to this particular Subject Area:

Title	Date
Failure to Identify Secondary Power Source Leads to Worker Exposure to 480V - from the DOE Hanford Site	Mar 06 2014
From DOE: Lockout/Tagout Lock Failure Allows Unexpected and Incorrect Key Access	Sep 14 2012
FROM DOE: Misinterpretation of Lockout/Tagout Requirements in Work Documents Lead to Work Performance without Lockout/Tagout	Apr 25 2012
From DOE: YELLOW - Failure to Identify Hazards Results in Work Being Performed without a Lockout/Tagout	Aug 27 2012
Not All LOTO Locks Provide Equal System Integrity but May Appear Similar	Mar 28 2013
Quick Read - Zero Energy Check Is Critical to Prevent Injury When Working on Electrical Systems from DOE Portsmouth Facility	Sep 27 2013

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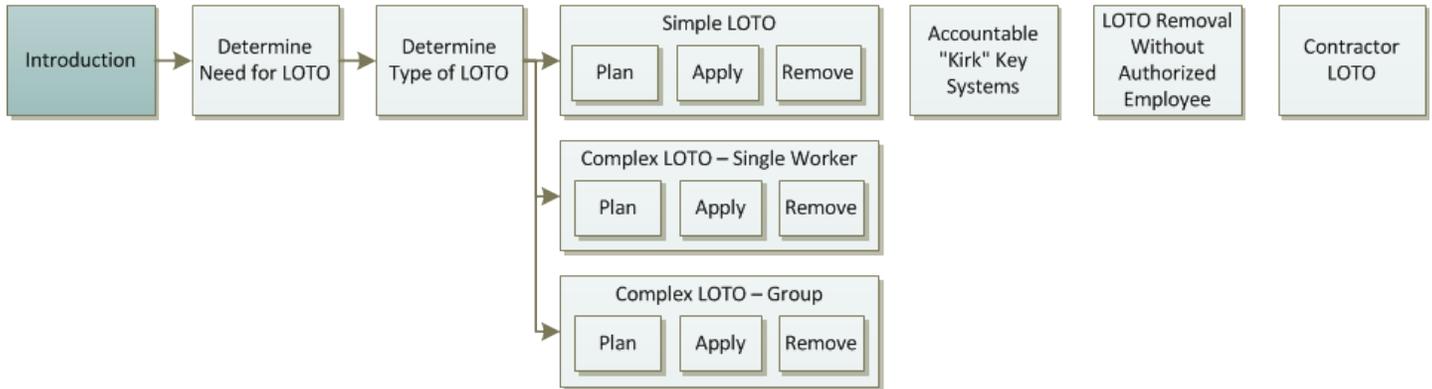
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Questions/Comments



Lockout/Tagout (LOTO) for Installation, Demolition, or Service and Maintenance

Subject Area
 Effective Date: **Jan 11, 2016** (Rev 8.0)
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Criteria for LOTO Inspections (Audits)

Effective Date: **Sep 30, 2013**

You must conduct an inspection of energy control procedures at least annually. Generally, you must inspect each device subject to this standard and the inspection must meet the following criteria:

- The inspection must be performed by an Authorized Employee/Worker designated as the "inspector" who is not the one using the energy control procedure under inspection;
- The inspection must be used to correct any deviations or inadequacies identified;
- For lockouts: Include a review between the inspector and each Authorized Employee/Worker of that Authorized Employee's/Worker's responsibilities under the energy control procedure;
- For tagouts: Include a review between the inspector and each Authorized Employee/Worker and Affected Employee/Worker of their responsibilities under the energy control procedure.

OSHA allows some flexibility in design of inspections. For example, if an employer has grouped together similar machines and/or equipment that have "the same type and magnitude of hazardous energy and ... the same or similar types of controls" then the employer may inspect a representative sample from each group each year. In these situations, OSHA also allows employers to adjust the requirements above to undertake representative reviews with representative Employees/Workers, rather than to review every separate machine or piece of equipment with every Authorized Employee/Worker. To qualify for this flexibility, however, OSHA requires that all the following aspects of all the procedures in the grouping be the same or similar:

- Intended machine or equipment use;
- Procedural steps for shutting down, isolating, blocking, and securing the machines or equipment;
- Procedural steps for the placement, removal, and transfer of the lockout or blockout devices, and the responsibility for them;
- Requirements for testing a machine or equipment to determine and verify the effectiveness of the lockout/tagout devices and other control measures.

If a grouping qualifies under these requirements, OSHA allows the employer to conduct representative inspections even if the employer provides some machine-specific tailoring of procedures.

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Questions/Comments

Complex Lockout/Tagout Instructions

Building/Location:	Prepared By:														
Work Order #:	Revision #:														
F&O FPM or Department Authorization* - (Print name and sign): <small>*Indicates approval to proceed with equipment shutdown and restoration of power when work is complete.</small> PAE checks this box if FPM or Department Authorization is verbally received and then prints the name of the authorizing person above.															
Primary Authorized Employee (PAE)** - (Print name and sign): <small>** For Complex LOTO - Single Worker, the Authorized Worker acts as the PAE.</small>															
Description of Work:															
Sources of Hazardous Energy and Disconnecting Means															
<input type="checkbox"/> STEAM	<input type="checkbox"/> CONDENSATE	<input type="checkbox"/> MOVING PARTS	<input type="checkbox"/> CHEMICALS												
<input type="checkbox"/> ELECTRIC	<input type="checkbox"/> COMPRESSED AIR	<input type="checkbox"/> PNEUMATIC	<input type="checkbox"/> CHILLED WATER												
<input type="checkbox"/> CONTROL POWER	<input type="checkbox"/> WATER	<input type="checkbox"/> HYDRAULIC	<input type="checkbox"/> FORCED AIR FLOW												
<input type="checkbox"/> OTHER:															
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%;">Hazardous Energy</th> <th style="width: 50%;">Disconnecting Means</th> </tr> </thead> <tbody> <tr><td> </td><td> </td></tr> </tbody> </table>		Hazardous Energy	Disconnecting Means												
Hazardous Energy	Disconnecting Means														
Sources of Stored Energy and Method Used to Eliminate Exposure:															

Coordination of Shutdown

1. F&O FPM or project lead notifies building/program personnel of shutdown or affected equipment as appropriate.
2. Primary Authorized Employee conducts LOTO application briefing with Authorized Employees.
3. Notify Affected Employees that equipment must be shut down and locked out (or confirms notification):
 Affected Employees to be notified (if necessary):
4. **VERIFY** proper equipment and isolation means identified.

5. Shutdown equipment/component to isolate hazardous energy and install LOTO as identified in Table 1. Place key(s) in lock box (if utilized).
6. Test LOTO devices to determine and verify their effectiveness.
7. Perform zero energy check as specified in Table 1 below (verified by PAE).

Primary Authorized Employee (PAE) Initial/Date: _____ /

8. **Primary Authorized Employee** applies LOTO to lock box or hasp.
9. Authorized Employee(s) apply personally identifiable lock(s) to lock box or hasp.
10. Perform work as authorized in work document (work order, work plan/permit, etc.), or provide additional work steps beneath the table below.

Locks Installed	Zero Energy Check			
	(Specify location and method of verifying the absence of hazardous energy)			
Location	Position	Signature/Date	Location	Method
1				
2				
3				
4				
5				

Table 1

Space for Work Steps (if needed/optional)

Restoring Equipment to Service

11. **Primary Authorized Employee** to perform the following:
 - Brief Authorized Employees on the LOTO procedure to restore equipment to service.
 - Inspects the work area to ensure nonessential items, such as tools, have been removed, guards and covers are installed properly, grounded equipment is removed, and the equipment is ready to be safely operated.
 - Ensure all controls are in the neutral position.
 - Verify the safe status of all employees working under the LOTO.
 - Notify all personnel involved in the Job/Task (including Affected Employees) that the work is completed and the system will be returned to service.

Primary Authorized Employee Initial/Date: _____ /

12. Remove LOTOs (identified in table above), log in table above, and return system to desired state.
13. Notify Affected Employees, as appropriate.
14. Verify LOTO complete.

Primary Authorized Employee Initial/Date: _____ /

Energy Sources and Threshold Information

This table on energy sources provides threshold information to evaluate whether lockout/tagout should be considered or is required.

Form of Energy	Consider Use of Lockout/Tagout Based on Results of Analysis	Lockout/Tagout is Required*
Electricity AC 60 Hz; DC	≥ 50 V and < 5 mA Or ≤ 50 V	≥ 50 V and > 5 mA
Electricity Capacitors All	Other than values specified in right hand column	Stored energy ≥ 50 V and > 1 J, or > 400 V and > 0.25 J
Electricity Batteries, All	< 50 V	≥ 50 V
Electricity Sub-RF 1 Hz to 3 kHz	> 50 V and < 5 mA Or < 50 V	≥ 50 V and > 5 mA
Electricity RF	All**	N/A
Thermal Energy (Hot)	Liquids less than 120°F (52°C)	Liquids equal to or greater than 120°F (52°C)
Thermal Energy (Cold)	Liquids greater than 27°F (-3°C)	Liquids equal to or less than 27°F (-3°C)
Mechanical Motion	All	N/A
Potential Energy	All	N/A
Pneumatic Energy***	Equal to or less than 150 psi	Greater than 150 psi
Hydraulic Energy***	Equal to or less than 150 psi	Greater than 150 psi
Nonionizing Radiation**	Other electromagnetic radiation	Class 3B or class 4 lasers**
Ionizing Radiation	Potential to exceed administrative control level – consult with operating department prior to starting work	N/A
Chemical	All	N/A
Noise	All – Consider noise as a startle hazard or when the potential of exceeding the occupational exposure limit exists	N/A

*Unless de-energizing the source by lockout/tagout introduces additional or increased hazards or is infeasible due to equipment design or operational limitations.

**Many sources of nonionizing electromagnetic radiation involve electrical hazards that must be considered even when the radiation emitted is not hazardous.

***Do not use check valves or regulators for LOTO isolations. Electrically or pneumatically operated valves may be used, provided appropriate means are in place to ensure the valve will not fail in an unsafe condition for the LOTO application.

Lockout/Tagout Job-Performance Measure

Candidate Name (Print)	Life/Guest/Contractor Number	Department/Division
Evaluator Name (Print)	Date JPM Completed	Bldg. Number where JPM Performed

Prerequisite Information

Prerequisites and Practice/Observation Activity must be completed before Job-Performance Measure is administered.

	<i>In addition to the web/classroom LOTO course, I verify that the candidate above has also received hands-on training and practice in the Lockout/Tagout process(es) indicated below.</i>	
Date of Lockout/Tagout training (classroom or web)	Name/Signature of Field Trainer	Date

Equipment/Task Steps

The evaluator identified below or the candidate's supervisor verifies that the above-named candidate has performed the checked-off steps below independently and without coaching. Write "NA" in an energy category column that does not apply.

Note to evaluator: Select the appropriate energy category/categories. The candidate may only LOTO equipment for which they are qualified based on energy category. Only check off each step after it has been successfully demonstrated.	Mechanical (TQ-LOTO-ME)	Electrical (TQ-LOTO-EL)	Electromagnetic (TQ-LOTO-EM)	Chemical (TQ-LOTO-CH)	Thermal-Hot (TQ-LOTO-TH)	Thermal-Cold (TQ-LOTO-TC)	Hydraulic (TQ-LOTO-HY)	Pneumatic (TQ-LOTO-PN)
1. Assess type, magnitude, hazards of energy source(s)								
2. Visually inspect the equipment, confirming isolation points								
3. Determine method of controlling the hazardous energy								
4. Identify and obtain appropriate lockout/tagout device(s) and personal LOTO padlock								
5. Notify Affected Employees								
6. Ensure equipment is safe to shut down								
7. Set up work boundaries								
8. Shut down the equipment								

Note to evaluator: Select the appropriate energy category/categories. The candidate may only LOTO equipment for which they are qualified based on energy category. Only check off each step after it has been successfully demonstrated. 	Mechanical (TQ-LOTO-ME)	Electrical (TQ-LOTO-EL)	Electromagnetic (TQ-LOTO-EM)	Chemical (TQ-LOTO-CH)	Thermal-Hot (TQ-LOTO-TH)	Thermal-Cold (TQ-LOTO-TC)	Hydraulic (TQ-LOTO-HY)	Pneumatic (TQ-LOTO-PN)
9. Apply personally identifiable lock, tag, LOTO device to energy isolating device, as appropriate								
10. Challenge the lock/device to ensure they are installed securely								
11. Attempt to restart the equipment								
12. Verify the absence of hazardous energy								
13. Relieve/render safe all potentially stored or residual energies								
14. Perform task								
15. After completion, inspect the area to ensure the equipment is ready to be safely operated								
16. Notify Affected Employees that the lockout/tagout devices will be removed and the equipment may start								
17. Verify operating controls for the equipment are off or in the neutral position								
18. Checks that all employees are safely positioned								
19. Remove the lockout/tagout device(s)								
20. Restart the equipment								
21. If applicable, complete logbook closeout								

Authorization Level (check one): Authorized Employee Primary Authorized Employee

Evaluator Signature: _____	Date: _____
Trainee Signature: _____	Date: _____
Supervisor Signature: _____	Date: _____

Signatures above indicate successful demonstration of all JPM steps and confidence in the Trainee's ability to perform LOTO for the indicated sources of hazardous energy on the equipment for which their group is responsible. Specific knowledge of the equipment being Locked/Tagged Out is required and is above and beyond the scope of this JPM.

When complete, please forward this signed JPM form to **Training & Qualifications in Building 400B** for processing.

Please keep a copy for your records.

Lockout/Tagout On-the-Job Training Tool

All persons performing LOTO at BNL must adhere to all elements of the BNL LOTO program.

Use this tool to document one on-the-job training session for BNL staff and contractors in preparation of a formal Job- Performance Measure for any type of LOTO.

During on-the-job training, the LOTO Authorized Candidate may apply locks and tags but can only perform LOTO **for their own protection** and cannot act as the Primary Authorized Employee.

LOTO Authorized Candidate name (Print)	LOTO authorized Candidate Life/Guest/Contractor Number	Department/Division	Job reference # If applicable
Facility Authorized LOTO Trainer name (print)	Facility Authorized LOTO Trainer Life Number	Date training completed	Bldg. # where training was performed

Prerequisites

- BNL staff and Contractors without a 10 CFR 851 compliant LOTO program: Appropriate BNL course (Classroom or Computer based LOTO training)
- or
- Contractors with a 10 CFR 851 compliant LOTO program: Receipt of proof of authorization regarding the LOTO Authorized Candidate.

Steps to be completed

- 1) **Discuss BNL LOTO Program with LOTO Authorized Candidate.** This discussion includes:
 - a. Purpose and function of the LOTO program per the BNL SBMS LOTO Subject Area
 1. Applies controls to prevent the unexpected energization or startup of machines or equipment upon which servicing or maintenance is being performed.
 2. Protects employees from exposure to hazardous energy while performing servicing or maintenance on machines or equipment.
 3. The importance of never tampering with another lock and tag other than their own
 - b. For contractors, differences in Contractor and BNL LOTO program.
 - c. Recognition of applicable hazardous energy sources
 - d. Type(s) and magnitude of hazardous energy in the work place
 - e. Methods and means necessary for hazardous energy isolation and control
 - f. Limitations of tag only per the BNL LOTO Subject Area, as applicable (if a situation involves a tag installed on an isolation device with no accompanying lock)
 - g. The importance of reporting nonconformances
- 2) **Conduct pre-job brief.**

- 3) **Observe, discuss and verify:** Facility Authorized LOTO Trainer accompanies the LOTO Authorized Candidate, observes and discusses performance, and verifies that the steps below were successfully performed. Check the steps in the Completed column that were completed successfully and write "NA" for the steps that do not apply.

LOTO Authorized Candidate asks questions and discusses concerns with the Facility Authorized LOTO Trainer.

Step #	Item	Completed
Applying LOTO		
1	Assess type, magnitude, hazards of energy source(s)	
2	Visually inspect the equipment, confirming isolation points	
3	Determine method of controlling the hazardous energy	
4	Identify and obtain appropriate lockout/tagout device(s) and personal LOTO padlock	
5	Notify Affected Employees	
6	Ensure equipment is safe to shut down	
7	Set up work boundaries	
8	Shut down the equipment	
9	Apply personally identifiable lock, tag, LOTO device to energy isolating device or lockbox, as appropriate	
10	Challenge the lock/device to ensure they are installed securely	
11	Attempt to restart the equipment	
12	Verify the absence of hazardous energy	
13	Relieve/render safe all potentially stored or residual energies	
Removing LOTO		
1	After completion of work on the equipment, inspect the area to ensure the equipment is ready to be safely operated	
2	Notify Affected Employees that the lockout/tagout devices will be removed and the equipment may start	
3	Verify operating controls for the equipment are off or in the neutral position	
4	Checks that all employees are safely positioned	
5	Remove the lockout/tagout device(s)	
6	Restart the equipment	
7	If applicable, complete logbook closeout	

Date: _____

Facility Authorized LOTO Trainer (Signature)

Date: _____

LOTO Authorized Candidate (Signature)

Keep on file within organization until JPM is complete.

Supplemental Information on Thresholds for Various Forms of Energy

While the most common energy source is electrical energy, it is critical that the organization consider all forms of energy that may be present. The following information is provided in support of thresholds where lockout/tagout becomes mandatory. **Levels below the thresholds require analysis because they may also cause injury depending on the work situation.**

1. **Electrical energy** refers to generated electrical power or static electricity. In the case of generated electricity, the electrical power can be turned on or turned off. Batteries convert chemical energy to electrical energy that can be switched on or off. Capacitors store an electrical charge that can only be dissipated or controlled. Static electricity cannot be turned off; it can only be dissipated or controlled.
2. **Thermal energy** is manifested by high or low temperature. This type of energy is the result of mechanical work, radiation, chemical reaction, or electrical resistance. It cannot be turned off or eliminated; however, it can be dissipated or controlled. The potential for hot or cold burn injuries is dependent on at least two variables
 - the temperature of the liquid or surface.
 - the period of contact.

The threshold for burn (scald) injuries from contact with hot liquids is 52°C (120°F). Typically any freezing of the tissue may cause a cold injury. The threshold for cold injuries to tissues is slightly below freezing (27°F or -3°C). Cryogenic liquids are normally gases at room temperature and pressure, but are converted into liquids which by definition have boiling points less than -150°C (-238°F). Consequently, they all present a cryogenic burn hazard. Liquid carbon dioxide and nitrous oxide also present cryogenic burn hazards, even though their boiling points are above -150°C. Contact hazards with hot or cold surfaces are typically controlled with insulation or PPE.

3. **Mechanical motion** (kinetic energy-the energy of motion) may involve linear travel, rotation or a combination of the two. This type of energy may be contained or stopped. No threshold is proposed for kinetic energy. Each situation must be evaluated.
4. **Potential energy** (configurational energy - the energy of position) involves the location of an object above a designated level or the compression of springs. Potential energy can be minimized by moving an object to a lower position. The energy of springs can be dissipated or controlled. No threshold is proposed for potential energy. Each situation must be evaluated.
5. **Hydraulic or pneumatic** energy is the pressure (either above or below atmospheric pressure) contained in a liquid (such as oil or water) or in a gas (such as air). Hydraulic or pneumatic energy may be turned off. Hydraulic or pneumatic energy also may be stored; in which case, it must be released or dissipated.

Where there is a potential for deadheading a pneumatic air source against unprotected skin, OSHA considers 30 psi air or greater to be hazardous because it can penetrate the skin barrier through open wounds or do damage if directed at body openings. OSHA's limit of 30 psi for use of compressed air for cleaning clothes does not protect from particulates that may be generated by cleaning with pressurized air below 30 psi.

Where the skin and eyes are protected and there is no potential for deadheading the source against the skin, the pressure required for pneumatic jet injuries to healthy unbroken skin is over 600 psi. Pneumatic sources directed at eyes or ears can cause injuries at significantly lower pressures depending on the proximity and diameter of the jet.

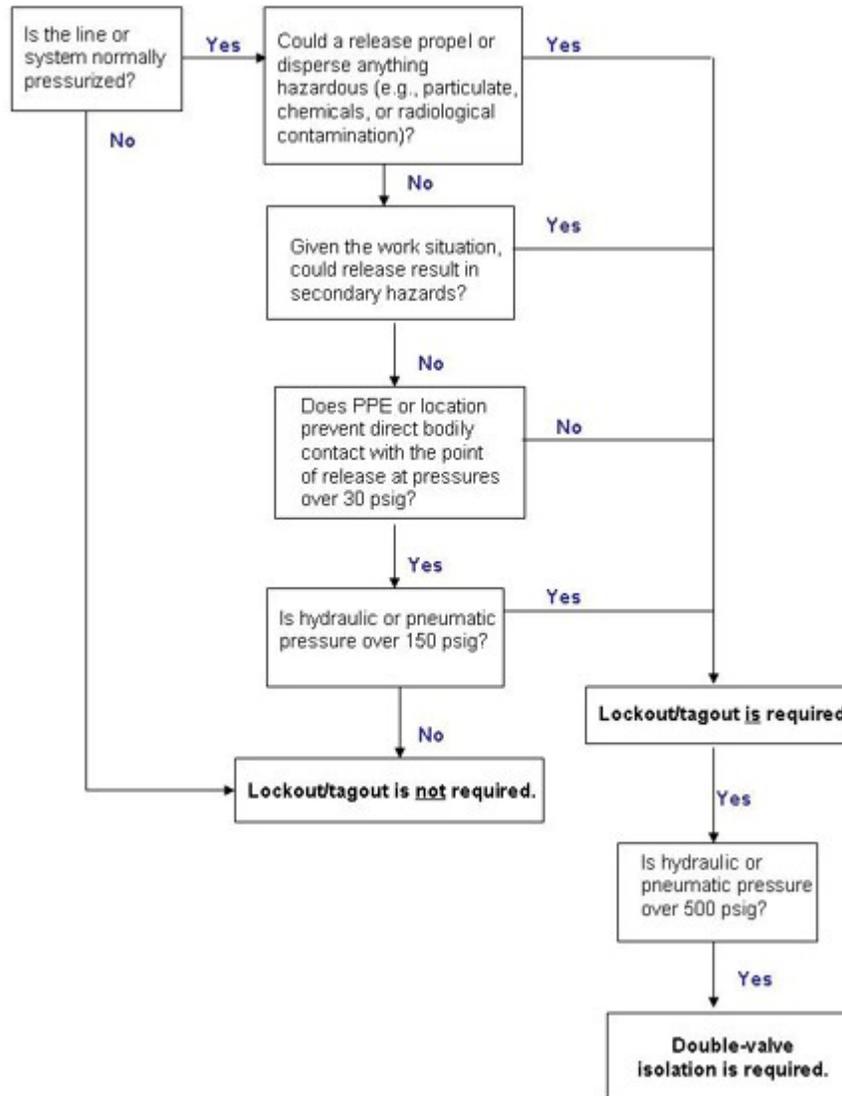
Hydraulic energy is liquid under pressure. The pressure of a hydraulic jet required to break intact healthy skin is over 600 psi. However, releases of liquids at much lower pressures are hazardous to eyes, ear drums and open wounds depending on the diameter of the jet and distance traveled by the fluid before it strikes the affected tissue. Hydraulic injection injuries have been recorded at distances up to 4 inches between the skin and the source. For water and other liquids conveyed in larger piping systems, the liquid momentum may be sufficient to knock a worker down depending on the diameter of the pipe and the pressure.

Water and compressed air pressures of 150 psig or less exist in nearly every industrial or commercial installation requiring these utilities. Historical evidence indicates that when using normal PPE (coveralls, gloves and safety glasses), lockout/tagout is not normally utilized or required for servicing and maintenance of these common utility water or compressed air systems operating at pressures up to 150 psig. Exceptions exist where the water temperature is over 120°F or the environment of the work activity introduces additional secondary hazards. The absence of injuries solely due to these common utility pressures during service and maintenance of such systems without lockout/tagout protection further substantiates that hazardous energy control is not required where secondary hazards do not exist.

Compressed gas cylinders or subsequent valves feeding downstream systems are subject to lockout/tagout where 1) the system is being serviced or modified, AND 2) the gas is flammable, the gas is toxic, or the delivery pressure can exceed 150 psig with the regulator valve fully open (i.e., regulator fails) Lockout/tagout does not apply to cylinder installation and removal.

Due to the range of pressures at which different types of hydraulic and pneumatic injuries can occur, each situation must be evaluated using the following decision tree. This decision tree only applies to non-hazardous gases and liquids. Hazardous gases and liquids at any pressure must be locked out due to their chemical hazards (e.g., toxic, flammable, reactive).

Start Here



6. **Nonionizing radiation** is electromagnetic radiation that is a health hazard over specified maximum permissible exposure (MPE) levels even though it does not cause ionization of molecules. Nonionizing radiation includes high intensity visible and invisible light (UV and IR) sources, microwaves, radiofrequency waves, and magnetic fields. Where nonionizing radiation sources exceed their respective MPE, the hazard must be evaluated. Where workers could be exposed to beams from Class 3B and Class 4 lasers while performing maintenance, lockout/tagout is required if the laser is not powered by cord and plug connection.

Note: Because a laser must be energized during alignment of Class 3B and Class 4 lasers, a Laser Standard Operating Procedure (SOP) is used to specify the control measures rather than lockout/tagout.

7. **Chemical** - there is no threshold for systems that may release hazardous chemical solutions at any pressure, flammable liquids or gases, or any gases that have a potential of creating a hazardous atmosphere. This includes gases used for fire suppression systems.

8. **Ionizing radiation** - When the potential exists for a worker to exceed an administrative control level in a short time period, consider the use of lockout/tagout as part of the work planning phase. Situations where lockout/tagout may apply include: 1) to prevent external radiation exposure during service or maintenance of radiation-generating devices, 2) to prevent external radiation exposure during use of exposure systems with sealed sources having pneumatic or mechanical transport systems, 3) to reduce external exposures from shielded storage areas during maintenance work in the immediate vicinity, and 4) to reduce internal exposures when energy sources located inside a contamination area have the potential to create airborne contamination.