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Glenn Safety Manual – Chapter 9

Lockout/Tagout

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**NASA - Glenn Research Center
Cleveland, OH 44135**

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Glenn Research Center Glenn Safety Manual	Title: Lockout/Tagout	
	Document No.: GLM-QS-1700.1.9	Rev.: Revision F

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***Include all information for each revision. Do not remove old revision data. Add new rows to table when space runs out by pressing the tab key in the last row, far right column.*

Glenn Research Center Glenn Safety Manual	Title: Lockout/Tagout	
	Document No.: GLM-QS-1700.1.9	Rev.: Revision F

Contents

1.0	PURPOSE.....	4
2.0	APPLICABILITY	4
3.0	BACKGROUND	4
4.0	POLICY.....	5
4.1	Measurement and Verification	5
5.0	RESPONSIBILITIES (NPR 8715.3 Section 3.4.2).....	5
5.1	Area Safety Committees	5
5.2	System Manager	5
5.3	Building Manager.....	5
5.4	Research Facility Manager and/or Facility Operations Specialist	6
5.5	Designated Person	6
5.6	Supervisory Personnel	6
5.7	Requestor (Authorized Employee or Primary Authorized Employee)	6
5.8	Qualified Operator (Switchperson).....	6
6.0	REQUIREMENTS (NPR 8715.3)	6
6.1	Medical and Physical Requirements (NPR 8715.3, Section 7.4)	7
6.2	Standards and Instructions	7
6.3	Energy Control Program (OSHA 29 CFR 1910.147 (c) (1)).....	7
6.4	Lockout/Tagout and Area Clearance Procedure	7
6.5	Minimum Isolation Criteria (OSHA 29 CFR 1910.147 (c)(4))	9
6.5.1	Isolation.....	9
6.5.2	Device Selection Responsibilities	10
6.5.3	Isolation of equipment/systems for safety or configuration control	10
6.6	Group Lockout or Tagout (OSHA 29 CFR 1910.147 (f)(3)).....	11
6.7	Shift or Personnel Changes (OSHA 29 CFR 1910.147 (f)(4))	12
6.8	Return to Service (OSHA 29 CFR 1910.147 (e)(3))	12
6.9	Emergency Lockout Removal (Exception to OSHA 29 CFR 1910.147 (e)(3))	12
6.10	Training and Communication (OSHA 29 CFR 1910.147(c) (7)).....	13
6.10.1	Limitations of Tags (OSHA 29 CFR 1910.147(c)(7)(ii)(A))	13
6.10.2	Employee Retraining (OSHA 29 CFR 1910.147(c)(7)(iii)).....	13
6.11	Inspections and Audits (OSHA 29 CFR 1910.147 (c)(6)(ii)).....	13
7.0	RECORDS.....	14
8.0	REFERENCES	14
	APPENDIX A.—DEFINITIONS AND ACRONYMS	15
	APPENDIX B.—LOCKS, TAGS, AND DEVICES	18
	APPENDIX C.—AREA CLEARANCE PROCEDURE.....	22

List of Tables

TABLE I.—TAG INFORMATION.....	9
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List of Figures

Figure B.1.—Lockout/Tagout Tag, shown above is the ONLY Authorized Tag at Glenn Research Center.	18
Figure B.2.—Lockout locks, ONLY red-bodied locks to be used for lockout/tagout.	18
Figure B.3.—All valve lockout.	19
Figure B.4.—Pneumatic valve lockout.....	19
Figure B.5.—Gate valve lockouts.	19
Figure B.6.—Large breaker lockout	19
Figure B.7.—Single-pole breaker lockouts.	20
Figure B.8.—Fuse lockouts.	20
Figure B.9.—Lockout/tagout kits.	20
Figure B.10.—Switching/Configuration Tag.	21

Printed copies are uncontrolled and are not to be used for operational purposes.

Glenn Research Center Glenn Safety Manual	Title: Lockout/Tagout	
	Document No.: GLM-QS-1700.1.9	Rev.: Revision F

Chapter 9—Lockout/Tagout

Note: The current version of this chapter is maintained and approved by the Safety and Health Division (SHeD). The last revision date of this chapter was December 2016. The current version is located on the Glenn Research Center (GRC) intranet within the BMS Library. Approved by: Chief of Safety and Health Division

1.0 PURPOSE

This chapter establishes requirements, in accordance with both the NASA General Safety Program Requirements (NPR 8715.3) and the Occupational Safety and Health Administration (OSHA) as given in 29 Code of Federal Regulations (CFR) 1910.147, Control of Hazardous Energy (LOTO), for a program to protect employees from sources of potentially hazardous energy while performing any construction, service, or maintenance on any machine, piece of equipment, or system at NASA Glenn Research Center (GRC). When an employee is required to remove or bypass a guard or other safety device; or an employee is required to place any part of his or her body into an area on a machine or piece of equipment where work is actually performed (point of operation) or where an associated danger zone exists during a machine operating cycle LOTO shall be required.

When LOTO is not used for tasks that are routine, repetitive, and integral to the production process or traditional LOTO prohibits the completion of those tasks, then other alternative control methodologies, procedures, or combinations thereof shall be used to protect personnel. However, before adopting alternative methods of control, a risk assessment that demonstrates the adequacy and the effectiveness to provide the same level of protection as if LOTO be accomplished must be done.

2.0 APPLICABILITY

The provisions of this chapter are applicable to all NASA employees and to all other agencies, organizations, and contractor personnel, who while in the performance of their assigned tasks, could become exposed to potentially hazardous sources of energy.

In this chapter, all mandatory actions (i.e., requirements) are denoted by statements containing the term “shall.” The terms “may” or “can” denote discretionary privilege or permission, “should” denotes a good practice and is recommended, but not required, “will” denotes expected outcome, and “are” or “is” denotes descriptive material,

3.0 BACKGROUND

Employees constructing, servicing, or maintaining machines, equipment, or systems may be exposed to serious physical harm or death if hazardous energy is not properly controlled. Craft workers, machine operators, and laborers are among the 3 million workers who service equipment and face the greatest risk. Compliance with the LOTO standard prevents an estimated 120 fatalities and 50,000 injuries each year. The authority for the LOTO chapter is derived from the “NASA General Safety Program Requirements,” NASA Procedural Requirement (NPR) 8715.3C, Section 3.4, in conjunction with the Personnel Safety Certification Programs for Potentially Hazardous Operations and Materials specified in Section 7.4. Because of the numerous types of hazardous energy sources one might be exposed to at GRC, the procedures set forth in this chapter apply, during all work activities, to the control and/or isolation of those energy sources capable of causing injury to personnel. In addition to the many types of hazardous energy sources there are three main categories that must be accounted for when providing a safe work environment, and they are

Main — the primary source of energy supplied to machines, equipment or systems for providing a required (designed) service or output that must be locked and tagged out to provide a safe work condition.

Secondary — (Ancillary Equipment) secondary energy sources, often used in conjunction with or as a substitute for main energy sources.

Stored — stored energy sources describe components that can re-accumulate or retain residual energy introducing hazards even after main sources have been locked out. If stored hazardous energy is present in any form, care must be taken to ensure that the residual energy is reduced to a nonhazardous level. Extra care must be exercised to avoid re-accumulation of energy to hazardous levels through special measures; grounding, continual bleed-off, and monitoring are some examples.

Printed copies are uncontrolled and are not to be used for operational purposes.

Glenn Research Center Glenn Safety Manual	Title: Lockout/Tagout	
	Document No.: GLM-QS-1700.1.9	Rev.: Revision F

Energy sources and work activities include, but are not limited to:

Energy sources

Pneumatic systems
 Electrical systems
 Mechanical systems
 Hydraulic systems
 Spring tension and compression

Work activities

Maintenance
 Close proximity
 Installation
 Construction
 Repair

These standards do not apply to operations known as “hot tapping” (see APPENDIX A, Definitions and Acronyms), dealt with on an individual basis by the appropriate Safety Committee and the Operational Safety Branch (QSS), or to cord- and plug-connected equipment if it is unplugged and the plug is controlled by the employee performing the maintenance.

4.0 POLICY

It is GRC policy at Lewis Field and Plum Brook Station to set requirements for the safe completion of tasks that introduce personnel to potentially hazardous sources of energy. Unless specifically stated otherwise in this document, proper work standards and safe procedures shall follow the recommendations of OSHA (1910) as well as American National Standards Institute (ANSI), Institute of Electrical and Electronics Engineers, and National Fire Protection Association (NFPA) standards and regulations listed later in this chapter. This policy has been put in place so that trained personnel take the proper precautions and safeguards. Variances to these codes or standards must be approved through the Center Authority Having Jurisdiction (AHJ) and/or QSS.

4.1 Measurement and Verification

Compliance with the responsibilities and requirements of this chapter are measured and verified through the use of programmatic self-assessments, regulatory and agency audits, and internal field inspections and surveys.

5.0 RESPONSIBILITIES (NPR 8715.3 SECTION 3.4.2)

Center Directors shall establish a program for controlling hazardous energy during service and maintenance operations where the unexpected energizing or startup of equipment could cause injury to employees or equipment damage (Requirement 32295).

5.1 Area Safety Committees

Area Safety Committees conduct third-party reviews of all proposed installations, modifications, and operations in their assigned area of responsibility. They should ensure that all systems containing energy sources meet minimum design, operational, and safety standards including methods of safely controlling that energy source when isolation (LOTO) is required.

5.2 System Manager

System Managers are the accepted experts on their particular systems and are responsible for the operational status of those systems. The isolation of energy sources within these systems should only be allowed to occur with the System Managers approval after they have concurred with the impact upon the system, by reviewing the support documentation accompanying the Area Clearance Form, GRC-978 (see Section 6.4). The System Manager should help in the initial process to determine where isolation should occur to prevent the least amount of impact to systems involved, while providing safe isolation between personnel and the energy sources to which they could potentially be exposed.

5.3 Building Manager

The primary responsibility of a Building Manager is to represent the building occupants as the primary communications focal point. The Building Manager is responsible for assuring that any concerns, changes, impacts (such as an interruption of services), plans, or general information is effectively communicated to all building personnel. (Affected Employees, see Appendix A, Definitions and Acronyms). The Building Manager can only forward the information provided by the Area Clearance Form (NASA GRC-978) as to the impact to building personnel; they are not responsible for unanticipated disruptions in service.

Printed copies are uncontrolled and are not to be used for operational purposes.

Glenn Research Center Glenn Safety Manual	Title: Lockout/Tagout	
	Document No.: GLM-QS-1700.1.9	Rev.: Revision F

5.4 Research Facility Manager and/or Facility Operations Specialist

The Research Facility Manager and/or Facility Operations Specialist directly oversee facilities within the aforementioned systems and in many situations may be considered the affected employee (see Appendix A, Definitions and Acronyms) or might even be the Designated Person. LOTO must be approved by the corresponding Research Facility Manager and/or Facility Operations Specialist through the Area Clearance Process, to ensure that operations, research in progress, or required services are not disrupted.

5.5 Designated Person

A Designated Person shall provide (author) written isolation procedures (GRC-787 Form or equivalent) showing tag placement and device activity and will determine (authorize) when the isolation procedure is to be accomplished. They shall document (record) when isolation is complete, when LOTO has been completed (including verification), when LOTO has been cancelled and when equipment/systems are back to normal. The Designated Person shall be kept informed of operating conditions affecting the safe and reliable operation of the system. They shall maintain a suitable record showing operating changes in such conditions, such as temporary releases, and issue or deny authorization for switching, as required, for safe and reliable operation.

5.6 Supervisory Personnel

Supervisors are responsible for assigning only trained personnel (certified if specified in the job classification) to accomplish tasks involving hazardous energy sources. It is the supervisor's responsibility to ensure assigned personnel are properly trained, whether acting as an Authorized Employee performing LOTO to safely work on equipment, systems, or processes they have been deemed qualified to work on, or as a Qualified Operator (Switchperson) performing isolation requirements. They are also responsible for providing lists of Authorized Employees (see Section 5.7) and Qualified Operators/Switchpersons (see Section 5.8) to the personnel responsible for providing the written LOTO procedures. Supervisors are also responsible for providing the list of personnel, whether by Qualified Operators List (GRC580) or other written means. Supervisors may also be required to perform emergency lockout removal (see Section 6.9).

5.7 Requestor (Authorized Employee or Primary Authorized Employee)

The Requestor (Authorized Employee) shall apply to the Designated Person (if other than themselves) to have the particular equipment/system, to be worked on, isolated and the associated energy source de-energized or controlled. The Requestor then places LOTO device(s) on the equipment, systems, or processes in order to perform the servicing, maintenance, alteration, or other activity as required. The Requestor is the one protected by the LOTO and is therefore the only one that shall actually place the LOTO device(s) and the only one authorized to remove the LOTO device(s) (see Section 6.9, Emergency Lockout Removal). The Requestor maintains possession of the keys to the lockout devices installed for their protection (see Section 6.7).

When a crew (group) is utilized to perform a task, a Primary Authorized Employee may be assigned as the Requestor and may have the LOTO plan/procedure in their name rather than requiring a separate LOTO plan/procedure for each Authorized Employee. Each member (Authorized Employee) of the crew has the responsibility for applying their own LOTO device(s).

5.8 Qualified Operator (Switchperson)

A Qualified Operator is someone who has received training on the machines, equipment, or processes being isolated and on the safe procedures for accomplishing that isolation including the proper PPE required to achieve isolation safely. Actual isolation procedures will only be performed by Qualified Operators (Switchpersons), who have, in the opinion of their supervisor, demonstrated through hands-on operation and site-specific knowledge the ability to safely perform isolation procedures. The isolation shall be performed under the direction of the Designated Person (if other than themselves) who has the overall authority for coordinating the Isolation/LOTO procedure.

6.0 REQUIREMENTS (NPR 8715.3)

Employees performing work on the various systems at GRC shall have a working knowledge of the following documents, procedures, and policies and shall comply with the requirements therein. If a conflict arises between this chapter and local, state, or Federal regulations, the most stringent requirements shall apply. Organizations involved

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Glenn Research Center Glenn Safety Manual	Title: Lockout/Tagout	
	Document No.: GLM-QS-1700.1.9	Rev.: Revision F

in these tasks shall, upon request, provide support information and/or documentation (Including training records if not available through SATERN) to QSS to show compliance with these requirements.

6.1 Medical and Physical Requirements (*NPR 8715.3, Section 7.4*)

Personnel who perform or control hazardous operations shall be trained and certified with the necessary knowledge, skill, judgment, and physical ability (if specified in the job classification) to do the job safely (*NPR 8715.3, Section 7.4, Requirement 25113*).

6.2 Standards and Instructions

The following standard and instructions cover the servicing and maintenance of machines and equipment in which the unexpected energization or startup of the machines or equipment, or release of stored energy, could harm employees at GRC. The latest versions of these publications or documents shall be followed.

- **Occupational Safety and Health Act (*OSHA 29 CFR 1910.147*)**

1910.147(a)(3)(i) This standard requires employers to establish a program and utilize procedures for affixing appropriate lockout devices or tagout devices to energy isolating devices, and to otherwise disable machines or equipment to prevent unexpected energization, start up or release of stored energy in order to prevent injury to employees.

- **Electric Power System Operating Instructions (*LVEPS-OI xx and HVEPS-OI xx*)**

The GRC Low-Voltage Electrical Power System (LVEPS) and High-Voltage Electrical Power System (HVEPS) Managers periodically issue numbered operating instructions applicable to their respective systems. Personnel responsible for maintenance, construction, or repair of such systems shall be familiar with and follow these instructions (see Glenn Safety Manual Chapter 8, Section 5.4).

6.3 Energy Control Program (*OSHA 29 CFR 1910.147 (c) (1)*)

The employer shall establish a program consisting of energy control procedures, employee training, and periodic inspections to ensure that before any employee performs any servicing or maintenance on a machine or equipment where the unexpected energizing, startup, or release of stored energy could occur and cause injury, the machine or equipment shall be isolated from the energy source and rendered inoperative. This will be accomplished through LOTO methods and an onsite LOTO training program sponsored through QSS. When outside contract personnel perform LOTO at GRC they shall be trained through their employer as Authorized Employees, if their training requirements are less stringent than those at GRC or procedures differ but are equal in application, GRC LOTO program policies shall be adhered to.

6.4 Lockout/Tagout and Area Clearance Procedure

The Requestor (authorized employee) working with the System Manager (SM), Facility Operations Specialist (FOS) and the Facility and/or Research Managers will identify any device(s) that are needed to safely isolate equipment, systems, or processes that are in their area of responsibility (often times this would be part of the coordination meeting). This step in the planning process is required to not only provide safe isolation/control of energy sources to protect the Requestor, but also to reduce impact to outlying facilities and/or systems. This step also determines how many personnel, if any, will be impacted by the performance of the isolation requirements and ensuing LOTO.

The Requestor shall apply to the Designated Person (if other than themselves) to have a particular energy source, piece of equipment or system isolated, identifying it by position, letter, color, number, or other means. The Designated Person shall provide written isolation procedures (Switching/Isolation Orders) that clearly and specifically outline the scope, purpose, and techniques to be utilized for the control of hazardous energy sources, and the means to enforce compliance including, but not limited to, the following:

- (A) A specific statement of the intended use of the procedure;
- (B) Specific procedural steps for shutting down, isolating, blocking and securing machines or equipment to control hazardous energy;
- (C) Specific procedural steps for the placement, removal and transfer of lockout devices or tagout devices and the responsibility of them; and

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Glenn Research Center Glenn Safety Manual	Title: Lockout/Tagout	
	Document No.: GLM-QS-1700.1.9	Rev.: Revision F

(D) Specific procedural steps for testing a machine or equipment to determine and verify the effectiveness of lockout devices, tagout devices, and other energy control measures.

NOTE: Not all pieces of equipment require a written LOTO procedure. A written procedure is not needed if all hazardous energy is controlled/isolated with the application of a single lock and tag, with no potential for stored or residual energy or re-accumulation of stored energy after shut down. For additional details/requirements see OSHA 29CFR 1910.147(c)(4)(1)

The Designated Person shall direct the operation of all switches, valves, or lines through which energy may be supplied to be placed in a state, by a Qualified Operator/Switchperson, as to control the possible energy release and shall direct that those components be rendered inoperable, locked, and tagged by the Requestor. The Designated Person shall maintain a record (GRC Lockout/Tagout Planning Form, GRC-787 or equivalent) showing tag placement and device activity.

After the equipment, lines, or sources of energy have been safely isolated, the application of lockout or tagout devices to energy isolating devices has been accomplished and all potentially hazardous stored or residual energy has been relieved, disconnected, restrained, and/or otherwise rendered safe, the Requestor and those under their direction may, once verified safe, proceed with work on the de-energized or isolated parts. Equipment may be re-energized for testing purposes (temporary release) only under the supervision of the Requestor (Authorized Employee) and subject to authorization/direction of the Designated Person. This shall be documented and the procedural steps tracked.

If a disruption in services is going to occur, impacting personnel whose job requires them to operate a machine or piece of equipment on which servicing or maintenance is being performed under LOTO, or whose job requires them to work in an area being directly affected by the interruption of services caused by the application of LOTO, these "Affected Personnel" shall be notified. 1910.147(c)(9) Affected employees shall be notified by the employer or authorized employee of the application and removal of lockout devices or tagout devices. Notification shall be given before the controls are applied, and before they are removed from the machine or equipment. This notification, "Area Clearance" document, when approved, authorizes the isolation/outage of GRC equipment and/or systems for the purposes of accomplishing maintenance, repairs or modifications. For localized disruptions in service, a single lab or office, an e-mail to notify all affected employees is acceptable upon their concurrence. Requirements for the Area Clearance should be coordinated and determined, with assistance as needed by System Managers, Facility Specialists, and other personnel knowledgeable on the systems being impacted. The Area Clearance Authorization Form GRC-978 is to be used where disruptions to services impact personnel on a larger scale.

EXAMPLES:

1.
 - a. Office fan coil unit, notify office personnel with an e-mail.
 - b. Building roof-top air-handler, route an Area Clearance Form
2.
 - a. Working on office lighting, notify office personnel with an e-mail.
 - b. Turning off power to building, route an Area Clearance Form

NOTE: If a fire protection system is shut down or impaired for greater than 4 hours a Fire Protection Impairment Authorization Form, GRC-316, shall be completed and approved by the Authority Having Jurisdiction (AHJ).

For further information see **Appendix C.—AREA CLEARANCE PROCEDURE**

To establish a safe work condition, it is critical to identify all sources or potential sources of energy. The method of hazardous energy control selected depends on whether the task can be performed with or without energized conditions. In all cases, the primary method of control will be LOTO. This process entails placing a red-bodied lock with a locking device, if required, and proper tag on the final point of isolation (see Appendix B for examples of LOTO devices). Tags shall be attached using a non-releasable, non-reusable nylon cable tie (tie wrap) with a minimum 50 pound breaking strength. Locks intended for use under the requirements of this chapter must not be used for any other purposes.

If an energy isolating device is capable of being locked out, lockout shall be used (see section 6.5.1). If an energy isolating device is not capable of being locked out, a tagout program shall be used (see section 6.10.1). When a

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Glenn Research Center Glenn Safety Manual	Title: Lockout/Tagout	
	Document No.: GLM-QS-1700.1.9	Rev.: Revision F

tagout device is used in lieu of lockout, it must be demonstrated that an effective level of safety is achieved, providing full employee protection, in the tagout program. Additional protective means shall include but are not limited to the:

- Removal of an isolating circuit element such as a fuse, verify loss of energy, and maintain control of the fuse(s)
- Blocking of a controlling switch and ensuring it cannot be inadvertently operated
- Opening of an extra disconnect, where a second action must now occur
- Removal of valve handles to reduce the chance of an inadvertent operation

All newly acquired equipment involving potentially hazardous energy sources must be outfitted to accommodate lockout devices per 29 CFR 1910.147 (c)(2)(iii). Also included is any equipment that is replaced, renovated, or has major repairs conducted on it. In these instances, the equipment must be retrofitted to accommodate lockout devices per 29 CFR 1910.147 (c)(2)(iii).

Before starting work on machines, equipment, or processes that have been locked and/or tagged out, verification of isolation and de-energization shall be accomplished by the authorized employee or primary authorized employee. Verification may be accomplished by testing circuitry, cycling, visually inspecting position, manually trying, monitoring movement or discharge, observing bleeds, gauges, indicators, etc., or other available means. When verifying voltage absence, the hot-dead-hot method shall be used (see Appendix A, Definitions and Acronyms). For electrical isolation, safety grounds may be required.

Whether lockout and/or tagout is used, the Requestor (Authorized Employee) shall be responsible for placing the LOTO device(s), verifying that the hazardous energy has been safely controlled, and removing the LOTO once it is no longer required for their protection (see Section 6.9 for emergency removal).

*Note: Whether LOTO or simply tagout methods are utilized, a DANGER, DO NOT OPERATE tag (NASA-C946a, Stock No. 7530-01-LNO-1449) shall be used and **completely** filled out. Table I below shows the information required on the tag. Tags shall be attached using a non-releasable, non-reusable nylon cable tie (tie wrap) with a minimum 50 pound breaking strength.*

TABLE I.—TAG INFORMATION

Front Side	Back (Reverse) Side
* Central Control Dispatch Tag (*If procedure is through CAD, EPD or EMCS) Tag Number Apparatus Name (Requestor) Date Phone Dispatcher (*on duty for isolation)	Switchperson(s) (Qualified Operator) Phone number Print lock number in the REMARKS area. Also indicate position that the tagged apparatus is in (open, closed, etc.)

6.5 Minimum Isolation Criteria (OSHA 29 CFR 1910.147 (c)(4))

The following minimum criteria will be used to determine that a “Safe Work Condition” has been achieved.

6.5.1 Isolation

Isolation is the operation of a device(s) necessary to make equipment (system) safe to work on.

- Mechanical Systems

One-point isolation is for working “on” the system and two-point isolation for working “in” the system. A point of isolation would be considered a valve, blind (blank) flange, blocking or bracing a valve, etc., that provides a physical means for the control of the hazardous energy source.

Printed copies are uncontrolled and are not to be used for operational purposes.

Glenn Research Center Glenn Safety Manual	Title: Lockout/Tagout	
	Document No.: GLM-QS-1700.1.9	Rev.: Revision F

- Electrical Systems

One break (open) is required for working on low-voltage systems, 600 volts and below, and two opens are required for working on high-voltage electrical systems, above 600 volts. A break would be an open breaker, disconnect, or fuse holder, etc. With high-voltage isolation, when two breaks are not available, grounds will be applied and represent the second means of isolation. These grounds will not replace the need for working crews' safety grounds.

6.5.2 Device Selection Responsibilities

It is important that the responsibilities for critical decisions be clearly defined when planning LOTO. The following is offered to clarify who is responsible for device selection.

6.5.2.1 Equipment/System/Process Isolation (Not Part of the Central Process System)

The authorized employee working with the System, Facility, and/or Research Managers along with the Area Supervisor and the affected employee(s) will identify all devices that are needed to safely isolate equipment, systems, or processes that are in their area of responsibility. This step in the planning process is required to not only provide safe isolation/control of energy sources to protect the authorized employee (Requestor) but also to provide minimal impact to outlying facilities and/or systems.

6.5.2.2 Central Process Distribution System Isolation

The EPD or CAD will assume the function of the Designated Person. This includes matters relative to distribution equipment modification or when facility isolation is necessary (single or group). The EPD will be responsible for defining all electrical isolation devices associated with the GRC power distribution system. The CAD will be responsible for defining all valves necessary to safely isolate the air distribution system. System Boundaries

The following devices are used to assist in defining boundaries within the Central Process System. When a device is needed for isolation and is outside the Area Supervisor's or Appropriate Manager's responsible area then the adjoining Area Supervisor and/or Manager will be responsible for clearly identifying the appropriate device.

The following are general guidelines to be used when specific guidelines are not available:

1. The boundary between the electrical power distribution system and an area is the first device outside of the substation.
2. The boundary between the air service generation equipment and the distribution system is the first valve outside the generating building.
3. The boundary between the distribution system and the utilization equipment is the cell isolation valve.

Note: In all cases, the final point of isolation is where the LOTO devices will be placed. Work may proceed only after verification to the control of the hazardous energy has been accomplished.

6.5.3 Isolation of equipment/systems for safety or configuration control

The LOTO, by OSHA definition, shall only be placed by the personnel that are being protected by the isolation device(s) that the LOTO devices are being attached to. They shall control the keys and they shall be the ones that remove the locks that they applied. The LOTO is not a means of controlling the configuration of systems or equipment to isolate potential areas where unsafe conditions might occur (example; equipment outside required test dates) or where simple control may be required, that should be accomplished using the GRC-946 "Caution - Do Not Operate" tag. In order to stay within this statement of application, and still provide safety through configuration (positioning) control of an isolation device from other situations or where exposure to a hazardous energy under abnormal circumstances might occur, the Glenn LOTO Program has authorized the use of this second tag for these situations.

The GRC-946 is a "Caution - Do Not Operate" tag, it is a yellow and black tag that indicates component/system control, configuration or status. Although this tag receives its authorization by virtue of the Glenn LOTO Program and is used, when accompanied by a lock (other than red) to secure isolation points in various types of systems it is not a "lockout/tagout tag" nor is it to be used for the purpose of LOTO by OSHA definition. The use of the "Caution - Do Not Operate" tag is also covered as part of the LOTO training.

Printed copies are uncontrolled and are not to be used for operational purposes.

Glenn Research Center Glenn Safety Manual	Title: Lockout/Tagout	
	Document No.: GLM-QS-1700.1.9	Rev.: Revision F

The intent behind these tags is to allow for the control of systems and/or equipment providing status of a required configuration or to provide warnings of tests in progress, secondary points of energy isolation, tie circuit status, etc. This tag should only be removed by or with permission of the person(s) who placed it. When used as a means for configuration control of distributive systems to or throughout buildings (Institutional, Central Process, Cryogenic/Gaseous, etc.) this tag should only be used with permission of the responsible FD System Manager. Though the removal of such tags may not place personnel or equipment directly in a hazardous situation it might have adverse effects that could potentially cause a hazardous situation to occur. Examples of institutional systems would include Chilled Water, Domestic Water, Electrical (high voltage and low voltage), Protective/Security, Steam/Condensate, etc.

The difference between these tags is that one (the NASA GRC946A, Danger tag) is saying that someone, in the process of performing a task, would be immediately exposed to a hazardous energy source if the tag were removed and the device operated (thus the warning “DANGER”). The other (the NASA GRC946, Caution tag) is saying there is a potential for someone to be injured;

- If the device were operated and if personnel were in the area where the equipment is located,
- If the device failed due to it being outside its required calibration/certification test date.
- If a configuration change is made to a system not approved by the responsible System Manager.

Both tags provide information on who to contact, both tags say “Do Not Operate”, both tags are authorized through the LOTO program and are to be adhered to. It is extremely important to differentiate between the “will place” (Danger tag) or “could place” (Caution tag) someone in jeopardy. With LOTO a red lock must be hung with the Danger tag on the isolating device, with the Caution tag a lock is optional (often preferred), but when a lock is used it shall not be a red lock

6.6 Group Lockout or Tagout (OSHA 29 CFR 1910.147 (f)(3))

Separate tasks require separate LOTO procedures, locks and tags to provide the proper level of protection for all employees involved.

When servicing and/or maintenance is performed by a crew, they shall utilize a procedure which affords each employee within the crew a level of protection equivalent to that provided by the implementation of a personal lockout or tagout device. Group LOTO shall be used in accordance with standard LOTO requirements: Procedures shall be developed, documented, and utilized for the control of potentially hazardous energy with primary responsibility vested in an “Primary Authorized Employee” for a set number of employees working under the protection of a group lockout or tagout device (such as a “job lock” or “operations lock”). In addition to the group lockout device each member of the crew shall hang their personal lock.

Each authorized employee shall affix a personal LOTO device to the group lockout device, group lock-box or comparable mechanism and remove that device when he/she are finished with the servicing or maintenance activity. No person may attach or remove another person's LOTO device. The authorized employee in charge of a crew (“Primary Authorized Employee”) does not remove the group lockout or tagout mechanism from the energy isolating device(s) until each employee in the group has removed their personal device. Individual employee device removal indicates that the employees are no longer exposed to the hazards from the servicing or maintenance operation. Most importantly, these group LOTO devices (personal lockout or tagout devices; group LOTO mechanisms) ensure that the equipment LOTO devices are maintained on energy isolation devices throughout the "life of the job."

When more than one crew, craft, department, etc. is involved, assignment of the overall lockout or tagout control responsibility will be assigned to a Designated Person to coordinate affected work forces and ensure continuity of protection. At GRC, each separate task shall require a separate LOTO be accomplished.

Instructions to re-energize machines, equipment, or processes that have been de-energized by permission of the Designated Person shall not be issued by the Designated Person until all employees who requested the LOTO have reported clear.

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Glenn Research Center Glenn Safety Manual	Title: Lockout/Tagout	
	Document No.: GLM-QS-1700.1.9	Rev.: Revision F

6.7 Shift or Personnel Changes (*OSHA 29 CFR 1910.147 (f)(4)*)

Specific procedures shall be utilized during shift or personnel changes to ensure the continuity of lockout or tagout protection, including provision for the orderly transfer LOTO device protection between off-going and oncoming employees, to minimize exposure to hazards from the unexpected energization or startup of the machine or equipment, or the release of stored energy. These procedures shall entail *personal* transference of keys from one authorized employee to another with notification to the Designated Person (EPD, CAD, etc.). This procedure also involves the use of the term “or” as the Requestor on the LOTO plan. The transference of lockout keys from one authorized employee to another constitutes transferring ownership of the “lock” because the protected authorized employee maintains control of the lockout device. If transference of keys does not occur then additional LOTO must be performed before the present authorized employee or primary authorized employee may begin work.

Based on the requirements found in the Directive on the Control of Hazardous Energy-Enforcement Policy and Inspection Procedures, CPL 02-00-147 p3-59; the *Job Lock* is the first lock placed on the energy isolating device(s) or lockbox, and it is the last one removed when the job is complete. Each primary authorized employee from each shift controls the key to the job lock. Individual Authorized Employees shall hang their locks respectively. The Authorized Employee (Primary Authorized Employee) who applies the continuity device, *Job Lock*, may or may not be the same Authorized Employee who removes it.

6.8 Return to Service (*OSHA 29 CFR 1910.147 (e)(3)*)

Prior to “return to service,” the work area(s) shall be inspected by the authorized employee or primary authorized employee to ensure that the system, equipment, or process is intact, free of tools and debris, all guards have been reinstalled, and all employees are in the clear. They must ascertain that everyone connected with the work on the system is accounted for before the locks and tags are cancelled. Each LOTO device shall be removed from the energy isolating device(s) by the authorized employee or primary authorized employee who was protected by the device.

The Requestor shall report to the Designated Person that all tags protecting that person or crew may be removed, but before a machine, piece of equipment or process is started or placed into service, the Affected Person(s) shall be notified. The Area Clearance Form provides tentative schedules for outages and restorations; personnel working in the affected areas shall be notified if those schedules are altered. The Designated Person working with the Requestor and Qualified Operator/Switchperson coordinates the removal of the LOTO devices and tags and the restoration of systems/equipment to normal service.

6.9 Emergency Lockout Removal (*Exception to OSHA 29 CFR 1910.147 (e)(3)*)

When the authorized employee/requestor is unavailable to remove their LOTO device(s), the device(s) may be removed by contacting the requestor’s supervisor (supervisor must be an authorized employee who has received LOTO training) and using the following procedures:

- The authorized employees’ Supervisor verifies that the authorized employee is not available to remove their LOTO device(s). This should occur only after every possible effort to contact the authorized employee has been made.
- The Supervisor of the authorized employee notifies the Area Supervisor, Designated Person, and/or the affected employee that he/she will assume responsibility of the LOTO device(s) and, when determined safe to do so, will remove them in accordance with the procedure that would have been used by the listed authorized employee.
- The Supervisor shall, either through discussion with personnel involved with the task or personal knowledge and inspection, verify that the worksite is cleaned up, tools are removed, and that the equipment/systems are safe to place back in service.
- The Supervisor of the authorized employee will notify all parties upon the actual removal of the LOTO device(s) and ensure that the authorized employee is notified prior to returning to the job.
- The Supervisor will also notify the authorized employee’s line management and QSS, documenting the required action(s) and the justification.

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Glenn Research Center Glenn Safety Manual	Title: Lockout/Tagout	
	Document No.: GLM-QS-1700.1.9	Rev.: Revision F

6.10 Training and Communication (*OSHA 29 CFR 1910.147(c) (7)*)

GRC, through QSS, shall develop and provide training to ensure that the purpose and function of the energy control program are understood by its employees. Classroom training and testing shall be utilized to verify that the knowledge and skills required for the safe application, usage, and removal of the energy controls are acquired by employees. The training shall be coordinated by the Human Capital Development Branch and records maintained in SATERN. The training shall include the following:

- Each authorized employee shall receive training in the recognition of applicable hazardous energy sources, the type and magnitude of the energy available in the workplace, and the methods and means necessary for energy isolation and control.
- Each affected employee shall be instructed in the purpose and use of the energy control procedure.
- All other employees whose work operations are or may be in an area where energy control procedures may be utilized, shall be instructed about the procedure, and about the prohibition relating to attempts to restart or re-energize machines or equipment that are locked out or tagged out.

6.10.1 Limitations of Tags (*OSHA 29 CFR 1910.147(c)(7)(ii)(A)*)

When tagout systems are used, employees shall also be trained in the following limitations of tags:

- Tags are essentially warning devices affixed to energy isolating devices and do not provide the physical restraint on those devices that is provided by a lock.
- When a tag is attached to an energy isolating means, it is not to be removed without authorization of the authorized person responsible for it, and it is never to be bypassed, ignored, or otherwise defeated.
- Tags must be legible and understandable by all authorized employees, affected employees, and all other employees whose work operations are or may be in the area, in order to be effective.
- Tags and their means of attachment must be made of materials that will withstand the environmental conditions encountered in the workplace.
- Tags may evoke a false sense of security, and their meaning needs to be understood as part of the overall energy control program.
- Tags must be securely attached to energy isolating devices so that they cannot be inadvertently or accidentally detached during use.

6.10.2 Employee Retraining (*OSHA 29 CFR 1910.147(c)(7)(iii)*)

Retraining shall be accomplished, at a minimum, every 4 years per NPR 8715.3C, Chapter 7, Section 7.4.6.1(e). Retraining shall also be provided for all authorized and affected employees whenever there is a change in their job assignments, a change in machines, equipment, or processes that present a new hazard, or when there is a change in the energy control procedures.

Additional retraining shall also be conducted whenever a periodic inspection reveals, or whenever the employer has reason to believe that there are deviations from or inadequacies in the employee's knowledge or use of the energy control procedures.

The retraining shall reestablish employee proficiency and introduce new or revised control methods and procedures, as necessary. If revised methods or procedures are not being introduced, proficiency can be reestablished by retesting only.

The employer shall certify that employee training has been accomplished and is being kept up to date. The certification shall contain each employee's name and dates of training.

6.11 Inspections and Audits (*OSHA 29 CFR 1910.147 (c)(6)(ii)*)

Inspections and audits to show compliance to the standards of this chapter and OSHA 29 CFR 1910.147 must be conducted at least annually. The purpose of these inspections and audits are to gauge the effectiveness of all written procedures kept on file for specific tasks (Tagout Plan Annual Audit, NASA GRC787D) and to ensure the

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Glenn Research Center Glenn Safety Manual	Title: Lockout/Tagout	
	Document No.: GLM-QS-1700.1.9	Rev.: Revision F

requirements of this program are being followed (GRC Lockout/Tagout Inspection Form, NASA GRC787C). Results of inspections or audits are to be certified by the employer and submitted to the responsible organization to be kept on file with a copy sent to QSS. The periodic inspection and/or audit shall follow the guidelines listed below;

- Inspections must be conducted by an authorized employee, other than the one utilizing the procedure being inspected (GRC787C)
- Where LOTO is used for energy control, include a review, between the inspector and each authorized employee, of that employees' responsibilities under the energy control procedure being inspected (GRC787C)
- Where tagout is used, include an understanding of the authorized employees' responsibilities and how they may differ from LOTO (GRC787C)
- Audits must be conducted by an authorized employee to correct any deviations or inadequacies identified (GRC787D)

NOTE: For purposes of procedure grouping, machines and equipment may be grouped together as one procedure if they all are listed or identified in the scope of the energy control procedure and if they all have the same or similar:

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

7.0 RECORDS

- GRC Switching and Lockout/Tagout Record, NASA GRC-787.—Maintained for 1 year by Designated Person.
- GRC Equipment/Apparatus Switching Record, NASA GRC-787A.—Maintained for 1 year by Designated Person.
- GRC Switching Action Record, NASA GRC-787B.—Maintained for 1 year by Designated Person.
- GRC Lockout/Tagout Inspection Form, NASA GRC-787C. — Maintained on file by Designated Person with a reference copy to QSS.
- GRC Lockout/Tagout Annual Audit Form, NASA GRC-787D. — Maintained on file by Designated Person with a reference copy to QSS.
- Area Clearance Form, NASA GRC-978.—Required for a disruption in service before a switching order is approved, maintained with GRC-787.

8.0 REFERENCES

Document Number	Document Name
29 CFR 1910 and 1926	Public Law 91–596, Occupational Safety and Health Act (OSHA), 1970
1910.147	The control of hazardous energy, lockout/tagout. (General Industry)
1926.417	Lockout and tagging of circuits. (Construction)
NPR 8715.3C	NASA General Safety Program Requirements
GLM–QS–1700.1	NASA Glenn Safety Manual, BMS Document
GRC–P7500.004	Configuration Management
NFPA	National Electrical Code
NFPA 70E	Standard for Electrical Safety in the Workplace
HVEPS–OI–xx	High-Voltage Electric Power System Operating Instructions, various dates
LVEPS–OI–xx	Low-Voltage Electric Power System Operating Instructions, various dates

Printed copies are uncontrolled and are not to be used for operational purposes.

Glenn Research Center Glenn Safety Manual	Title: Lockout/Tagout	
	Document No.: GLM-QS-1700.1.9	Rev.: Revision F

APPENDIX A.—DEFINITIONS AND ACRONYMS

Affected employee.—An employee whose job requires him/her to operate machinery or equipment on which servicing or maintenance is being performed under lockout/tagout (LOTO), whose job requires him/her to work in an area in which such servicing or maintenance is being performed, or works in an area that has a disruption in services caused by the required LOTO.

American National Standards Institute (ANSI)

Area Clearance Process.—Documented way of communicating a disruption in service. See Appendix C.

Area Supervisor.—An employee who is responsible for the operation of equipment and personnel in a given area.

Authorized. — Deemed qualified (certified where required) by one’s supervisor to be able to perform an assigned task safely and competently.

Authorized employee (Requestor).— A person (certified as required) who locks out and/or tags out machines or equipment in order to perform servicing or maintenance on that machine or equipment. The Requestor is the one protected by the LOTO and is therefore the only one that actually places the LOTO device and the only one that will remove that LOTO device. An affected employee becomes an authorized employee when that employee's duties include performing servicing or maintenance covered under this section.

Capable of being locked out.—Equipped with an energy-isolating device that is designed with a hasp or other attachment or integral part to which, or through which, a lock can be affixed, or that has a locking mechanism built into it. Also includes other devices if lockout can be achieved without the need to dismantle, rebuild, or replace the device.

Central Air Dispatch (CAD)

Central process systems.—Services, facilities, equipment, and components managed, operated, and maintained by the Facilities and Test Engineering Division, which directly support research facilities. These facilities include any system, equipment, or component used for generating, supplying, conveying, distributing, conditioning, monitoring, measuring, removing, or processing of air, exhaust, lubricating oil, control oil, pneumatic controls, refrigerants, cooling tower water, natural gas, and the entire high-voltage electrical power distribution system. The end point of these systems, relative to test cells is generally recognized as the Central Process Systems isolation valve(s) serving a particular facility. The electrical power dispatcher (EPD) and the central air dispatcher must be involved in all LOTO procedures involving the central process systems.

Code of Federal Regulations (CFR)

Contracting Officers Technical Representative (COTR)

Designated Person.—Person responsible for providing/preparing switching/isolation procedures for all individuals working within their area/system of responsibility on a specific job or task. The Designated Person shall be kept informed of operating conditions affecting the safe and reliable operation of these systems. They shall also maintain suitable records showing operating changes in such conditions and issue or deny authorization for switching, as required, for safe and reliable operation. Prior to releasing the lockout, the Designated Person will verify and assure that all individuals working under their lockout have completed their work, are accounted for, and will ensure that all employees are clear, all tools removed, and all guards reinstalled.

Designated safety person (DSP).—See Section 5.5.

Electrical Power Dispatch (EPD)

Electrically safe work condition.—A state in which the conductor or circuit part to be worked on or near has been disconnected from energized parts, locked/tagged in accordance with established standards, tested to ensure absence of voltage, and grounded if determined necessary. In this condition protective clothing is no longer needed.

Energized.—Connected to an energy source or containing residual or stored energy.

Energy isolating device.—A mechanical device that physically prevents the transmission or release of potentially harmful energy, for example, a disconnect switch, a blind flange, or a physical block preventing motion of a

Printed copies are uncontrolled and are not to be used for operational purposes.

Glenn Research Center Glenn Safety Manual	Title: Lockout/Tagout	
	Document No.: GLM-QS-1700.1.9	Rev.: Revision F

mechanical device or valve. (Control components such as push buttons and operating levers that are used in normal operation to direct energy flow or release do not qualify as energy-isolating devices.)

Energy source.—A source of potentially harmful electrical, thermal, pneumatic, mechanical, hydraulic, chemical, or other energy.

Final point of isolation.—The selected energy isolating device closest to the work being performed which is identified in the LOTO procedure.

Glenn Research Center (GRC)

High-Voltage Electrical System.—Equipment, parts, and components used in distributing and utilizing electrical power to all institutional and research loads throughout the Glenn Research Center, at a voltage level greater than 600 V. This system is considered to be part of the Central Process Systems.

High-Voltage Electrical Power System (HVEPS)

Hot-dead-hot.—Validate the test equipment being used by measuring a known energized source, verify absence of isolated energy source, and validate the test equipment once more on a known energized source.

Hot tapping.—A procedure used in the repair, maintenance, and services activities which involves welding on a piece of equipment (pipelines, vessels, or tanks) under pressure, in order to install connections or appurtenances. It is commonly used to replace or add sections of pipeline without the interruption of service for air, gas, water, steam, and petrochemical distribution systems.

Lockbox.— Container for keys used for multiple lock tasks. Where multiple points of lockout are required for isolation, where the application of multiple locks on a single device could cause damage to that device, or where more than one crew or department may be working within the same isolation device(s) (each task requiring its own LOTO procedure) a lockbox may be utilized. The actual “lockout” device keys shall be placed in the box with application of individual employee locks applied (with lock extenders as required) to the lockbox.

Lockout.—A procedure whereby one or more lockout device(s) is placed on an energy-isolating device(s) to ensure that neither the energy-isolating device nor the equipment being controlled can be operated until the lockout device is removed.

Lockout device.—A device that utilizes a positive means (such as a keyed lock) to hold an energy-isolating device in the safe position, thereby preventing the energizing of a machine or equipment. Lockout devices shall be substantial enough to prevent removal without the use of excessive force or unusual techniques, such as with the use of bolt cutters or other metal cutting tools.

Lockout/tagout (LOTO)

Low-Voltage Electrical Power System (LVEPS)

Multiple lockout device(s).—A mechanical device, such as a hasp, enabling application of more than one lock to an energy-isolating device.

Normal operation.—The utilization of a machine or piece of equipment to perform its intended function.

NASA Procedural Requirement (NPR)

National Electric Safety Code (NESC)

National Fire Protection Association (NFPA)

Occupational Safety and Health Administration (OSHA)

Personal protective equipment (PPE)

Positive means of protection.—Prevention of potentially harmful release of energy by a means that would require unusual and obvious measures to defeat.

Primary Authorized Employee. – For group LOTO this employee would exercise primary responsibility for implementation and coordination of the overall LOTO of hazardous energy sources for the equipment to be serviced.

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Glenn Research Center Glenn Safety Manual	Title: Lockout/Tagout	
	Document No.: GLM-QS-1700.1.9	Rev.: Revision F

He also has the responsibility to ensure continuity of protection with respect to multi-shift energy isolation (e.g., through the use of group continuity devices, such as "Job Lock" or "Operations Lock" procedures).

Qualified.—Knowledgeable in the construction, operation, and installation of machines, equipment, and/or processes pertaining to one's assigned tasks and trained in recognizing and controlling any hazards involved.

Qualified Operator/Switchperson.—Personnel meeting minimum site-specific knowledge requirements on the machines, equipment, and/or processes they are responsible for during the execution of their daily duties. This knowledge is achieved through hands-on training and demonstrating the ability to safely operate and maintain the machines, equipment, or processes involved.

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 any situation where the employee may be exposed to the unexpected energization or startup of equipment or release of hazardous energy.

Safety and Health Division (SHeD)

Safety and Mission Assurance (SMA)

Safety and Mission Assurance Directorate (SMAD)

Support service contractor (SSC)

Switching orders.—Written or verbal step-by-step procedures developed by Designated Persons and utilized in the process for isolating and controlling sources of hazardous energy. These procedures specify an exact sequence of steps to be taken by Qualified Operators (Switchpersons) that are responsible for performing the isolation required for lockout and/or tagout of equipment, systems, and/or components.

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 devices, including their means of attachment, shall be substantial enough to prevent inadvertent or accidental removal. Tagout device attachment means shall be of a non-reusable type, attachable by hand, self-locking, and non-releasable with a minimum unlocking strength of no less than 50 pounds and having the general design and basic characteristics of being at least equivalent to a one-piece, all-environment-tolerant nylon cable tie.

Glenn Research Center Glenn Safety Manual	Title: Lockout/Tagout	
	Document No.: GLM-QS-1700.1.9	Rev.: Revision F

APPENDIX B.—LOCKS, TAGS, AND DEVICES

Front Side	Back (Reverse) Side

Figure B.1.—Lockout/Tagout Tag, shown above is the ONLY Authorized Tag at Glenn Research Center.



Figure B.2.—Lockout locks, ONLY red-bodied locks to be used for lockout/tagout.

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Glenn Research Center Glenn Safety Manual	Title: Lockout/Tagout	
	Document No.: GLM-QS-1700.1.9	Rev.: Revision F



Figure B.3.—All valve lockout.



Figure B.4.—Pneumatic valve lockout.



Figure B.5.—Gate valve lockouts.



Figure B.6.—Large breaker lockout.

Glenn Research Center Glenn Safety Manual	Title: Lockout/Tagout	
	Document No.: GLM-QS-1700.1.9	Rev.: Revision F

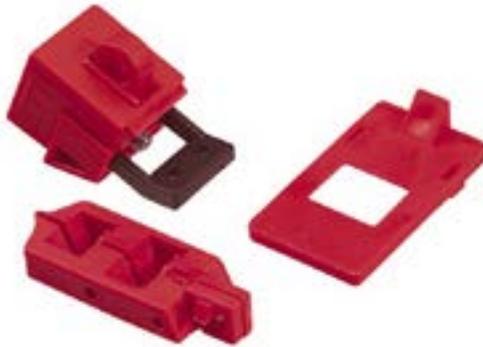


Figure B.7.—Single-pole breaker lockouts.



Figure B.8.—Fuse lockouts.



Figure B.9.—Lockout/tagout kits.

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Glenn Research Center Glenn Safety Manual	Title: Lockout/Tagout	
	Document No.: GLM-QS-1700.1.9	Rev.: Revision F



Figure B.10.—Switching/Configuration Tag, provides information on system status or position, and it is not to be used for lockout/tagout purposes.

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Glenn Research Center Glenn Safety Manual	Title: Lockout/Tagout	
	Document No.: GLM-QS-1700.1.9	Rev.: Revision F

APPENDIX C.—AREA CLEARANCE PROCEDURE

Table of Contents

1.0 Introduction

2.0 Definitions

3.0 Responsibilities

4.0 Procedures with Flow Chart

1.0 INTRODUCTION

This document addresses the Area Clearance Authorization process. It is applicable to both Government and Contractor activities requiring an interruption in services at the Glenn Research Center, Lewis Field or Plum Brook Station, in order to accomplish work in a safe and protected manner.

1.1 Purpose

When the performance of scheduled tasks require an interruption in equipment, services and/or systems where that disruption directly impacts others (Affected Employees) and the ability to perform their assigned tasks, prior notification shall be given. This procedure provides a means of providing adequate notification of the timing, duration and nature of the impact of the proposed isolation/outage.

2.0 DEFINITIONS

Affected Employee An employee whose job requires him/her to operate machinery or equipment on which servicing or maintenance is being performed under LOTO, whose job requires him/her to work in an area in which such servicing or maintenance is being performed, or works in an area that has a disruption in services caused by the LOTO.

Area Clearance A document which, when approved, authorizes the isolation/outage of GRC equipment and/or systems for the purposes of accomplishing maintenance, repairs or modifications. For localized disruptions in service, a single lab or office, an e-mail to notify all affected employees is acceptable upon their concurrence. Requirements for the Area Clearance should be coordinated and determined, with assistance as needed by System Managers, Facility Specialists, and other personnel knowledgeable on the systems being impacted. The Area Clearance Authorization Form GRC-978 is to be used where disruptions to services impact personnel on a larger scale.

EXAMPLES:

3.
 - a. Office fan coil unit, notify office personnel with an e-mail
 - b. Building roof-top air-handler, route an Area Clearance Form
4.
 - a. Working on office lighting, notify office personnel with an e-mail
 - b. Turning off power to building, route an Area Clearance Form

NOTE: If a fire protection system is shut down or impaired for greater than 4 hours a Fire Protection Impairment Authorization Form, GRC-316, shall be completed and approved by the Authority Having Jurisdiction (AHJ).

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Glenn Research Center Glenn Safety Manual	Title: Lockout/Tagout	
	Document No.: GLM-QS-1700.1.9	Rev.: Revision F

Authority Having Jurisdiction (AHJ)	Refers to the individual(s) at the NASA Centers and Headquarters responsible for implementing the fire safety provisions of NPR 8715.3, NASA General Safety Program Requirements, and with the authority for approving/concurring with associated installations, procedures, and equipment.
Authorized Employee	Personnel determined, by their supervisor, to be qualified to perform the assigned task and have received training in LOTO. They shall be trained on the necessary test equipment and use of such equipment to properly verify the loss/absence of the energy source(s) being isolated. They shall also be trained on the required Personal Protective Equipment (PPE) to safely accomplish these duties.
Building Manager	Represents the building occupants as the primary communications focal point. The Building Manager is responsible for assuring that any concerns, changes, impacts, plans, or general information is effectively communicated to all building occupants. Building Managers are responsible for concurring with utility system outages and interruptions per the Construction Management Manual
Central Process Systems	Services, facilities, equipment, and components, managed, operated and maintained, which directly support research facilities. These facilities include any system, equipment or component used for generating, supplying, conveying, distributing, conditioning, monitoring, removing or processing of air, exhaust, lubricating oil, control oil, pneumatic controls, refrigerants, cooling tower water, natural gas. This also includes the High Voltage Distribution System and the Central Process Distributed Control System (CP-DCS), which monitor and control the aforementioned processes and equipment.
Designated Person	<p>The individual who coordinates the timing of shutdowns/outages, assists in implementation planning and developing isolation plans, and approves area clearance forms. The Designated Person shall be kept informed of operating conditions affecting the safe and reliable operation of these systems.</p> <ul style="list-style-type: none"> ➤ For maintenance activities on a single piece of equipment, not directly impacting central process, or institutional systems, this would be the individual performing the maintenance activity. ➤ For research/test facilities or institutional facilities, not covered as part of the Central process system, the Research, Facility or System Managers (or their designee). At the Plum Brook Station (PBS) the Systems Managers designated System Engineer acts on their behalf. ➤ For isolation of energy sources within the Central Process Systems at GRC Lewis Field the Electrical Power Dispatch (EPD) or Central Air Dispatch (CAD) would serve in this capacity. ➤ For institutional systems, at Lewis Field, either the EPD for electrical, or the EMCS Dispatch for mechanical (steam, chilled water, etc.).
Electrical Systems	<p>High Voltage System – Electric power system(s) and equipment operating above 600 volts nominal, inclusive of all transformer secondaries up to the first device beyond the secondary bushings.</p> <p>Low Voltage System – Electric power system(s) and equipment operating at or below 600 volts nominal.</p>
Facility Manager	Oversees the major research facilities and the associated test operations, maintenance, improvements, and strategic planning activities for those research facilities managed and

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Glenn Research Center Glenn Safety Manual	Title: Lockout/Tagout	
	Document No.: GLM-QS-1700.1.9	Rev.: Revision F

implemented through the Facilities Test Division (FT). Interruptions to facility services shall be with the approval of the Facility Manager.

Facility Operations Specialist	Provides contract oversight for the operations and maintenance of all facilities, systems, and grounds that provide safe, efficient, reliable, cost-effective, and environmentally responsible working conditions. They also provide facilities management of major systems such as electric power distribution, Central Process, and institutional systems
Isolation Device	A device that physically prevents the release or transmission of potentially harmful energy e.g., a circuit breaker, disconnect switch, a blind (blank) flange, a valve or a physical block preventing motion of a mechanical device.
Isolation Plan	A documented plan, which identifies impacted systems, affected parties and point(s) of isolation. This plan may include a listing of electrical disconnects/breakers or valves along with a draft sequence of operation in order to isolate the system.
Lockout	A procedure whereby one or more lockout device(s) (as defined in the Glenn Safety Manual, Chapter 9 – "Lockout/Tagout") are placed on energy- isolating devices to ensure that neither the energy- isolating device nor the equipment being controlled can be operated until the lockout device is removed.
Lockout Device	A device that provides a means of attachment for a lock, that secures an energy isolation device to ensure protection against operation and/or harmful energy release.
Lockout-Tagout (LOTO) Process	Refers to specific practices and procedures (as found in this chapter) to safeguard employees from the unexpected energization or startup of machinery and equipment, or the release of hazardous energy during construction, servicing or maintenance activities.
Mechanical System(s)	Equipment, piping, and components which supply, convey, distribute, condition, monitor or process any of the following utility supply or return to GRC facilities. This includes: natural gas, domestic water, chilled water, cryogenic/compressed gas, HVAC, steam and condensate, and underground storage tank (UST) systems.
Project Engineer	Discipline-specific project team member
Project Manager	Provides contract management ensuring the proper oversight, and quality assurance for the implementation of construction projects
Requestor	The Requestor for purposes of routing the Area Clearance may be the Authorized Employee (person performing LOTO) or a knowledgeable representative (Inspector, QAE, etc.) for the project or task notifying Affected Employees of the equipment and/or systems being impacted by LOTO.
Safety System(s)	Mechanical system equipment, piping or components and low voltage electrical system components that provide personnel safety or equipment protection within GRC facilities. Including: Fire detection/alarm, fire suppression, PPSS, combustible gas/low oxygen systems.
Sewer System(s)	Equipment, piping, and components which convey, monitor or process sanitary, storm or industrial waste products. Specifically includes lift stations, pumping stations and oil/water separators.

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Glenn Research Center Glenn Safety Manual	Title: Lockout/Tagout	
	Document No.: GLM-QS-1700.1.9	Rev.: Revision F

Schematics and One-line Diagrams	System diagrams which indicate service, voltage, isolation and protective devices on electrical systems and service, flow, pressure(s) and isolation points for mechanical systems.
Switching and Lockout/Tagout Record, GRC-787	Documented procedures developed by the Designated Person, and utilized in the process of isolating hazardous sources of energy. These procedures specify an exact sequence of steps to be taken by Qualified Operators (Switchperson) performing isolation to allow for the safe application of lockout and/or tagout of equipment and/or systems to be worked on. This record can serve as the LOTO plan.
Switchperson/ Qualified Operator	Someone who has received training on (1) the machines, equipment or processes being impacted, (2) the safe procedures and methods used for accomplishing the required isolation and (3) in the proper personal protective equipment required to achieve isolation safely. It is also someone who, in the opinion of their supervisor, has demonstrated through hands on operation and site-specific knowledge the ability to safely perform isolation procedures. Often the list of Qualified Operators accompanies, or is part of, Safety Permit Request forms required for System, Process or Test Facility Operational Safety Permits.
System Manager	The System Manager ensures the system (s) and associated components are operated, maintained, and modified in a safe, effective, and efficient manner to support their intended use at the Center. They provide authoritative and expert information on technical issues, while managing the planning and prioritization of work in the system(s). These individuals are the accepted experts on their particular systems and the isolation of energy sources within these systems shall only occur with their approval, and after they have concurred with the impact upon the system. System Managers are part of the Facilities Division
Tagout	Accomplished by affixing a Danger - Do Not Operate tag on an energy isolating device, in accordance with an established procedure, to indicate that the device shall not be altered until the tag has been removed. (Stock No. 7530-01-LNO-1449).
Utilization Equipment	For the purposes of this document, the equipment beyond the last disconnecting means or last isolation valve in the system.

3. RESPONSIBILITIES

Affected Employee(s)	Affected Employees upon being informed of the reason for the required interruption in service(s) shall work with the Requestor to provide a schedule to allow the necessary interruption of services to occur.
Building Manager	The Building Manager reviews planned system outages and impacts, advises the requester the preferred timing of the outage, communicates the scheduled outages/impacts to all building occupants, and approves area clearance authorizations. The Building Manager can only forward the information provided by the Area Clearance Authorization, Form GRC-978, as to the impact to building personnel, they are not responsible for unanticipated disruptions in service.
Designated Person	The Designated Person shall coordinate LOTO procedures, tracking the positioning (open or closed) of isolation points and documenting the status of the LOTO procedures (isolated, locked/tagged, verified, canceled, back to normal).

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Glenn Research Center Glenn Safety Manual	Title: Lockout/Tagout	
	Document No.: GLM-QS-1700.1.9	Rev.: Revision F

Glenn Network Operations Center (GNOC)	GNOC is responsible for the operation and maintenance of the Glenn Research center data network. This area will review proposed scheduled outage(s) and the impact on the network, advise the requestor on the preferred timing of the outage and communicate the scheduled outage to the Network Operations area personnel.
Facility Manager	This is the individual responsible for the scheduling of projects, test operations, maintenance, improvements, and strategic planning activities of the major research facilities at GRC.
Facility Operation Specialist	This individual works with the QAE in coordinating system operation & maintenance efforts in support of shutdowns/outages, developing system isolation plans, and approving area clearance authorizations.
Project Engineer	Responsible for the design & implementation of construction, rehabilitation, alteration or repairs to equipment and/or systems requiring isolation. The Project Engineer is often times the author of the required Integrated Systems Testing required to accept the equipment and/or systems for readiness for service.
Project Manager	Responsible for the overall project, including technical requirements, customer interface, budget, schedule, design quality, and team/customer coordination. Responsible for project level implementation plans and concurrence with planned system shutdowns/outages through the area clearance process.
Quality Assurance Evaluator (QAE)	This is the individual responsible for coordinating system operation & maintenance activities. The QAE participates in coordination of shutdowns/outages, develops system isolation plans, and approves area clearance authorizations.
Requestor (Area Clearance)	This individual(s), with assistance as required by System Managers and personnel knowledgeable on the systems being impacted, develops task-specific implementation plans, coordinates the review of plans & the notification of Affected Employees. The Requestor shall work with the Affected Employee(s) to provide a schedule to allow the interruption to occur. The Requestor shall apply to the Designated Person to have the particular energy source de-energized/controlled and coordinate this effort with the Authorized Employee, as required. The Requestor shall route the Area Clearance Form, NASA GRC-978, and ensure that necessary work requests (NASA GRC-709) are submitted. If a fire protection system is shut down or impaired for greater than 4 hours a Fire Protection Impairment Authorization Form (NASA Form GRC-316) shall be completed and the Authority Having Jurisdiction (AHJ) contacted for approval.
Research Facility Manager	Serves as the research customer focal point that advises (as required) on the preferred timing of shutdowns/outages and approves area clearance authorizations.
Safety and Health Division (SHeD)	This is the identified owner of the area clearance process and the local outage process. SHeD is responsible for process documentation & maintenance as well as concurrence with planned shutdowns/outages, which fall under the area clearance process.
System Manager	This is the individual responsible for the safety and reliability of the system (high voltage, low voltage, mechanical, architectural/civil/structural, central process, communications, etc.). They assist in the review of task specific implementation plans prior to scheduled outages, provide advice of system impacts, recommend isolation points to safely accomplish system outages, and approve area clearance authorizations. At the Plum Brook Station (PBS) the designated System Engineer assists in the development of the written procedures for LOTO of the equipment and systems under their assigned areas and signs as the System Manager.

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Glenn Research Center Glenn Safety Manual	Title: Lockout/Tagout	
	Document No.: GLM-QS-1700.1.9	Rev.: Revision F

4.0 PROCEDURES

Responsible Person	Block #	Activity
Requestor	4.1	Preparation: Identify task and need for isolation of equipment/systems to be worked on.
Requestor /Project Management Team	4.2	Process: Working with the Project Manager, Project Engineer(s) and Quality Assurance Evaluators a detailed implementation plan is written, if it does not already exist, to determine the exact equipment and/or systems to be impacted.
Requestor /Project Management Team	4.3	Decision: Area Clearance Required? – If an outage or interruption in service is required the Requestor needs to determine the Affected Personnel that will require notification.
Requestor/System Manager	4.4	Process: Requestor working with System Manager(s) to develop the safest way to isolate sources of hazardous energy with the least impact on system configuration.
Requestor, Designated Person and System Manager	4.5	Process: With input from the Authorized Employee on their needs and from the System Manager on system requirements the Designated Person can develop an Isolation Plan (Switching Record).
Requestor	4.6	Decision: Is a Fire Protection System being impaired for more than 4 hours?
Requestor	4.7	Process: If 4.6 above is yes the requestor will be required to route a NASA form GRC-316 for approval
Requestor	4.8	Process: The Requestor generates an Area Clearance with the implementation plan, isolation plan and schematics/one-lines as support data.
All Parties	4.9	Process: As required a System Coordination Meeting is held for all Parties to review and concur with the task, the need for service interruption and when this is to occur.
Requestor	4.10	Decision: Requestor to determine the need to schedule the Support Service Contractor to assist or provide the required isolation.
Requestor	4.11	Process: Submit the Work Request (NASA GRC-709) to schedule work or call (216) 433-4948 (FIX IT).

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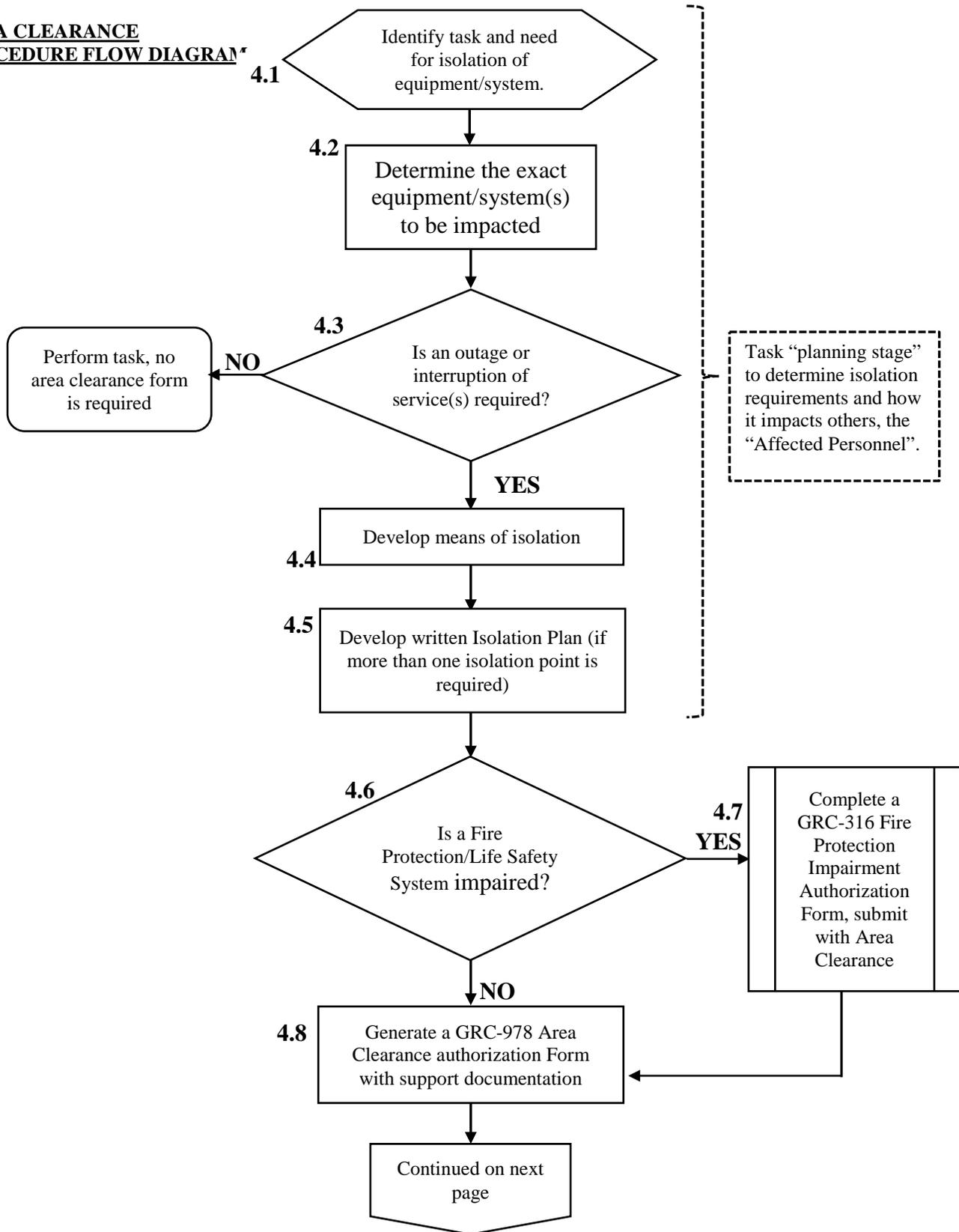
Glenn Research Center Glenn Safety Manual	Title: Lockout/Tagout	
	Document No.: GLM-QS-1700.1.9	Rev.: Revision F

Requestor	4.12	Process: Route the Area Clearance for Approval Signatures The requestor initiates this process a minimum of 10 working days prior to the planned isolation/outage.
Requestor	4.13	Decision: Determine if there have been any changes to the schedule or required outages, if yes, reschedule and reroute clearance form. If no changes are required, continue process.
Requestor	4.14	Process: Make required changes to schedules or plans, update the area clearance form and reroute for signatures.
Requestor	4.15	Process: Distribute copies of the signed area clearance form to the Approvers
Requestor	4.16	Process: Submit request for scheduled outage
Requestor	4.17	Process: Requestor to provide electronic notification to all parties when work is complete and services are restored to normal operating conditions.

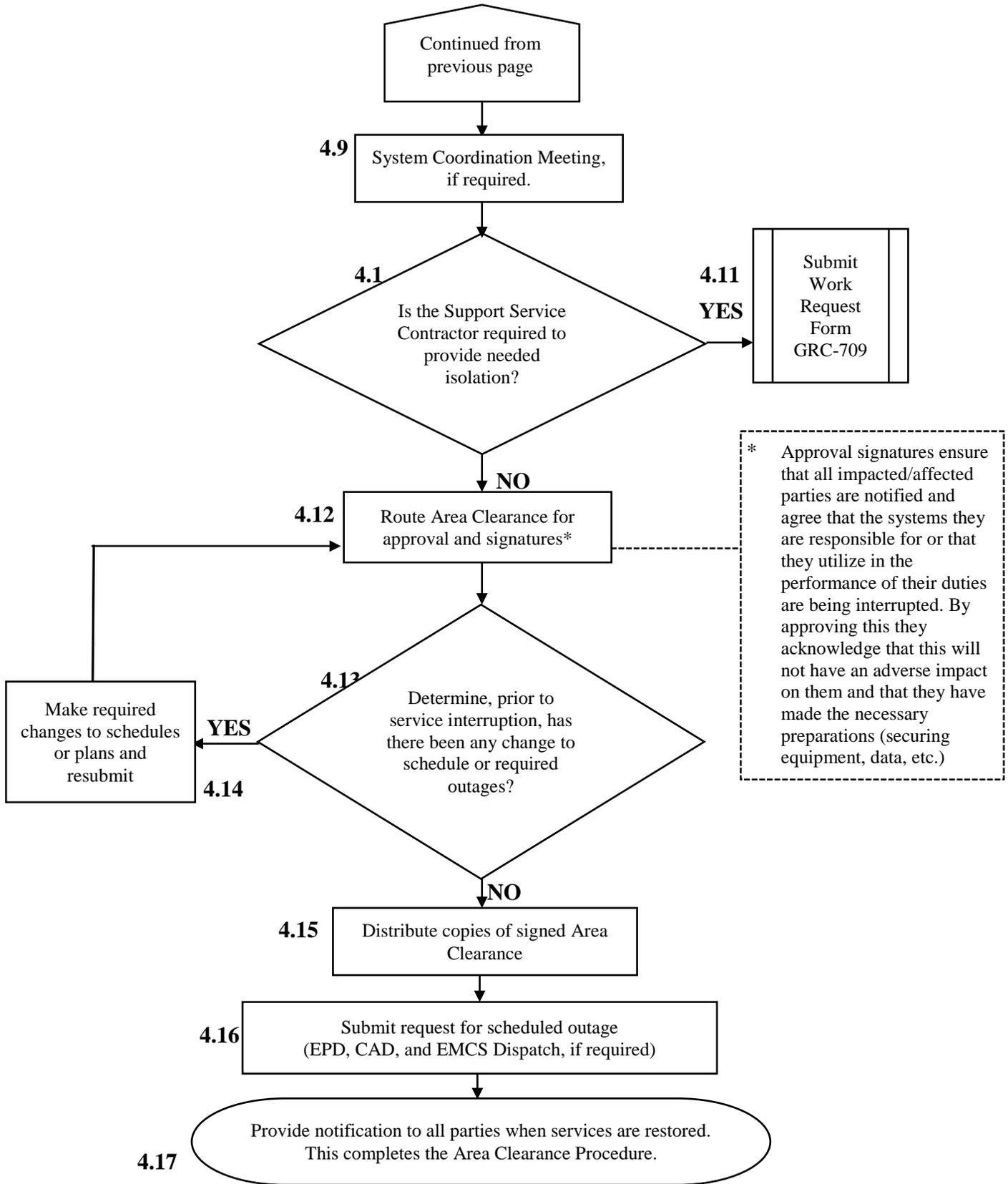
SEE AREA CLEARANCE PROCEDURE FLOW DIAGRAM ON THE FOLLOWING PAGES

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**AREA CLEARANCE
PROCEDURE FLOW DIAGRAM***



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Glenn Research Center Glenn Safety Manual	Title: Lockout/Tagout	
	Document No.: GLM-QS-1700.1.9	Rev.: Revision F

REFERENCES

Applicable Documents

Document Number	Document Title
GLM-QS-1700.1	Glenn Safety Manual, Chapter 7 - Process Systems Safety
GLM-QS-1700.1	Glenn Safety Manual, Chapter 8 - Electrical Systems Safety
GLM-QS-1700.1	Glenn Safety Manual, Chapter 17 - Construction Safety

Records

NASA Form GRC-978 – Area Clearance Authorization

NASA Form GRC-787 – Glenn Research Center Switching and Lockout/Tagout Record

NASA Form GRC-709 – Work Request

NASA Form GRC-316 – Fire Protection Impairment Authorization Form

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