Subject: Langley Research Center Energy Control Program (Lockout/Tagout)

Responsible Office: Safety and Mission Assurance Office

CONTENTS

PREFACE

P.1 PURPOSE

a. This Langley Research Center (LaRC) Procedural Requirements (LPR) establishes a Lockout/Tagout (LOTO) program for controlling hazardous energy sources where the start up or release of stored energy could cause injury to employees or damage to equipment. This LPR is a part of the LaRC safety program and is intended to assist supervisors and employees with their individual responsibilities for safety.

P.2 APPLICABILITY

a. This program is applicable to all persons including all contractors at LaRC performing maintenance, repair, or servicing activities, as covered in the Occupational Safety and Health Administration (OSHA) Standards.

b. The requirements of this LPR apply to workplace activities such as constructing, installing, setting up, adjusting, inspecting, modifying, maintaining, and/or servicing machines or equipment. These activities include but are not limited to lubrication, cleaning or unjamming of machines or equipment, and making adjustments or tool changes, where the employee may be exposed to the energization or startup of the equipment or release of hazardous energy.

c. Noncompliance with the requirements of this LPR may result in appropriate disciplinary action against civil service employees or sanctions against contractors in accordance with the terms of their contracts.

d. In this directive, 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/is" denotes descriptive material.

e. In this directive, all document citations are assumed to be the latest version unless otherwise noted.

P.3 AUTHORITY

a. Occupational Safety and Health Standards, 29 CFR pt. 1910.

b. Safety and Health Regulations for Construction, 29 CFR pt. 1926.

c. NPR 8715.1, NASA Safety and Health Programs.

P.4 APPLICABLE DOCUMENTS

a. Occupational Safety and Health Standards, 29 CFR pt. 1910.

b. Safety and Health Regulations for Construction, 29 CFR pt. 1926.

c. LPR 1710.6, Electrical Safety.

d. LPR 1710.40, Langley Research Center Pressure Systems Handbook

e. LPR 1740.6, Personal Safety Certification.

f. LPR 1740.2, Facility Safety Requirements.

g. LPR 3752.1, Discipline and Adverse Actions.

h. LMS-CP-7151, Obtaining Waivers for Langley Management System (LMS) Requirements.

i. LF 287, Lockout/Tagout (LOTO) Station Review.

j. LF 383, Red Tag Lockout Tag.

k. LF 403, Craft Specific Authorization Card (blue).

l. LF 416, LaRC Energized Electrical Work Permit.

m. LF 425, Shop Machine Authorization Card (yellow).

n. LF 451, Safety Operator Appointment Form.

o. LF 453, NASA Langley Safety Operators Permit.

p. LF 493, Lockout/Tagout Release (Without Red Tag Stub or Removal of Personal Lock by Facility Coordinator).

q. LF 495, Energy Control Procedure.

r. LF 496, Lockout/Tagout Records.

s. LF 519, Safety Operator Field Verifier Appointment Form.

t. LF 566, Lockout/Tagout “Hands-On Proficiency” Certification.

u. LF 567, Field Verifier Checklist.

v. LF 571, Shop Machine Safety Operator Appointment Form.

w. LF 572, LaRC Safety Assessment for Mechanical Lockout/Tagout.

x. LF 610, Lockout/Tagout (LOTO) Lock Box Log

y. NFPA Standard for Electrical Safety in the Workplace

P.5 MEASUREMENT/VERIFICATION

None

P.6 CANCELLATION

LPR 1710.10L, dated November 14, 2016

Trina M. Dyal *9/27/24*

Deputy Director Date

Distribution: Limited to NASA Langley Research Center Employees, Civil servants, and Contractors.

CHAPTER 1: INTRODUCTION

1.1 SCOPE

This Langley Procedural Requirement (LPR) establishes the energy control program for protecting all employees who perform **servicing or maintenance** on machines, equipment, or vehicles. This program requires that machinery or equipment be stopped, isolated from all hazardous energy sources, and properly locked out/tagged out (LOTO) so work may be safely performed.

Note: Words in bold are defined in Appendix A.

1.2 APPLICATION

1.2.1 This program shall apply to all employees working at LaRC, including contractors and subcontractors, who may be exposed to hazardous energy during servicing or maintenance work. The requirements established by this energy control program (hereby known as the LOTO Program) shall apply to the servicing and maintenance of machines, equipment, and vehicles when any of the following are true:

a. An employee is exposed to the energization or startup of the machine, equipment, or vehicle.

b. An employee is exposed to the potential of a release of stored energy (e.g., capacitor, spring).

c. An employee is required to remove or bypass a guard or other safety device.

d. An employee is required to place any part of his or her body into an area on a machine, piece of equipment, or vehicle where work is actually performed upon the material being processed or where an associated danger zone exists during a machine operating cycle.

1.2.2 These requirements shall NOT apply to:

a. An “administrative” control. See LPR 1740.2 for **administrative lock** requirements.

b. Minor tool changes, adjustments, and other minor servicing activities that take place during **normal production operations**.

c. Outside, commercial utility providers supplying LaRC with electricity, natural gas, or other utilities under their exclusive control, who may follow their own LOTO program.

d. Work on “cord and plug connected” electrical equipment where unplugging the cord will completely de-energize and deactivate the machine or equipment. The plug shall remain within arm’s reach and sight of the employee during servicing and maintenance activity at all times.

(1) If the employee completing the service and maintenance has to leave the area for any reason without completing the work, then a LOTO shall be initiated per Section 3 of this LPR.

e. **Energized** electrical work where de-energizing equipment introduces additional or increased hazards or is infeasible due to equipment design or operational

limitations. This exception shall require issuance of an LF 416 in accordance with LPR 1710.6.

f. New construction activities with special approval. In special circumstances, the Safety and Facility Assurance Branch (SFAB), in collaboration with the Standard Practice Engineer as appropriate, may allow the use of a contractor's LOTO program in lieu of LPR 1710.10. This special approval is intended for construction activities under contractors' control before delivery to the Government. Approval from the LaRC Safety Manager will be granted on a case-by-case basis if the contractor's LOTO program meets the minimum LOTO requirements of 29 CFR 1910.147 and 29 CFR 1926.417. In addition, contractors shall also provide the following:

(1) A request submitted to SFAB through the Contracting Officer no later than 30 days prior to commencement of work.

(2) A well-defined point of demarcation between existing LaRC facilities and the new facility under construction.

(3) A list of personnel qualified to understand and control the energy at the new facility during the construction project.

(4) A well-defined plan to communicate the approved program to the rest of the contractors on site.

g. Service contractors or subcontractors. It is always preferable to use LPR 1710.10, but in special circumstances, the prime contractor may request an exemption to these requirements. The LaRC Safety Manager may approve the plan and shall coordinate with **Facility Safety Heads** (FSHs) and **Facility Coordinators** (FCs) as appropriate for the work being performed. The prime contractor shall submit a plan which includes:

(1) Location of the work (e.g., particular building or center-wide).

(2) Length of the exemption.

(3) A LOTO program that:

(a) Meets, at a minimum, 29 CFR 1910.147 requirements.

(b) Meets all the exception elements in Section 3.2.2.1 of this LPR.

(c) Includes a well-defined plan to communicate the approved program to all **affected employees**.

(d) Lists personnel authorized to perform LOTO.

(4) The request shall be submitted to SFAB through the Contracting Officer no later than 30 days prior to the commencement of work.

1.3 WAIVERS

Request for waivers to any of the requirements in this LPR shall be submitted to the LaRC Safety Manager in writing and processed in accordance with LMS-CP-7151, "Obtaining Waivers for Langley Management System (LMS) Requirements."

CHAPTER 2: GENERAL POLICY

2.1 AUTHORITY

It is LaRC policy to comply with 29 CFR 1910.147 by setting requirements to prevent an undesirable release of hazardous energy during any servicing, maintenance, or modification activity. Therefore, all **protected employees** performing **servicing or maintenance** activities shall maintain exclusive control of the **Lockout**/Tagout (LOTO) that is protecting them.

2.2 SCOPE

These requirements shall be strictly followed when it is necessary to work on any equipment that may release any form of hazardous energy including, but not limited to, electrical, rotational, mechanical, chemical, hydraulic, laser, steam, or pneumatic energy while the equipment is shut down. This chapter delineates the responsibilities, training, and methods of LaRC's LOTO Program.

2.3 AUTHORIZED EMPLOYEES

2.3.1 At LaRC, only authorized employees are allowed to perform LOTO. These authorized employees are called **Safety Operators** (SO). SOs are designated according to their functions and include:

a. Electrical Safety Operator over 600 volts

b. Electrical Safety Operator 600 volts or less

c. Mechanical Safety Operator

d. Mechanical Safety Operator with electrical 600 volts or less

e. Craft Specific Safety Operator (CSSO)

f. Shop Machine Safety Operator (SMSO)

2.4 OTHER KEY PERSONNEL

2.4.1 Other key personnel associated with the control of hazardous energy at LaRC include:

a. Responsible employee (RE)

b. Protected employee (PE)

c. Affected employees

d. Facility Coordinator (FC)

e. Facility Safety Head (FSH)

2.5 RESPONSIBILITIES

2.5.1 Safety and Facility Assurance Branch shall:

a. Develop and manage the LOTO Program.

b. Conduct periodic facility program reviews to ensure facilities are following the requirements of this LPR.

c. Procure and/or approve purchases of all LOTO hardware.

d. Provide LOTO training relating to this LPR.

(1) Ensure that LOTO-specific training is included in the mandatory annual FSH/FC training.

e. Investigate any violations of this LPR and recommend corrective actions as appropriate.

f. Ensure all new equipment installed or major repairs, renovations, or modifications conducted after January 2, 1990 are **capable of being locked out**. See 29 CFR 1910.147.

g. Issue SO, CSSO, and SMSO certification cards and administer the required tests.

2.5.2 Supervisors shall:

a. Ensure the proper LOTO procedures are followed in their areas of control per this LPR.

b. Initiate requests for SO, CSSO, SMSO, and Field Verifier (FV) appointments using the proper Langley Forms. See LF 451, LF 519, LF 566, LF 567, and LF 571.

c. Ensure that each SO candidate meets the qualification prerequisites of LPR 1740.6 and has received appropriate on-the-job training that is appropriate for the expected SO duties.

d. Ensure employees with LOTO responsibilities attend the training delineated in LPR 1740.6 as related to the LOTO Program.

e. Participate in investigations of possible violations of this LPR and implement corrective actions as appropriate.

f. Assist with SFAB's periodic inspections of the LOTO Program in their facilities.

2.5.3 Field Verifiers shall:

a. Verify, using LF 567, that the candidate seeking authorization as an SO has a working knowledge of the system(s), including **energy sources,** hazards, and the controls required for effective LOTO, as necessary for the expected SO duties.

b. Ensure SOs understands that:

(1) Their safety and the safety of the PEs depend on their ability to LOTO a system safely; and

(2) They have the authority and responsibility to refuse to LOTO a system if they feel they are not qualified to do so or if for any reason they think their safety or the PEs' safety will be compromised.

c. Attend mandatory annual SO training.

d. Re-apply for certification every four years per LPR 1740.6.

2.5.4 **Facility Coordinators** (FCs) shall:

a. Maintain and control requisitioned hardware, locks, and identification tags and designate an area where employees have access to lockboxes and LOTO documentation during a LOTO.

b. Maintain the LOTO documentation during and after a LOTO has occurred.

(1) Review all LF 495s, “Energy Control Procedures,” to determine whether they should be disposed, archived, or maintained.

(a) Dispose or archive expired or completed LF 495s.

i If LF 495s older than one year are kept for future reference, then the LF 495s shall be placed in a location (e.g., behind a tab in a binder or in a drawer) that is labeled something to the effect of "For Reference Only" or "Archived LF 495s."

(b) Sign, date, and maintain the LF 495 for **active LOTO**s older than one year, thus indicating that the LOTO is still in place.

i Signature and date shall be placed below the original FC signature in the “Concurrence” section of the LF 495.

c. Ensure that LF 495s are prepared, approved by the SO, and verified by a knowledgeable employee.

(1) Understand the equipment in their facilities and how LOTOs may affect other occupants so that they may communicate warnings as appropriate.

(2) Sign after concurring that the location identified in the LF 495 is the location of the planned maintenance/repair work and, if appropriate, that the equipment/system under a LOTO has been shut down (using the **Standard Operating Procedure** (SOP)), and that it is safe for the Safety Operator to execute this LOTO energy control procedure.

d. Ensure that an LF 496, “Lockout/Tagout Records,” is used by the facility as an ongoing log to indicate active and historical lockout conditions in the facility.

(1) Entries recorded in the log shall be kept for a minimum of one year or until all records have been closed, whichever is longer.

e. Issue personal locks to the **Responsible Employee** (RE) and instruct them on the **group LOTO** list/log, LF 610 “Lockout/Tagout (LOTO) Lock Box Log”.

(1) The LF 610 will be completed for every LOTO event's lock box.

(2) Once the LOTO job is complete, the facility will maintain the log for at least one year in their LOTO binder.

f. Be responsible for communicating essential information about the LOTO with all **affected employees** in the area and those employees involved with the LOTO.

g. Assist with the SFAB periodic inspection of the LOTO Program as applicable to the

facility.

h. Correct noncompliant findings identified during the SFAB periodic inspections.

i. Conduct an annual inspection of the LOTO Program as applicable to the facility using LF 287, “Lockout/Tagout (LOTO) Station Review.”

j. Maintain completed LF 287s in the facility’s Lockout/Tagout binder for a minimum of three years.

k. Contact the FSH to initiate an LF 572, “LaRC Safety Assessment for Mechanical Lockout/Tagout,” if a **double block and bleed** is unable to be accomplished or a kirk key is used during an LOTO energy control procedure. See Section 3.2.2 for energy control procedure requirements.

l. Send LF 493s to the LaRC Safety Manager upon completion.

m. File the LF 493s in their LOTO binder for a minimum of three years.

n. Attend the mandatory annual FSH/FC training.

2.5.5 Integrated Operations Center (IOC) (LaRC Duty Officer) shall:

a. Have the authority to apply an **administrative lock** to safe the system/equipment in an emergency until an SO is ready to apply a LOTO.

b. Notify the appropriate FC of any lock placed in his or her facility after normal duty hours.

c. Attend annual LOTO training.

2.5.6 **Facility Safety Heads** (FSHs) shall:

a. Become familiar with this LPR and how it affects their organization/facility.

b. Maintain a current list of facility SOs in the Facility Resume.

c. Contact a Safety Engineer to initiate an LF 572 when an alternate to **double block and bleed** or inclusion of a **Kirk Key interlock system** is needed.

d. Attend the mandatory annual FSH/FC training.

2.5.7 Safety Operators (SOs) shall:

a. Possess a current LF 453, “NASA Langley Safety Operators Permit,” and have it on hand or readily accessible while performing lockouts.

b. Determine the hazards, **energy sources**, and energy isolation devices (such as valves or switches) that must be secured to safe a system or equipment.

c. Approve LF 495s relating to the locking and tagging of equipment or systems they are authorized to lock out.

d. Document pertinent information on LF 383, “Red Tag Lockout Tag,” and LF 496.

e. Disqualify themselves from performing LOTO if they feel they lack the knowledge or experience to safely lock out a system.

f. Communicate with everyone involved with the LOTO about hazards, controls, or any other safety concerns that may affect them.

g. Demonstrate verification of absence of energy to the RE.

h. Demonstrate verification of absence of energy to the PE(s) upon request.

i. Attend mandatory annual SO training.

j. Renew certification every four years per LPR 1740.6.

2.5.8 Responsible Employees (REs) shall:

a. Assume overall responsibility for a LOTO.

b. Communicate with SOs and FCs to ensure that RE roles and responsibilities for this LOTO are understood.

c. Have complete knowledge of the LF 495 being implemented.

d. Obtain personal locks from the FC or designee to assign to PEs.

e. Maintain the LF 610 for all PEs that have assumed responsibility.

2.5.9 Protected Employees (PEs) shall:

a. Obtain a personal lock from the RE.

b. Ensure the system is **de-energized** before starting work by verifying the absence of energy.

(1) Have the right to request the SO and/or RE verify the absence of energy to the PE's satisfaction.

c. Ensure that their personal lock is in place on the lockbox before commencing work.

d. Sign in and out of the LF 610 maintained by the RE.

2.5.10 Craft Specific Safety Operators (CSSOs) shall:

a. Possess a current CSSO certification card, LF 403.

b. Ensure that no other employee works under their CSSO certification tags.

c. Attend mandatory annual SO training.

d. Renew certification every four years per LPR 1740.6.

2.5.11 Shop Machine Safety Operators (SMSOs) shall:

a. Possess a current SMSO certification card, LF 425.

b. Ensure that no other employee works under their SMSO certification tags.

c. Attend mandatory annual SMSO training.

d. Renew certification every four years per LPR 1740.6.

2.6 **TRAINING**

2.6.1 All prerequisites to qualify as a FV, SO, CSSO, and SMSO are specified in LPR 1740.6.

2.6.2 Responsible, protected, and affected employees shall receive on-the-spot job-specific awareness training from the FC or SO.

2.6.3 All LaRC employees and contractors shall receive the appropriate training and retraining on LPR 1710.10.

2.6.4 All construction personnel shall attend the LaRC Construction Safety Briefing, conducted Monday, Wednesday and Friday at 7:30 a.m. at the Badge and Pass Office conference room, prior to beginning work at LaRC. The briefing is valid for one year from the date taken.

2.7 HARDWARE

2.7.1 The SFAB shall provide locks, tags, and other hardware needed for isolating, securing, or blocking machines or equipment from energy sources.

2.7.2 LOTO devices shall:

a. Be singularly identified (i.e., red locks and hardware),

b. Be the only device(s) used for controlling energy, and

c. NOT be used for other purposes.

2.7.3 LOTO devices shall not be modified without approval from the LaRC Safety Manager.

2.7.4 At LaRC, all LOTO devices shall be red in color and shall comply with OSHA 29 CFR 1910.147(c)(5).

2.8 SAFING OF PRESSURE SYSTEMS

2.8.1 The preferred method of safing a pressure system at LaRC is to implement a **double block and bleed.**

2.8.2 A double block (closed) and bleed (open) is often used to ensure positive isolation of a pressure system (e.g., liquid, gas, hazardous materials) from other equipment. The double block and bleed consists of two closed valves (blocks) in series with an intervening open valve used to vent (bleed) pressure away from the work area. With this configuration there will be no pressure accumulation between the two isolation (closed) valves because leaking or trapped material will flow to “a safe place” through the open valve. See figure 1.

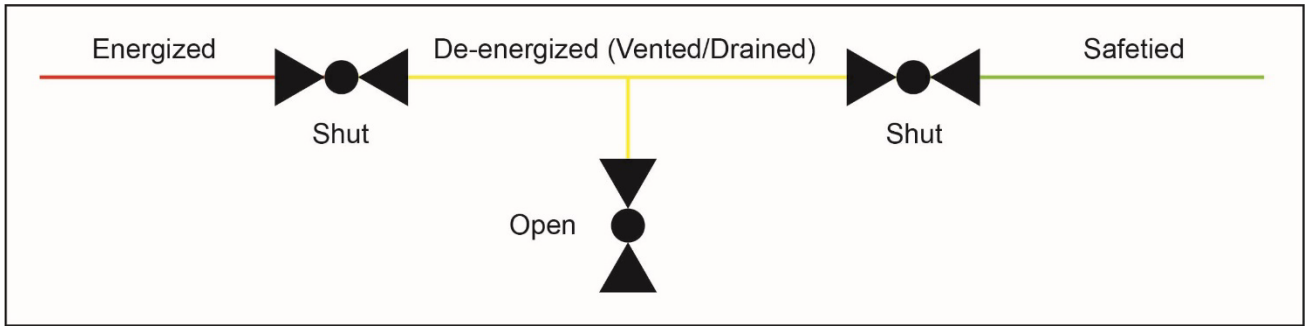

Figure 1. Example of double block and bleed

2.8.3 In the event that this method cannot be accomplished (e.g., single block), an LF 572 shall be initiated by the FSH.

2.8.3.1 See figure 2 for an example of a single block that would require an LF 572. This configuration is considered a single block and bleed due to the potential of pressure buildup behind the isolation valve immediately adjacent to the work area.

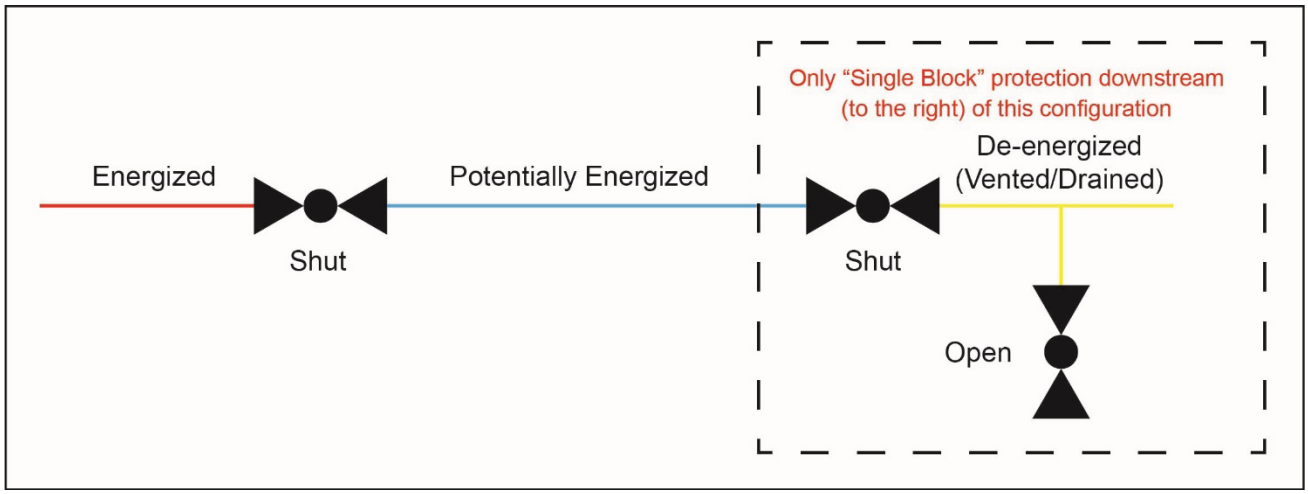

Figure 2. Example of single block

2.8.4 Upon completion and approval, the LF 572 shall be attached to the LF 495 before proceeding with the LOTO.

NOTE: The LF 572 expires when the LOTO packet (LF 495 and all its attachments) expires.

2.8.5 A pressure system shall be exempt from requiring an LF572, if it meets ALL of the following requirements:

a. The pressure system is an excluded system listed in Appendix D,

b. The pressure system is not in a confined space, and

c. The maintenance required does not disturb the **isolation device**.

NOTE 1: SFAB or FC may require the safing of a pressure system to comply with the requirements in sections 2.8 even if the pressure system meets all of the requirements in section 2.8.5, if it is deemed necessary to ensure the safety of personnel and property.

NOTE 2: Systems listed in Appendix D shall continue to perform LOTO in accordance with this LPR.

2.9 ENERGY-ISOLATING DEVICE(S) NOT CAPABLE OF BEING LOCKED

2.9.1 If an energy-isolating device is **not capable of being locked**, it shall be the responsibility of the SO, FC, and FSH, with the approval of the LaRC Safety Manager or his/her designee, to implement alternative procedures and controls that meet the requirements of 29 CFR 1910.147(c)(2), (c)(7)(ii), and (d)(4).

2.9.2 If an energy isolating device is not **capable of being locked** out directly but may be

locked by indirect means and rendered inoperable, it shall be documented by an approved LF572.

Example 1: Pneumatically actuated isolation valves that may be rendered inoperable by isolating and locking out service air from the actuator.

Example 2: Electrically operated circuit breakers or disconnect switches may be locked out indirectly by isolating and locking out the control power to the disconnect switch actuator or circuit breaker close coil.

NOTE: The LF 572 expires when the LOTO packet expires.

2.10 **SAFING OF KIRK KEY SYSTEMS**

The Kirk Key system may be used in conjunction with LaRC's LOTO Program, but by itself does not meet the requirement for personal LOTO per 29 CFR 1910.333. In the event that the LOTO cannot be accomplished without using a portion of the Kirk Key system, an LF 572 shall be initiated by the FSH. Upon completion and approval, the LF 572 shall be attached to the LF 495 before proceeding with the LOTO.

NOTE: The LF 572 expires when the LOTO packet expires.

CHAPTER 3: GENERAL LOCKOUT/TAGOUT PROCEDURES

3.1 INTRODUCTION

3.1.1 It is NASA LaRC policy that when **servicing and/or maintenance** is performed by a single employee, crew, craft, branch, or other group, a procedure (e.g., **Standard Operating Procedures**, LF 495, Job Hazard Analysis) shall identify the level and methods to protect those performing the work.

3.1.2 It is imperative that each employee protected by a LOTO procedure understands the type and magnitude of the energy, the hazards of the energy to be controlled, and the procedure to be used to control the hazardous energy.

3.1.3 The three LOTO methods approved for use at LaRC are Red Lock/Red Tag, Craft Specific, and Shop Machine.

3.2 RED LOCK/RED TAG (RL/RT) LOCKOUT PROCEDURE

3.2.1 APPLICABILITY

3.2.1.1 This method shall require using the LF 383 (red identification tag), affixed with a red lock. See Figure 3.

3.2.1.2 The RL/RT method shall be acceptable for locking out any machine, equipment, or system. It can be used for all LOTO methods that include multiple shifts, group LOTO, multiple **energy sources**, Craft Specific, Shop Machine, or when exception elements to an LF 495 are met.

3.2.1.3 The LOTO shall be performed by an authorized **Safety Operator** (SO).

Figure 3. Example of Red Lock/Red Tag (RL/RT) Method

3.2.2 ENERGY CONTROL PROCEDURE

3.2.2.1 In accordance with OSHA 29 CFR 1910.147(c)(4)(i), the RL/RT method shall require that a written procedure for each LOTO event be documented on an LF 495, unless all of the following exception elements are met:

Note: FCs have the authority to require an LF 495 for the servicing or maintenance of machinery or equipment even if the exception elements are met.

a. The machine or equipment operates at a potential of 600 volts or less.

Note: This is a Langley-specific requirement.

b. The machine or equipment has no potential for stored or residual energy or re-accumulation of stored energy after shut down that could endanger employees.

c. The machine or equipment has a single **energy source** that can be readily identified and isolated.

d. The isolation and locking out of that energy source will completely de-energize and deactivate the machine or equipment.

e. The machine or equipment is isolated from that energy source and locked out during servicing or maintenance.

f. A single LOTO device will achieve a locked-out condition.

g. The LOTO device is under the exclusive control of the authorized employee performing the servicing or maintenance.

h. The servicing or maintenance creates no hazards for other employees.

i. LaRC, in using this exception, has had no incidents involving the activation or re-energization of the machine or equipment during servicing or maintenance.

Note: If an incident occurred while using these exception elements on a type of machine or equipment, then an LF 495 shall be created for the servicing and maintenance of that machine or equipment. SFAB shall review these procedures periodically to determine if the LF 495 requirement can be lifted.

3.2.3 COMMUNICATIONS

3.2.3.1 The SO, RE, and FC shall coordinate and discuss the servicing or maintenance of the machine or equipment.

3.2.3.2 The SO, or FC shall notify the **affected employees** that a LOTO is in progress.

3.2.4 CONTROLLING THE ENERGY

3.2.4.1 The SO (at the direction of the FC) or the FC shall enter the required information in an LF 496.

3.2.4.2 The SO shall implement the LOTO of hazardous **energy sources** and ensure that all the steps taken have isolated the machine or equipment from the hazardous **energy sources**.

3.2.4.3 The SO shall install energy **isolation device**s, locks, and red identification tags. See Appendix C for instructions on filling out LF 383s.

3.2.4.4 The SO shall maintain possession of red identification tag stubs with keys until the verification step is complete.

3.2.5 VERIFICATION

3.2.5.1 The SO shall verify that isolation and de-energization of the machine or equipment have been accomplished.

3.2.5.2 Depending upon the measures necessary to detect the presence of hazardous energy, the verification of isolation may involve the use of a test instrument (e.g., combustible gas indicator or electrical meter), a visual inspection (e.g., physical blocks or chocks), and/or a deliberate attempt to start machines or equipment.

3.2.5.2.1 Depressurization of systems shall always be verified by the opening of vent valves or by other positive means in accordance with LPR 1710.40.

3.2.5.2.2 Pressure gauges and pressure transmitters shall not be relied upon as the single means to verify a system is de-energized in accordance with LPR 1710.40.

3.2.6 TRANSFER CONTROL OF THE LOCKOUT/TAGOUT

3.2.6.1 The SO shall give the red identification tag stub(s) with the key(s) to the RE.

3.2.6.2 The SO shall provide the RE with training on the following elements:

a. The scope of the LOTO, which includes a review of the planned work to determine if the LOTO is adequate for the work being performed.

b. The controls in place, which includes a review of the boundaries of the **safetied** systems:

(1) LF 495 with associated drawings, highlighted switching diagrams, one-line diagrams, etc.

(2) Locations of any roped-off sections.

(3) Areas that have and have not been safetied.

c. Any other safety concerns associated with the LOTO.

d. Verification of absence of energy to include how the verification was accomplished.

Note: The RE may ask the SO to demonstrate how verification was completed.

e. Requirements for removing the LOTO. See Section 3.2.9.

f. Locking the red identification tag stub(s) with the key in a lockbox with the RE's personal lock and logging in/out of the LF 610.

g. The need for the RE to have the PEs log in/out of the LF 610.

3.2.7 TRAINING TO PROTECTED EMPLOYEES

3.2.7.1 The RE shall provide a training briefing to PEs prior to commencing work.

The briefing shall include, at a minimum:

a. The RE's contact information.

b. Information about the **energy source**(s) and associated hazards, the controls, the location of the controls, and the person who locked out the isolation control device.

c. Clarification of any questions about the LF 495.

d. Discuss verification of absence of energy to include how the verification was accomplished.

Note: The PE may ask the RE to have the SO demonstrate how verification was completed.

e. Discuss requirement for each PE to place a lock on the lockbox and log in/out of the LF 610.

3.2.8 EXCLUSIVE CONTROL OF LOTO

3.2.8.1 The RE shall lock the red identification tag stub(s) with the key in a lockbox with his/her personal lock and log into the LF 610.

3.2.8.2 The PE shall place and lock their personal lock on the lockbox and log into the LF 610.

Note: No one is allowed to place a lock on the box for another PE.

3.2.9 REMOVING THE LOTO

3.2.9.1 PEs shall notify the RE when they have finished the task and no longer require protection.

3.2.9.2 PEs shall remove their personal lock from the lockbox, return the lock to the RE, and log out of the LF 610.

3.2.9.3 The RE and the FC shall inspect the work area to verify that system components have been reassembled after PEs complete their tasks.

3.2.9.4 The RE personal lock shall be the last lock removed from the lockbox once the job is complete.

3.2.9.4.1 The RE shall notify the FC or their designee to initiate an LF 493 if a personal lock is left on the lockbox and the employee who placed the lock is unknown, unavailable or cannot be found.

Note: This applies anytime a personal lock is removed from a lockbox by someone other than the employee who applied that lock.

3.2.9.5 The RE shall take the red identification tag stub(s) from the lockbox and return them to the FC or SO.

3.2.9.6 The SO shall notify the FC that the LOTO is going to be lifted.

3.2.9.7 To lift the LOTO, the SO shall reunite the red identification tag stub(s) with the corresponding red identification tag(s) on the energy **isolation device**.

3.2.9.8 The SO shall remove the LOTO.

3.2.9.8.1 The SO shall notify the FC or the FC's designee to initiate an LF 493 if a red identification tag stub and/or key is not available for the SO's verification.

3.2.9.9 The SO or the FC shall document the LOTO release in LF 496.

3.2.9.9.1 The SO or FC shall notify affected employees that the LOTO has been completed.

3.2.10 TEMPORARY REMOVAL OF A LOCKOUT DEVICE

3.2.10.1 There are circumstances when it is necessary to re-energize a portion of the machinery or equipment to accomplish a particular task (e.g., diagnostic testing, maintenance troubleshooting, vehicle or component repositioning). OSHA allows energization for testing or repositioning purposes, as specified in 29 CFR 1910.147(f)(1), only for the limited time during which it is necessary to test or reposition the portion of the machinery or equipment, but shall not exceed the current work shift.

3.2.10.2 In situations that require removal of the LOTO device from the isolating device for testing or repositioning, the following actions shall be taken:

a. The SO, FC, and RE shall discuss the new designated boundaries, limitations, hazards, and any special requirements necessary to ensure safe testing/repositioning of the re-energized system.

b. The SO shall ensure the RE and PE(s) have a clear understanding of the new designated boundaries.

c. The procedure for **temporary** removal and reapplication shall be documented and approved by all parties (i.e., SO, FC, and RE) on the LF 495.

3.2.10.3 While the red locks and red identification tags have been temporarily removed from the system:

a. The RE shall remain present during the temporary removal to ensure that only the PE(s) needed for the testing/repositioning are doing the work and that all other PE(s) associated with the job have been removed from the area to minimize exposure.

b. The SO shall remain accessible to address any concerns related to the LOTO and immediately reapply or clear the LOTO as needed.

c. Under no circumstances shall the area be left unattended while the RL/RT is removed.

d. The SO shall maintain control of the RL/RT keys and stubs until the testing/repositioning is complete and the system is returned to its original safe state.

3.2.11 MULTIPLE SHIFT LOTOS

3.2.11.1 Personal locks may be left on the lockbox across shifts with agreement from the RE. PE shall verify that their lock is still on the lockbox prior to starting work on subsequent shifts.

3.2.11.2 The RE for the out-going shift shall communicate with the oncoming shift to verify the current LOTO condition.

3.2.11.3 The RE shall ensure that the PE(s) from the oncoming shift have received PE instruction/training in accordance with Section 3.2.7.

3.3 CRAFT SPECIFIC SAFETY OPERATOR LOCKOUT PROCEDURE

3.3.1 APPLICABILITY

3.3.1.1 The Craft Specific (CS) lockout procedure requires using the “danger” tag with the blue identification card, LF 403, affixed with a red lock. See Figure 4.

3.3.1.2 The CSSO shall ensure that no other personnel works under his/her LF 403.

3.3.1.3 The CS LOTO shall be performed by an authorized CSSO.

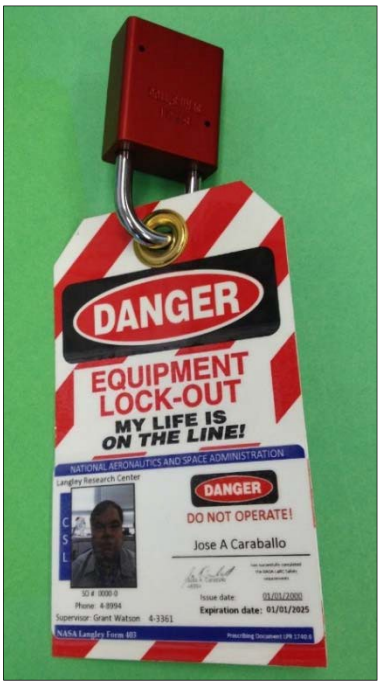

Figure 4. Example of Craft Specific Method

3.3.1.4 A CSSO LOTO can be used only if all of the following exception elements exist, per OSHA 29 CFR 1910.147(c)(4)(i):

a. The machine or equipment operates at a potential of 600 volts or less.

Note: This is a Langley-specific requirement.

b. The machine or equipment has no potential for stored or residual energy or re-accumulation of stored energy after shutdown that could endanger employees.

c. The machine or equipment has a single energy source, which can be readily identified and isolated.

d. The isolation and locking out of that energy source will completely de-energize and deactivate the machine or equipment.

e. The machine or equipment is isolated from that energy source and locked out during servicing or maintenance.

f. A single LOTO device will achieve a locked-out condition.

g. The LOTO device is under the exclusive control of the authorized employee performing the servicing or maintenance.

h. The servicing or maintenance creates no hazards for other employees.

i. LaRC, in utilizing this exception, has had no incidents involving the activation or re-energization of the machine or equipment during servicing or maintenance.

Note: If an incident occurred while using these exception elements on a type of machine or equipment, then an LF 495 shall be created for the servicing and maintenance of that machine or equipment. SFAB can review these procedures periodically to determine if the LF 495 requirement can be lifted.

3.3.2 COMMUNICATION

3.3.2.1 The CSSO and FC shall coordinate and discuss the servicing or maintenance of the machine or equipment.

3.3.2.2 The CSSO or the FC shall notify the affected employees that a LOTO is in progress.

3.3.3 CONTROLLING THE ENERGY

3.3.3.1 The CSSO shall implement the LOTO of hazardous **energy source** and ensure that all the steps taken have isolated the machine or equipment from the hazardous **energy source**.

3.3.3.2 The CSSO shall install the energy **isolation device**, lock, and LF 403.

3.3.4 VERIFICATION

3.3.4.1 The CSSO shall verify that isolation and de-energization of the machine or equipment have been accomplished.

3.3.4.1.1 Depending upon the measures necessary to detect the presence of hazardous energy, the verification of isolation may involve the use of a test instrument (e.g., combustible gas indicator or electrical meter), a visual inspection (e.g., physical blocks or chocks), or a deliberate attempt to start machines or equipment.

3.3.4.1.1.1 Depressurization of systems shall always be verified by the opening of vent valves or by other positive means in accordance with LPR 1710.40.

3.3.4.1.1.2 Pressure gauges and pressure transmitters shall not be relied upon as the single means to verify a system is de-energized in accordance with LPR 1710.40.

3.3.5 REMOVING THE LOTO

3.3.5.1 The CSSO shall inspect the work area to verify that system components have been properly reassembled after completing the work.

3.3.5.2 The CSSO shall remove the LOTO hardware and notify the FC that the system is no longer under LOTO.

3.3.5.3 The CSSO or FC shall notify affected employees that the LOTO has been

completed.

3.3.6 TEMPORARY REMOVAL OF A LOCKOUT DEVICE

3.3.6.1 In situations that require removal of the **lockout device** from the energy **isolation device** for testing or repositioning, the following sequence of actions shall be followed by the CSSO:

a. Release the lockout device.

b. Energize and proceed with testing or repositioning.

c. De-energize the system, reapply the lockout device, and verify the absence of energy.

3.3.7 MULTIPLE SHIFT LOTOS

3.3.7.1 If the servicing will be completed by the next shift personnel, then:

a. The CSSO(s) for the incoming shift shall transfer their CS Authorization Card(s) (i.e., LF 403) and red lock with that of the out-going CSSO(s).

b. The CSSO(s) from the outgoing shift shall ensure that the incoming CSSO(s) receive instruction/training about the LOTO they are assuming.

c. The CSSO(s) from the incoming shifts shall verify the absence of energy.

3.3.7.2 If there is a break between the outgoing shift and the incoming shift, the outgoing shift shall transfer the LOTO to an RL/RT.

3.3.7.3 The CSSO can leave their CS Authorization Card(s) on the equipment if no other work will be performed on this system by other shift personnel.

a. If work requires a waiting period of more than two workdays, for parts or other delays, the CSSO shall transfer the LOTO to a RL/RT.

3.4 **SHOP MACHINE SAFETY OPERATOR LOCKOUT PROCEDURES**

3.4.1 APPLICABILITY

3.4.1.1 The Shop Machine (SM) lockout procedure requires using the “danger” tag with the yellow identification card, LF 425, affixed with the red lock. See Figure 5.

3.4.1.2 The Shop Machine Safety Operator shall ensure that no other personnel works under his/her LF 425.

3.4.1.3 The SM method is acceptable for locking out any shop machine.

3.4.1.4 The SM LOTO shall be performed by an authorized **Shop Machine Safety Operator** (SMSO).

Figure 5. Example of Shop Machine Method

3.4.1.5 A SM LOTO can be used only if all the following exception elements exist, per OSHA 29 CFR 1910.147(c)(4)(i):

a. The machine or equipment operates at a potential of 600 volts or less.

Note: This is a Langley-specific requirement.

b. The machine or equipment has no potential for stored or residual energy or re-accumulation of stored energy after shutdown that could endanger employees.

c. The machine or equipment has a single energy source that can be readily identified and isolated.

d. The isolation and locking out of that energy source will completely de-energize and deactivate the machine or equipment.

e. The machine or equipment is isolated from that energy source and locked out during servicing or maintenance.

f. A single LOTO device will achieve a locked-out condition.

g. The LOTO device is under the exclusive control of the authorized employee performing the servicing or maintenance.

h. The servicing or maintenance creates no hazards for other employees.

i. LaRC, in using this exception, has had no incidents involving the activation or re-energization of the machine or equipment during servicing or maintenance.

Note: If an incident occurred while using these exception elements on a type of machine or equipment, then an LF 495 shall be created for the servicing and maintenance of that machine or equipment. SFAB can review these procedures periodically to determine if the LF 495 requirement can be lifted.

3.4.2 COMMUNICATION

3.4.2.1 The SMSO and FC shall coordinate and discuss the servicing or maintenance of the machine or equipment.

3.4.2.2 The SMSO shall notify the affected employees that a LOTO is in progress.

3.4.3 CONTROLLING THE ENERGY

3.4.3.1 The SMSO shall install the energy **isolation device**, lock, and LF 425.

3.4.4 VERIFICATION

3.4.4.1 The SMSO shall verify that isolation and de-energization of the machine or equipment has been accomplished by attempting to start the machine or equipment prior to starting work.

3.4.5 REMOVING THE LOTO

3.4.5.1 The SMSO shall inspect the work area to verify that the machine or equipment components have been properly reassembled after completing the work.

3.4.5.2 The SMSO shall remove the LOTO hardware.

3.4.5.3 The SMSO shall notify the FC and affected employees that the LOTO has been completed.

3.5 SPECIAL INSTRUCTIONS FOR MECHANICAL SAFETY OPERATORS 600 VOLTS OR LESS

3.5.1 An authorized “Mechanical Safety Operator with electrical 600 volts or less" can perform LOTO on electrical **isolation device**s for the purpose of performing non-electrical work without an Electrical Safety Operator’s oversight if all of the following are true (See Figure 6):

a. The **isolation device**s controlling the power to the equipment are easily correlated and clearly marked.

b. The machine or equipment can be verified without using an electric meter (e.g., push buttons, levers).

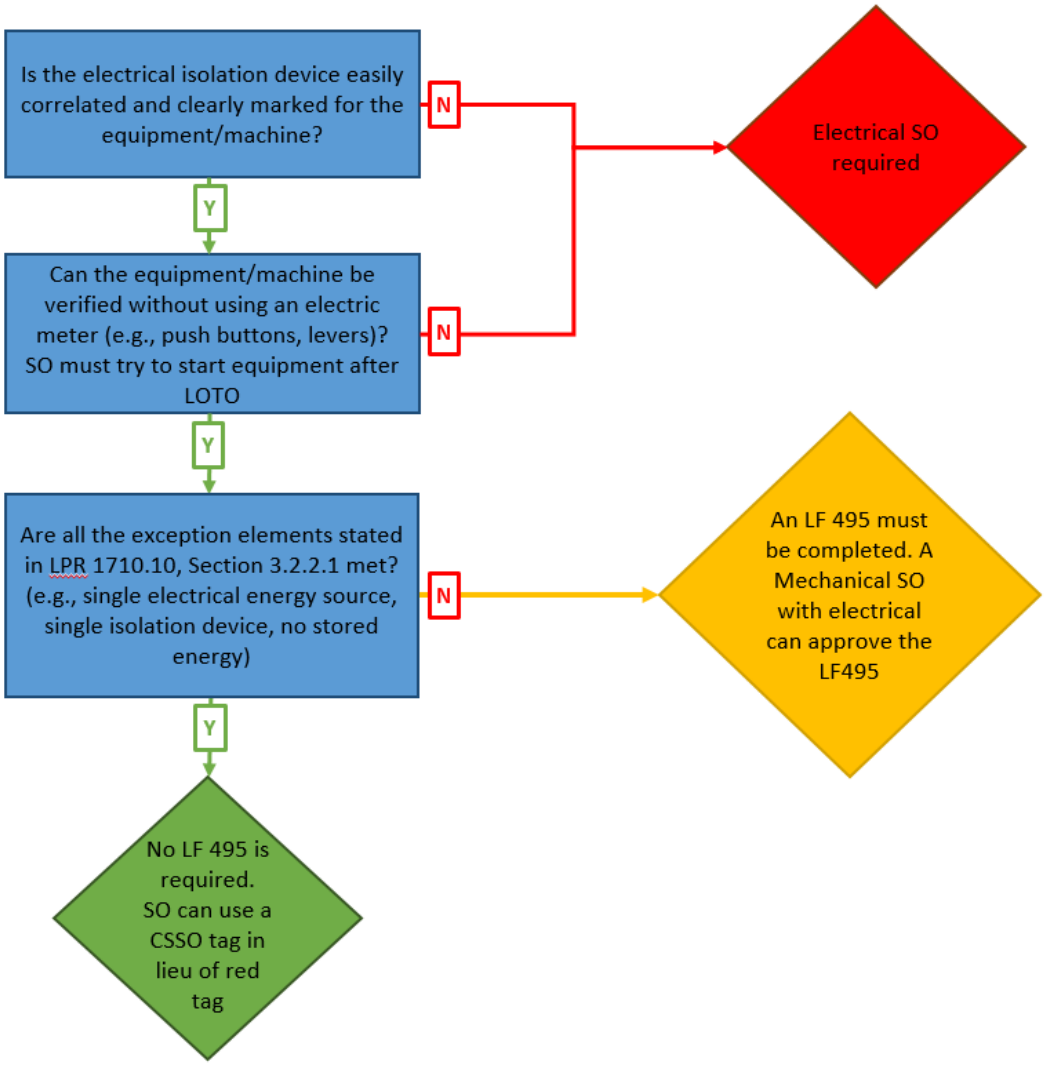

Figure 6. Flow chart for mechanical work requiring electrical LOTO

3.6 SPECIAL INSTRUCTIONS FOR ELECTRICAL SAFETY OPERATOR OVER 600 VOLTS

3.6.1 When performing LOTO for the purpose of doing work on **de-energized** electrical circuit parts and conductors over 600 volts, the SO shall perform the following steps, in addition to the requirements of Section 3.2 of this LPR:

a. Highlight the appropriate switching diagram or one-line diagram to document the **energized** (red), de-energized (yellow), and safetied (green) state of all current carrying parts, as well as identify the temporary personal protective grounds of the switchgear, equipment, or feeders, and attach the diagram to the LF 495.

b. For switching diagrams or one-line diagrams that include multiple switchgears or pieces of equipment, draw a cloud around the switchgear or equipment included in the scope of work, then highlight the state of all current carrying parts within the cloud.

c. Install barriers, locks and signage as required to identify clearly the safetied areas of the switchgear, equipment, or feeders to prevent inadvertent access to non-safetied areas.

d. With diagram sources/options being varied, e.g., digital versus handwritten, drawings used by practitioners in the field should include a legend to indicate what each color in the diagram is used for each of the different energy states.

3.7 SPECIAL INSTRUCTIONS FOR PRESSURE SYSTEMS SAFETY OPERATOR FOR SYSTEMS

3.7.1 When performing LOTO for the purpose of doing work on de-energized pressure systems, the SO shall perform the following steps, in addition to the requirements of Section 3.2 of this LPR:

a. Highlight the appropriate piping and components on the current revision of the Process and Instrumentation Diagram (P&ID) to document the energized (red), de-energized (yellow), and safetied (green) state of all pressure carrying parts, as well as identify the vent locations, pressure sources, and attach the diagram to the LF 495.

b. With diagram sources/options being varied, e.g., digital versus handwritten, drawings used by practitioners in the field should include a legend to indicate what each color in the diagram is used for each of the different energy states.

APPENDIX A: DEFINITIONS

Active LOTO – Work performed under a lockout/tagout that has not reached completion.

Administrative Lock - Locks are used any time equipment, systems, or areas need to be locked for any purpose other than Lockout/Tagout.

Affected employee – An employee whose job requires operating or using a machine or equipment on which servicing or maintenance is being performed under **lockout** or **tagout**, or whose job requires working in an area in which such servicing or maintenance is being performed.

Capable of being locked – An **energy-isolating device** is capable of being locked out if it has a hasp or other means of attachment to which, or through which, a lock can be affixed, or it has a locking mechanism built into it. Other **energy-isolating device**s are capable of being locked out if **lockout** can be achieved without the need to dismantle, rebuild, or replace the **energy-isolating device** or permanently alter its energy control capability. (OSHA 1910.147)

De-energized – A state at which the stored potential energy of an isolated piece of equipment has been discharged. Electrical equipment is considered de-energized when it is free from any electrical connection to a source of potential difference and from electrical charge; not having a potential different from that of earth. (NFPA 70E). Mechanical equipment is considered de-energized when hazards due to temperature, pressure, chemical substances, gases, radiation and motion have been minimized or, where practical, eliminated (e.g., operation of valves, applying brakes and blocking motion, discharging loaded springs).

Double block and bleed - the closure of a line, duct, or pipe by closing and locking or tagging two in-line valves and by opening and locking or tagging a drain or vent valve in the line between the two closed valves. (OSHA 1910.146)

Electrically safe work condition – A state in which an electrical conductor or circuit part has been disconnected from **energized** parts, locked/tagged in accordance with established standards, tested to ensure absence of voltage, and grounded if deemed necessary.

Energized – Connected to an **energy source** or containing residual or stored energy. (OSHA 1910.147)

Energy-isolating device – A mechanical device that physically prevents the transmission or release of energy, including but not limited to the following: a manually operated electrical circuit breaker; a disconnect switch; a manually operated switch by which the conductors of a circuit can be disconnected from an ungrounded supply conductor, and no pole can be operated independently; a line valve; a block; and any similar device used to block or isolate energy. Push buttons, selector switches, and other control circuit-type devices are not energy-isolating devices. (OSHA 1910.147)

Energy source – Any source of electrical, mechanical, hydraulic, pneumatic,chemical, thermal, or other energy. (OSHA 1910.147)

Facility Coordinator (FC) – An employee designated to deal with the day-to-day facility operations within their assigned facility(ies) (e.g., maintenance, scheduling) and ensure these operations do not conflict with each other nor create any unnecessary hazards within the facilities. The Facility Coordinator also interacts with the FSH to ensure safety is maintained throughout the facility.

Facility Safety Head (FSH) – An employee designated with the responsibility of safety within his or her assigned facility(ies). They ensure compliance with LaRC's safety policies, and identify, by themselves or with other employees, safety concerns and provide corrective actions to eliminate hazards.

Group lockout – A group lockout occurs when maintenance, repair, or service is performed by an employee(s) other than the employee(s) who locked out the machine or system.

Kirk Key Interlock System – A permanent mechanical or electromechanical interlock that ensures a predetermined sequence of operation is followed.

Lockout – The placement of a **lockout device** with a red tag, LF 383, on an **energy-isolation device**. A mechanical device that physically prevents the transmission or release of energy, including but not limited to the following: A manually operated electrical circuit breaker; a disconnect switch; a manually operated switch by which the conductors of a circuit can be disconnected from all ungrounded supply conductors, and, in addition, no pole can be operated independently; a line valve; a block; and any similar device used to block or isolate energy. Push buttons, selector switches and other control circuit type devices are not energy isolating devices. (OSHA 1910.147)

Lockout device – A device that uses a positive means, such as a lock, to hold an **energy-isolating device** in the safe position and prevent the energizing of a machine or equipment.

Protected employee (PE) – An employee whose duties include servicing or maintenance of machines, equipment, or systems under a LOTO condition. PEs can be any appropriate personnel including SOs and offsite contractors.

Normal production operations – The use of a machine or equipment to perform its intended production function. (OSHA 1910.147)

Responsible employee (RE) – A designated employee who accepts primary responsibility for a group of employees working under the protection of a **group lockout** and does not require any certifications on the systems or knowledge requirements about the facility. REs can be any appropriate personnel including SOs and offsite contractors.

Safetied – A **safe work condition** achieved by **de-energizing** the equipment or system, and has been locked, tagged, and tested to verify absence of energy through positive means. For electrical systems operating over 600V, an electrically safe work condition achieved by the use of temporary personal protective grounds after de-energizing and verifying absence of voltage.

Safety operator (authorized employee) – A person authorized and certified to lock and tag out machines, equipment, or systems to perform servicing or maintenance. This is equivalent to an **authorized** employee as defined by 29 CFR 1910.147 (b).

Servicing and/or maintenance – Workplace activities, such as constructing, installing,

setting up, adjusting, inspecting, modifying, maintaining, and/or servicing machines, equipment, or systems. These activities include lubrication, cleaning, or unjamming of machines, equipment, or systems and making adjustments or tool changes during which the employee may be exposed to the energization or startup of the equipment or release of hazardous energy. (OSHA 1910.147)

Setting up – Any work performed to prepare a machine or equipment to perform its **normal production operation**. (OSHA 1910.147)

Standard Operating Procedures (SOPs) – Detailed, written, step-by-step instructions to be routinely followed in operating a facility. SOPs contain all of the information considered pertinent to safe and efficient operation of the facility. SOPs are the source documents for Operational Checklists and are the basis, in part, for the facility Hazard Control Analysis. SOPs may also be used for training certified operator personnel. SOPs are under the control of the configuration management program (i.e., CMOL).

Tagout without locking – 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. (OSHA 1910.147)

Tagout device – A prominent warning device, such as a tag and a means of attachment that can be securely fastened to an **energy-isolating device,** in accordance with an established procedure, to indicate that the **energy-isolating device** and the equipment being controlled may not be operated until the **tagout device** is removed. (OSHA 1910.147)

Temporary or limited time – The period during which it is necessary to test or reposition the portion of the machinery or equipment. The period cannot exceed the current work shift.

APPENDIX B: ACRONYMS

CFR	Code of Federal Regulations
CMOL	Configuration Management On-Line
CS	Craft Specific
FC	Facility Coordinator
FSH	Facility Safety Head
FV	Field Verifier
LaRC	Langley Research Center
LF	Langley Form
LOTO	Lockout/Tagout
LPR	Langley Procedural Requirements
NPR	NASA Procedural Requirements
OSHA	Occupational Safety and Health Administration
PE	Protected Employee
RE	Responsible Employee
RL/RT	Red Lock/Red Tag
SFAB	Safety and Facility Assurance Branch
SM	Shop Machine
SMSO	Shop Machine Safety Operator
SO	Safety Operator

APPENDIX C: LANGLEY FORM INSTRUCTIONS

C.1 This appendix includes only the instructions for the Langley forms referenced in this LPR that cannot support their own instruction page.

C.2 LF 383, RED IDENTIFICATION TAG

C.2.1 The information required on the red identification tag is as follows:

a. **Location:** Building/facility name or number

b. **Date**: Date when the lockout was applied

c. **Equipment:** Name of the machine/equipment or system being locked out

d. **Tagged Out:** Whom the tag is issued to

(1) **Name**: Name of RE

(2) **Section:** Organization responsible for the lockout

(3) **Telephone:** Contact number of the RE

e. **Time**: Time the lockout was applied

f. **Equipment Position:** Choose the appropriate selection

g. **Remarks**: Any pertinent notes

h. **Locked/Tagged By**: SO who locked out the isolation device

i. **Reported Clear**: Time and date the lock and lockout devices were removed from the energy isolation device

j. **Returned to Service**: N/A

k. **Cleared By**: SO who removed the lockout devices

C.2.2 Complete the bottom half of the tag/stub section with the same information listed above at the time the tag is written. The only additional item on the stub is:

a. **Worker signature –** This is to be signed by the RE when the stubs and keys are returned to the SO.

Note: This is done after the work has been completed and the RE/PE(s) are clear from the system or equipment.

C.2.3 Peel off the white backing on the top half of the form and place the protection window over the information to protect it from the environment.

Peel off the white backing on the bottom stub and affix the key to the stub using the protection window. Give the stub/key portion to the RE to be locked in a lockbox.

APPENDIX D: SYSTEMS EXCLUDED FROM LF 572 REQUIREMENTS

Excluded System	Condition(s) for Exclusion
Water piping systems under 160 psig and 210 °F.	Potable hot water lines
Commercial-Off-The-Shelf (COTS) water heaters for buildings.	
Water storage tanks and small potable water heaters in heating boilers.	
Packaged, COTS, facility hot water boilers and low-pressure steam boilers within the scope of ASME Boiler and Pressure Vessel Code, Section IV.	
Water deluge systems under 250 psig.	
Inert gas piping systems, e.g., control air, instrument air, and shop air systems.	Design pressure not exceeding 150 psig. Line size not exceeding 2 inch for all methods of fabrication.
COTS prepackaged pressurized water and steam cleaning systems.	
Fire protection water systems for facilities.	

Excluded System	Condition(s) for Exclusion
COTS prepackaged refrigerators, freezers, and Heating, Ventilation, and Air Conditioning (HVAC) equipment.	
Fire extinguishers, portable extinguishers, standpipe and hose systems, automatic sprinkler systems, fixed dry chemical extinguishing systems, carbon dioxide extinguishing systems, and halogenated extinguishing agent systems.	
Fuel storage pressure systems.	
COTS prepackaged hydraulic systems.	
COTS laboratory equipment.	
Vacuum vessels.	Volumes not greater than 100 cubic feet. Not connected to a positive-pressure fluid delivery system.
Vacuum piping.	Nominal diameter of less than 6 inches. Not connected to a positive-pressure fluid delivery system.
Atmospheric storage tanks.	

Excluded System	Condition(s) for Exclusion
COTS self-contained pressurized eye wash systems	
Tube trailers.	
Natural gas distribution systems.	Design pressure not exceeding 22 psig.