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Standard Operating Procedure
for

Lockout / Tagout

REVISION

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1. PURPOSE AND SCOPE

1.1 Purpose

1.1.1 This Lockout/Tagout (LOTO) Program is intended to protect College of Nanoscale Science and Engineering (CNSE) Albany NanoTech Facility employees, tenant employees, contractors and sub-contractors performing service or maintenance on a piece of facility equipment or a tool where an unexpected start-up or release of stored energy could cause injury.

1.1.2 This LOTO Program provides procedures to be followed in accordance with the Occupational Safety and Health Administration's (OSHA) Part 29 Code of Federal Regulations (CFR) 1910.147 – *The Control of Hazardous Energy (Lockout/Tagout*).

1.1.3 This program identifies that individuals performing work on a piece of facility equipment or on a tool are responsible for controlling these energy sources prior to initiating their work.

1.1.4 The program provides procedures for situations in which equipment or machinery must remain energized to enable proper testing and/or servicing.

1.1.5 This program established exceptions to LOTO which are single energy sources that have a single disconnecting means and are clearly identifiable.

1.2 Scope

1.2.1 This program establishes the minimum requirements for LOTO of energized equipment or systems during maintenance or servicing operations at the CNSE Albany NanoTech Facility. Tenant employees, contractors and sub-contractors may comply with their own organization's program provided that it meets and/or exceeds the minimum requirements set forth in this procedure.

1.2.2 This program applies to CNSE Albany NanoTech Facility employees, tenant employees, contractors and sub-contractor who may be performing work within the facility or on a tool.

1.2.3 CNSE Albany NanoTech Facility employees, tenant employees, contractors and sub-contractors will be notified of the requirement to follow this program and are required to comply with the restrictions and limitations imposed upon them by CNSE during LOTO activities.

1.2.4 CNSE Albany NanoTech Facility employees, tenant employees, contractors and sub-contractors will be responsible for preparing their own

tool, equipment, machinery and/or facility specific LOTO procedures and devices while conducting LOTO work activities on site. Documentation of which must be provided to and reviewed by the EH&S Department. See EHS-00008-F1 for a LOTO Equipment Checklist Procedure example that may be used to create tool, equipment, machinery and/or facility specific LOTO procedures.

1.2.5 If tool, equipment, machinery and/or facility specific LOTO procedures have been provided by the manufacturer or own tenant, contractor or sub-contractor organization, such procedures are also acceptable for use as long as they meet or exceed the requirements set forth in the LOTO Equipment Checklist Procedure (EHS-00008-F1) example.

1.2.6 Only authorized employees may implement LOTO procedures in accordance with this LOTO Program. No person may attempt to start, energize or use a machine, piece of equipment, tool or cabinet that is locked out or tagged out.

2. RESPONSIBILITIES

2.1 The CNSE and Tenant Department Managers shall be responsible to ensure that their supervisors are fully aware of and understand the requirements of the Lockout and Tagout procedure.

The CNSE and Tenant Department Managers are also responsible for ensuring that employees within their department or organization, whether affected or authorized, have received the correct training.

2.2 CNSE, Tenant, Contract and Sub-Contract Supervisors are responsible to ensure that:

2.2.1 Any person who has to repair, adjust or maintain equipment or machinery has:

- Received proper training on the recognition of all hazardous energy sources and the correct methods or means for their neutralization.
- Been formally notified of the LOTO Procedure.
- Received a safety lock and/or tag(s).

2.2.2 The LOTO Procedure is implemented and adhered to.

2.2.3 Disciplinary action is taken when an employee fails to adhere to this.

2.2.4 Conduct an annual LOTO procedural audit using EHS-00008-F2 - Lockout/Tagout Audit Checklist and submit to the EH&S Department on an annual basis for recordkeeping purposes.

2.2.5 Authorized CNSE Albany NanoTech Facility Employees, Tenant Employees, Contractors and Sub-Contractors are identified by job title and are responsible for performing hazardous energy control in compliance with this LOTO Program, procedures and detailed training provided to them by the CNSE with further tool or equipment specific training provided by their particular organization.

2.3 Affected employees consist of all personnel who are not authorized employees and who must receive LOTO awareness training, which will include the types of locks and tags and the importance of not attempting to start up a locked out or tagged out machine, equipment, process or circuit. Affected employees need to recognize and understand LOTO principles and procedures.

2.4 The EH&S Department is responsible for providing training to authorized and affected employees, ensuring all LOTO procedures have been completed and verifying the accuracy of the procedures with their owners.

3. ASSOCIATED DOCUMENTS

3.1 **EHS-00008-F1** – LOTO Equipment Checklist Procedure

3.2 **EHS-00008-F2** – Lockout/Tagout Audit Checklist

3.3 **EHS-00008-F3** – Authorization for Removal of Lockout/Tagout Devices

3.4 **EHS-00008-F4** - LOTO Authorized Personnel Classroom Test

4. LOCK AND TAG-OUT DEVICE REQUIREMENTS

4.1 The locks and tags shall be provided by CNSE and shall be the only devices used to lockout or tagout personnel protection. Locks and tags shall be made up of the following:

4.1.1 Standardized according to one of the following: color, size, shape, type, or format.

4.1.2 Distinctive in appearance, easily recognizable and clearly visible.

4.1.3 Designed to convey all information required for the application.

4.1.4 Designed to deter accidental or unauthorized removal.

4.1.5 Designed to withstand the environment to which they are exposed for the duration of their application.

4.1.6 Locks and tags shall be issued by department Supervisor(s).

4.2 Each lock and tag shall be marked to identify the employee.

4.3 No two locks shall be keyed alike.

4.4 Only one key shall be issued to each person for his/her lock. A master key shall be maintained by the EH&S Manager.

4.5 Both the Department Manager and EH&S should be advised about any lockout and tagout removal. At a minimum EH&S or department Manager must be informed with follow-up documentation (EHS-00008-F3-Authorization for Removal of Lockout/Tagout Devices).

5. APPLICATION OF LOCKS AND/OR TAGS

5.1 All energy sources to the area of the equipment or machine or tool must be neutralized using the appropriate shut-down procedure(s). One example of such a procedure is as follows:

5.1.1 Check to ensure that no one is operating the machine before turning off the power.

5.1.2 Turn off the point of operation controls.

5.1.3 Turn off the main power controls, e.g. switches, breakers, valves.

5.1.4 Bleed all energy from lines and reservoirs.

5.1.5 Release and block any mechanism under pressure or tension.

NOTE: When access to an area in which energized circuits or moving parts is made possible through the removal of guards or interlocks, the sources within that area must also be neutralized.

5.2 Identify all secured disconnecting means by conducting the following:

5.2.1 Place your lock and/or tag on each disconnecting means that is used to de-energize the equipment to be worked on.

5.2.2 The tag shall include your full name and the date and time it was placed on the disconnecting means.

5.3 Verify that the equipment or machines cannot be restarted.

5.3.1 Be sure that all personnel and tools are clear, then operate the equipment controls to assure that the equipment or machine is inactive.

5.3.2 Check to be sure that the equipment controls have been returned to the off position after the test.

5.3.3 Relieve, disconnect or restrain any residual or stored energy.

5.3.4 All capacitors shall be discharged and high capacitance elements short-circuited and grounded before the associated equipment is touched or worked on.

5.3.5 Test the equipment or machinery to verify that the circuits and equipment are de-energized.

5.3.6 On circuits operating at 600 volts nominal or greater, the test equipment shall be checked immediately before and after the above test to verify that it is operational.

6. APPLYING TAGS ONLY

6.1 Where locks cannot be applied or are not feasible, or where it can be demonstrated that tags will provide equivalent safety, tags only shall be permitted, provided the following:

6.1.1 The disconnecting device is adjacent to the circuit parts and equipment, and is clearly visible to all employees involved in the work.

6.1.2 The tags are of a distinctive, standardized design that clearly prohibits unauthorized energizing or removal.

6.1.3 The use of the tag is in conjunction with the removal of an isolating circuit element, blocking of the energy source and/or opening a disconnecting device.

6.1.4 The work does not extend beyond the shift.

NOTE: In situations requiring the lock or tag to remain in place beyond the normal work shift, it is that employee's responsibility to inform the upcoming shift and review methods for its safe removal. If continued work is to be performed, employee's locks and tags shall be swapped and the new employee shall verify proper shutdown and proceed through the specific LOTO procedure prior to applying their own lock or tag.

7. GROUP LOCKOUT OR TAGOUT

7.1 When service and/or maintenance is performed by two or more people they shall utilize a group lockout or tagout device (hasp) which will provide the same level of protection provided by the implementation of a personal lockout or tagout device.

7.1.1 Each authorized employee shall affix a personal lockout or tagout device to the group lockout device when he or she begins work, and shall remove those devices when the work being performed is completed.

7.1.2 In order to ensure continuity of this program primary responsibility for overall jobs associated with group lockout or tagout shall be assigned to an authorized employee by their Supervisor.

7.1.3 The designated employee shall ascertain the exposure status of individual group members with regard to the lockout or tagout of the equipment, tool or machine.

8. ELECTRICAL TESTING PROCEDURE

8.1 The following testing procedures are mandatory for work at or in excess of 600 volts unless the Supervisor determines the situation is “essential and unavoidable” as determined under section 9.1 of this program:

8.1.1 Select proper testing equipment as rated for the particular job.

8.1.2 Check the operation of the testing equipment and its integrity - probes fit snugly, no cracks in casing, etc.

8.1.3 De-energize the circuit to be tested.

8.1.4 Connect testing probes to de-energized circuit being tested.

8.1.5 Energize the equipment. "NO HANDS" policy on testing equipment at all times. Only read the meter.

8.1.6 De-energize circuit.

8.1.7 Disconnect the meter from the de-energized circuit.

9. RESTORING ENERGY

9.1 Before restoring energy to the equipment or machinery, the following shall be observed by the worker(s) who apply the lockout or tagout devices:

9.1.1 Verify that circuits and equipment are in good condition to energize.

9.1.2 Conduct appropriate tests and visual inspections to verify that all tools, mechanical restraints and electrical jumpers, shorts and grounds, and all non-essential items have been removed.

9.1.3 Verify that all equipment components are operationally intact, including guards and safety devices.

9.1.4 Verify that equipment or machine point of operation controls are in the off position.

9.1.5 Verify that employees are clear of circuits and equipment.

9.1.6 Repair or replace any defective safeguards or safety devices.

9.2 Restoring and Testing Energy

9.2.1 Close and secure all cover panels and doors. If all cannot be closed as may happen when testing, place barricades or rope off a safety zone with nonconductive material.

9.2.2 Advise all affected employees that the system will be re-energized.

9.2.3 Check and ensure all persons are clear of the equipment.

9.2.4 The authorized employee who applied the device shall remove each lockout/tagout device from each disconnecting means.

9.2.5 If the person who placed the locks and tags is not available, only his/her supervisor may remove the locks and tags after personally making all reasonable efforts to contact the person who placed the lock and determining it is safe to do so. This must be documented by using EHS-00008-F3 Authorization for Removal of Lockout/Tagout Devices.

9.3 Release for Energizing

The employees responsible for operating the equipment or machines shall be notified when they are ready to be energized, and shall be provided assistance as necessary to safely energize the equipment or machinery.

10. WORKING ON ENERGIZED EQUIPMENT OR MACHINERY

Please refer to Section 9.0 of the EHS-00054 – Electrical Safety Program, for circumstances requiring permitted work on energized equipment or machinery to be performed. For the associated Energized Electrical Work Permit that must be completed see EHS-00054-F1.

11. OUTSIDE PERSONNEL (CONTRACTORS, VENDORS, ETC)

11.1 Whenever outside servicing personnel are to be engaged in activities covered by the scope and application of this procedure, it is the responsibility of the CNSE /Tenant employee managing the project involving the outside personnel; to review the hazards associated with the work to be performed and inform each other of their respective lockout and tagout procedures.

11.1.1 The CNSE and Tenant Department Managers and Supervisors shall ensure that his/her personnel understand and comply with the restrictions and prohibitions of the outside employer's energy control procedures.

12. PERIODIC INSPECTION

12.1 The CNSE/Tenant Department Managers shall conduct periodic inspections of the lockout and tagout procedure at least annually to ensure that the requirements of this procedure are being followed. The Lockout/Tagout Audit Checklist (EHS-00008-F2) must be submitted to the EH&S Department on an annual basis for recordkeeping purposes.

12.2 The periodic inspection shall include a review with the authorized employee of that employee's responsibilities under the lockout and tagout procedure.

a. The inspection and review shall be documented, indicating the date of the inspection, the equipment or machinery the lockout and tagout procedure was used on, the person(s) inspected and the inspector's signature.

12.3 The audit checklist should remain on file for a minimum of 2 years.

12.4 The audit checklist should be filed in a location accessible to the EH&S Department.

13. ADDITIONAL PRECAUTIONS

13.1 High voltage circuits and components shall be guarded by cabinets, panels, enclosures, or other means to prevent access by unauthorized and untrained persons.

13.2 High voltage circuits and components within cabinets or enclosures containing other electrical or mechanical parts shall be shielded or enclosed to physically separate them from the other parts whenever possible.

13.3 High voltage circuits, components and systems, and the cabinets, enclosures, and shielding panels of high voltage circuits, components and systems, shall be clearly and distinctly labeled; 'DANGER-HIGH VOLTAGE".

13.4 Clearances in accordance with associated codes must be maintained while work is performed.

14. LOCKOUT AND TAGOUT PROCEDURE SUMMARY

14.1 During maintenance or repair, all power sources to equipment and machinery shall be removed and locked or tagged on the de-energized position. This requires the use of:

14.1.1 Locks-to assure against inadvertent energizing of the equipment or machinery, and/or.

14.1.2 Warning tags-placed in conspicuous locations to identify the equipment or machinery being worked on and the person performing the work.

14.2 All devices capable of storing energy have been discharged.

14.3 Instruments used to measure voltage or current shall not be held in the hand during actual measurements. Proper procedures shall include the following precautionary measures.

14.3.1 Disconnect the electrical current to the equipment or machinery.

14.3.2 Attach the leads to the appropriate connections, including the ground lead.

14.3.3 Step away from the instrument and turn off the power. Take necessary readings and turn the power off.

14.4 Work shall not be performed on exposed energized parts of equipment until the following conditions have been met.

14.4.1 The Supervisor has determined that the work to be performed requires the system to be energized.

14.4.2 The involved personnel have received instructions on the work techniques and the hazards involved.

14.4.3 Suitable personal protective equipment has been provided and is used. Suitable insolated gloves shall be worn for voltages in excess of 600 volts phase to phase.

14.4.4 All test equipment has been checked, calibrated, and is rated for the voltage being used.

14.5 When work is completed, inspect your work, clear the area, remove your devices, energize the system, and test its operation.

14.6 Notify your Supervisor if, for any reason, your lock or tag must remain in place beyond your shift.

15. EXCEPTIONS

15.1 Where a machine, equipment, process or circuit has a single energy source that will accomplish complete deactivation, written procedures are not required as long as the disconnect for this energy source remains under the exclusive control of the authorized employee. This means within sight and arm's reach.

15.2 This applies to work on single energy source plug-and-cord connected electrical equipment for which exposure to the hazards of unexpected energization or start up of the equipment is controlled by unplugging the equipment from the energy source. If the plug cannot be maintained under the exclusive control of the individual, a lockout device must be used on the plug.

15.3 Work within a charged Valve Manifold Box (VMB) with appropriate PPE as listed in Appendix C of EHS-00010, Personal Protective Equipment, provided that the work does not involve breaking any fittings from any previously used (charged) section of the VMB. If the work involves breaking a fitting of a line that has been used, then the entire VMB needs to be purged with the supply gas cabinet locked out. The same logic would follow for a Gas Interface Box (GIB) and a tool's gas box. In essence the local box where the work is being done is completely purged, evacuated and locked out with the upstream supply source also locked out. New sticks and new lines would not require this same level of isolation since no potentially charged fittings would be being broken.

16. ALTERNATIVE METHODS

16.1 In situations where locks can not be applied or where numerous locks (i.e. greater than 20 locks) must be applied for the locking out of a system the process/facility engineer must select an alternative method of control.

16.2 Selection of an alternative control method will be based on a risk assessment of the machine, tool or piece of equipment. The risk assessment will take into consideration that existing safeguards provided may need to be removed or modified to perform a given task.

16.3 The alternative method selected will have detailed procedures developed and documented for the control of hazardous energy and authorized employees will be trained in these procedures prior to implementation.

16.4 Such alternative methods shall be reviewed, approved and kept on file by the EH&S Department prior to their implementation.

17. PROCESS CONTROL PROCEDURE

17.1 This process control procedure will be implemented when work is to be performed by the chemical/gas service supplier, tool engineer, facility engineer or contractor on a gas or chemical system at the CNSE facility.

17.2 This process control procedure shall also apply to any gas or chemical system process line or stick that is going to be capped in place or as directed by EHS is otherwise taken offline.

17.3 EHS Process Control locks shall be green in color and process control tags shall be yellow in color and read “Caution – Do Not Operate”.

17.4 The chemical/gas services Process Control locks shall be orange in color and process control tags shall be yellow in color and read “Caution – Do Not Operate”.

17.4.1 The chemical/gas services supplier who manages the gas/chemical systems must coordinate and communicate the scope of work with EHS and with the group performing the work via e-mail or other documentation.

17.4.2 The chemical/gas services supplier shall identify which tool, line/stick and gas/chemical equipment that is to be isolated.

17.4.3 The chemical/gas services supplier will fill out the correct paperwork in regards to their process control procedure.

17.4.4 The chemical/gas services supplier will contact EHS, the tool engineer or the contractor and schedule time to isolate the system and have the responsible parties apply their process control locks and tags.

17.4.5 Once the chemical/gas services supplier applies their process control lock/tag to the system, EHS will apply their process control lock/tag to the system and update the Control of Hazardous Energy Log (EHS-00008 F5).

17.4.6 Once all work has been completed, the person doing the work will contact chemical/gas services supplier and EHS via e-mail requesting that the system be restored to an operational state.

17.4.6.1 Documentation must include the verification that the integrity of the system has been restored.

17.4.7 Once notification has been received that work has been completed the chemical/gas services supplier will contact the person performing the work and schedule time for such responsible parties to remove their locks / tags.

17.4.8 Once the locks / tags have been removed, the chemical/gas services supplier and EHS will lastly remove the process control lock/tag and complete the Control of Hazardous Energy Log entry.

18. TRAINING

Authorized employees shall be trained prior to performing any type of LOTO activity. Affected employees shall also be trained per this program.

18.1 Affected Employee Training

The facility will provide affected employees with LOTO awareness training. This training allows affected employees to identify LOTO situations, understand their responsibilities and to take no action that might defeat the LOTO process. Training requirements and objectives are listed below:

18.1.1 Training will be site specific and based on this LOTO Program.

18.1.2 Affected employees will be able to recognize that authorized employees are performing service and/or maintenance to the machine, piece of equipment, tool or facility.

18.1.3 Affected employees will be able to identify locked out equipment.

18.1.4 Affected employees will have a general understanding of shift or personnel LOTO changes.

18.1.5 Affected employees will recognize that a transition tag indicates a “Do Not Operate” situation.

18.1.6 Every effort will be made to structure training so that all affected employees regardless of their level of education, primary language or disabilities understand it. Annual refresher training will be conducted to maintain an appropriate level of awareness.

18.2 **Authorized Employee Training**

The EH&S Department will provide initial training, prior to an authorized employee performing LOTO, that will demonstrate that authorized employees understand the purpose and function of the LOTO Program. Training will be such that all authorized employees have an understanding that is appropriate for the level of hazard exposure they may encounter. Training requirements and objectives are listed below:

18.2.1 Individual training will be carried out prior to authorized employees performing service and/or maintenance tasks or prior to being potentially exposed to hazardous energy.

18.2.2 Training will be site specific and based on this LOTO Program. Training given will not be tool, equipment and/or machine specific. Such specific training will be given by the supervisor.

18.2.3 Each authorized employee will receive training in the type of energy that might be encountered during service and/or maintenance and methods or means to control and isolate that energy.

18.3 CNSE will document that training has been conducted and ensure those completing the training session pass the LOTO Authorized Personnel Classroom Test, see EHS-00008-F4. Alternative tests that meet or exceed the requirements set forth in this procedure may also be used.

18.3.1 Each person completing the tool, equipment and/or machine specific training will be required to successfully demonstrate LOTO to an authorized employee prior to being authorized to perform LOTO without direct supervision.

18.4 Authorized employees who do not demonstrate an adequate level of knowledge or use of appropriate hazardous energy control procedures will be retrained.

18.5 Authorized employees participating in the LOTO Program will receive training annually.

18.6 Additional Training

18.6.1 Retraining will be provided for authorized employees whenever there is a change in their job assignments, a change in machine, equipment, process or circuit that presents a new hazard, or when there is a change in the LOTO procedures.

18.6.2 Additional retraining will also be conducted immediately whenever an audit reveals, or whenever the facility has other reason to believe, that the authorized employee's knowledge or use of the energy control procedures is inadequate or inconsistent with the requirements.

19. RECORDS

19.1 The Lockout/Tagout Audit Checklist (EHS-00008-F2) must be submitted to the EH&S Department on an annual basis for recordkeeping purposes, where they shall remain on file for a minimum of 2 years.

19.2 Copies of tool, equipment, machinery and/or facility specific LOTO procedures shall also be kept on file by the EH&S Department.