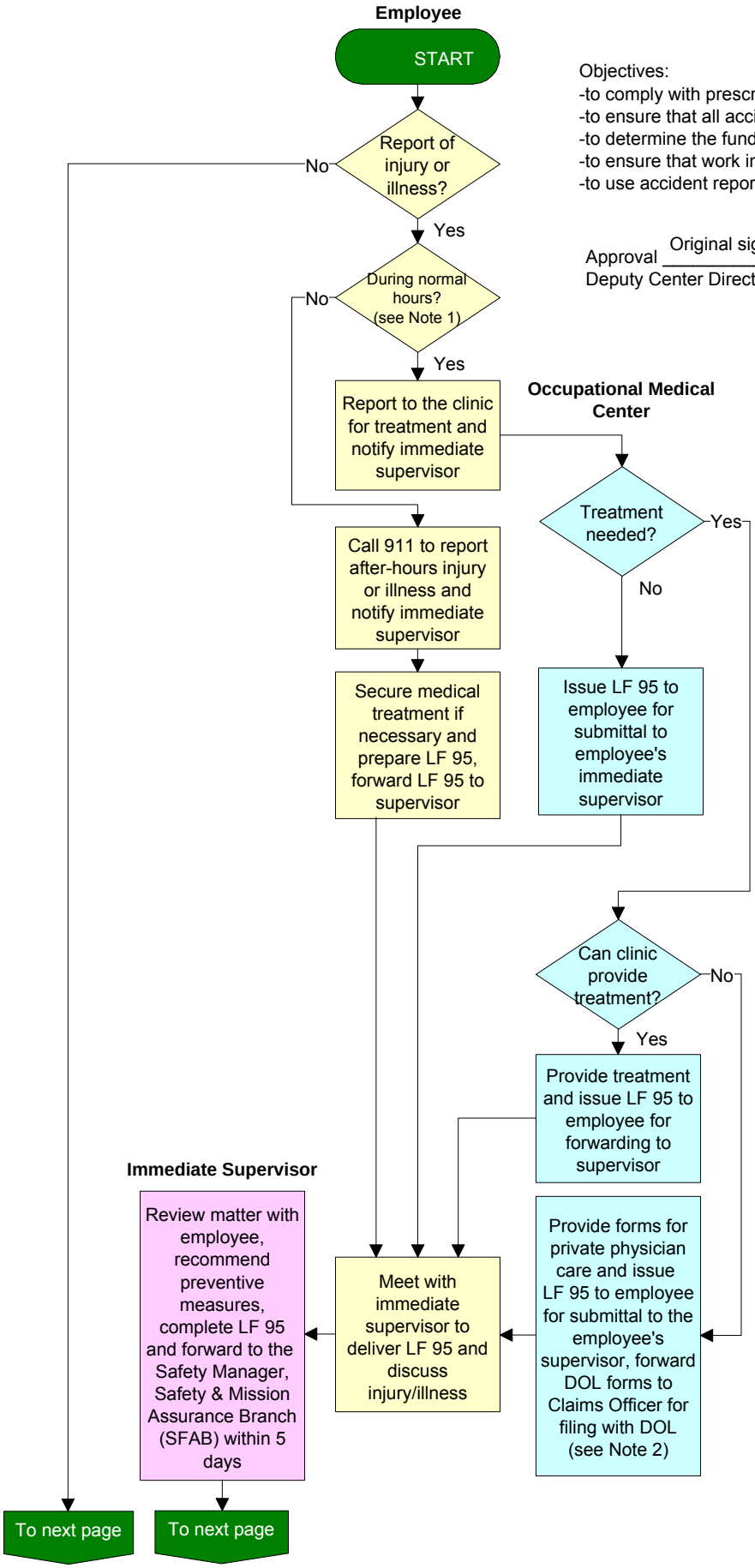
REPORTING INJURIES, ILLNESSES, COMPENSATION CLAIMS AND UNSAFE WORKING CONDITIONS

LMS-CP-4760
Rev. A-5: SMAO
Expires:3/9/2012

Objectives:
-to comply with prescribing NASA and Federal regulations
-to ensure that all accidents and injuries are reported
-to determine the fundamental cause of all accidents
-to ensure that work injury compensation claims are processed
-to use accident reports for prevention, not disciplinary action

Approval Original signed on file
Deputy Center Director



General Information

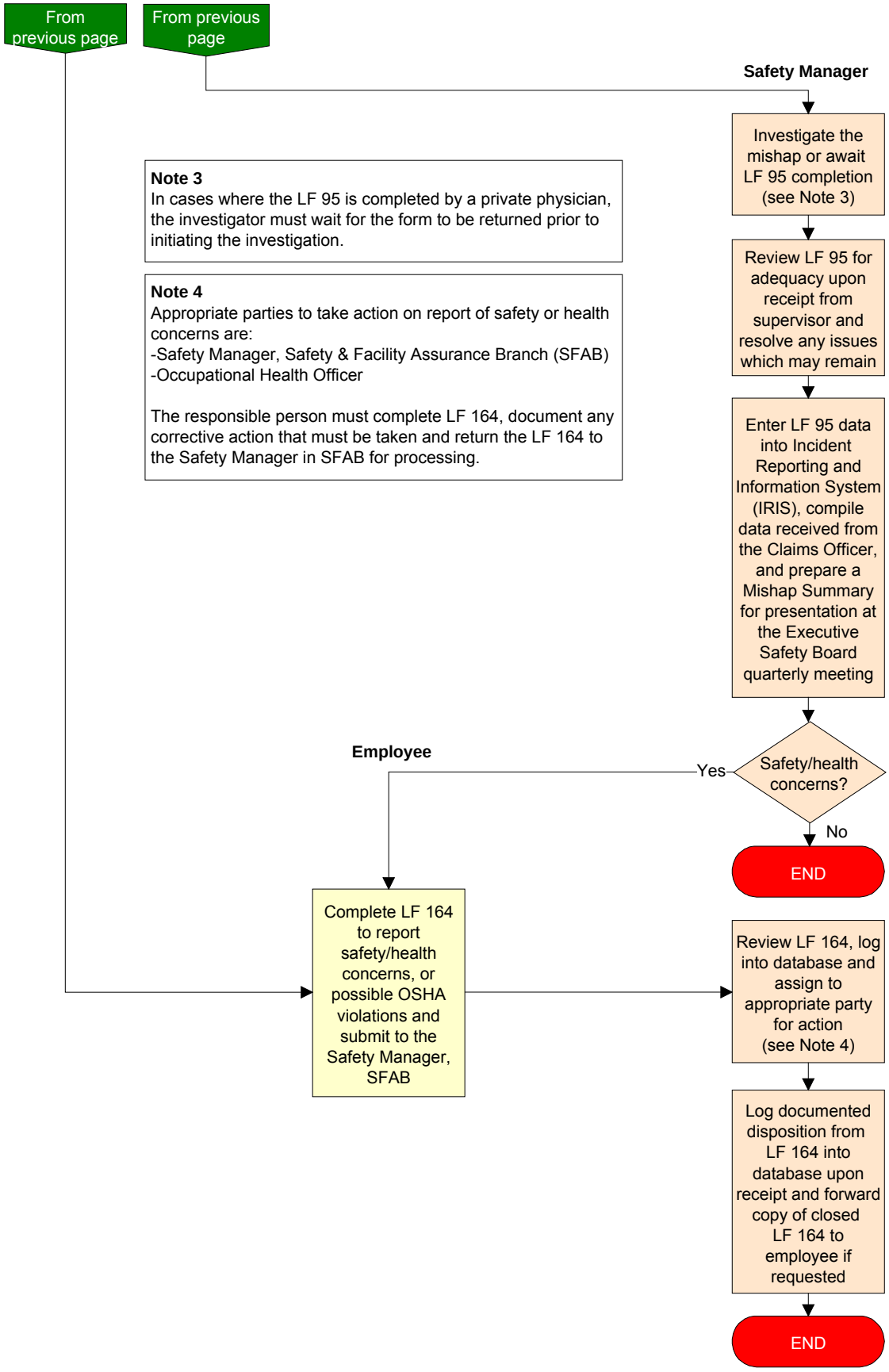
The following records are generated by this procedure and are maintained in accordance with CID 1440.7:
-Mishap Summary
-Incident Reports
-LF 164 Log

Note 1
Normal hours are considered as those between 7:00 am and 3:00 pm, Monday - Friday

Note 2
Provide the employee with:
-Department of Labor (DOL) form CA-16 to be completed by attending physician
-DOL Booklet CA11 "When Injured at Work"
-Guidance of rights of reporting

Submit the following forms to the Claims Officer:
-CA1 "Notice of Injury"
-CA2 "Notice of Occupational Disease"

Verify correct revision before use by checking the LMS Web Site



Note 3
In cases where the LF 95 is completed by a private physician, the investigator must wait for the form to be returned prior to initiating the investigation.

Note 4
Appropriate parties to take action on report of safety or health concerns are:
-Safety Manager, Safety & Facility Assurance Branch (SFAB)
-Occupational Health Officer

The responsible person must complete LF 164, document any corrective action that must be taken and return the LF 164 to the Safety Manager in SFAB for processing.

REPORTING, INVESTIGATING, AND RECORDKEEPING FOR MISHAPS, CLOSE CALLS, AND PREVIOUSLY UNIDENTIFIED SERIOUS WORKPLACE HAZARDS

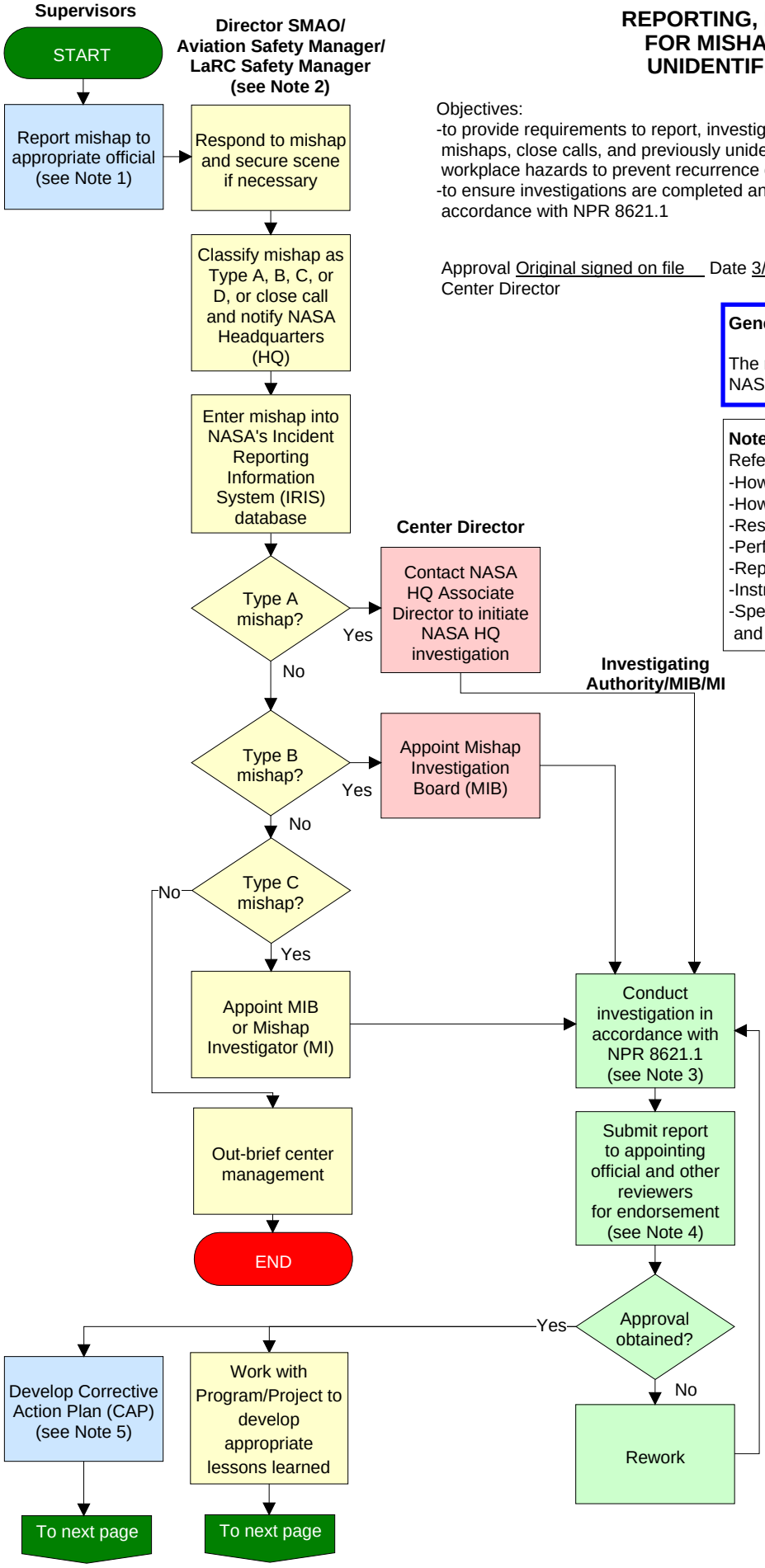
LMS-CP-8621
Rev. A: SMAO
Expires:9/27/2013

Objectives:
-to provide requirements to report, investigate and document mishaps, close calls, and previously unidentified serious workplace hazards to prevent recurrence of similar accidents
-to ensure investigations are completed and documented in accordance with NPR 8621.1

Approval Original signed on file Date 3/28/2007
Center Director

General Information

The records generated by this procedure are maintained in NASA's IRIS database.



Note 1
Refer to NPR 8621.1 for:
-How to respond to mishaps
-How to classify mishaps
-Responsibilities in establishing investigative authorities
-Performance of investigation
-Reporting obligations
-Instructions on release of information to the public
-Specifies the relationship and interaction with OSHA, NTSB, and other government agencies

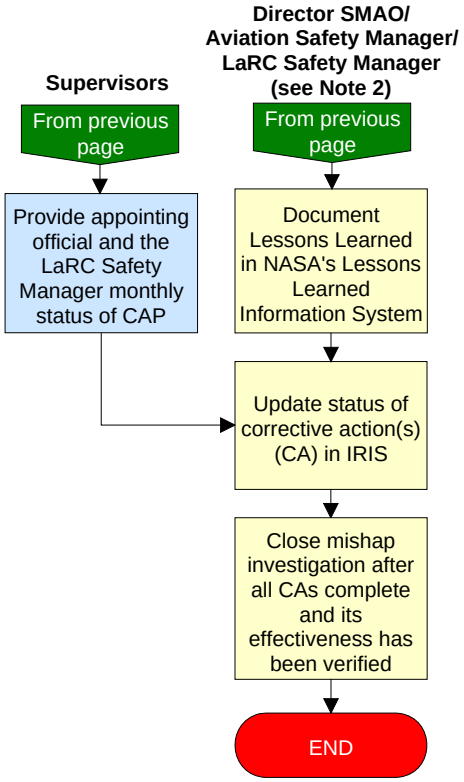
Note 2
-The LaRC Safety Manager is responsible for any mishaps involving personnel injury or facility damage.
-The Director of SMAO is responsible for any mishaps involving non-aviation projects.
-The Aviation Safety Manager is responsible for any aircraft mishaps.

Note 3
Refer to NPR 8621.1. Investigation must identify proximate cause, root cause, and barrier analysis.

Note 4
MIB/MI endorsing official shall also approve/ disapprove individual recommendations in the MIB/MI report.

Note 5
•The appointing official shall instruct the responsible organization(s) to develop a CAP, in accordance with the requirements of NPR 8621.1, for the recommendations identified in the MIB/MI Report approved by the MIB/MI endorsing officials.
•The responsible organization(s) shall confer with the LaRC Safety Manager on the MIB/MI approved recommendations and together determine whether the recommendations should be accepted or rejected and develop the CAP appropriately.
•Upon completion of the CAP it shall be submitted to the LaRC Center Director for review and approval.
•Upon approval of the CAP from the LaRC Center Director, the responsible organization(s) shall proceed with implementation of the CAP.

Verify correct revision before use by checking the LMS Web Site


Supervisors
Director SMAO/ Aviation Safety Manager/ LaRC Safety Manager (see Note 2)
From previous page
From previous page
Provide appointing official and the LaRC Safety Manager monthly status of CAP
Document Lessons Learned in NASA's Lessons Learned Information System
Update status of corrective action(s) (CA) in IRIS
Close mishap investigation after all CAs complete and its effectiveness has been verified
END

Langley Research Center

LAPD 1700.1

Effective Date: September 9, 2009

Expiration Date: October 9, 2014

Responsible Office: Safety and Mission Assurance Office (SMAO)

SUBJECT: Safety Program

1. Policy

a. Since safety cannot be separated from planning, management, and operations, it is the policy of the Langley Research Center (LaRC) that the primary responsibility for safety begins with the Center Director and flows down through line organization management to each individual employee. The primary objective of LaRC's Safety Program is to ensure LaRC's mission is accomplished while proactively controlling hazards to personnel and facilities.

b. The nature of our research organizations and the multiple and varied types of facilities and research equipment at LaRC means that considerable reliance and responsibility for ensuring adherence to safety policy rests within our research and engineering organizations. Therefore, each facility has a designated Facility Safety Head and Facility Coordinator to ensure safety. They are appointed by their management and approved by the Vice Chairperson, Executive Safety Council. They are responsible for activities within their designated facilities.

c. Day-to-day implementation of LaRC's Safety Program is the responsibility of the Safety Manager, Branch Head of the Safety and Facility Assurance Branch (SFAB), SMAO. The Safety Manager has a staff of specially trained individuals to ensure compliance with safety policy. SMAO is responsible for assisting and supporting the Facility Safety Heads, Facility Coordinators, Center Director, line management, and employees to ensure a safe and healthful environment.

d. Effective enforcement and development of the safety program at LaRC is made possible through the efforts of the Executive Safety Council, a full-time safety staff, functional committees in designated technical areas, Facility Safety Heads, Facility Coordinators, and line management all of whom advise the Center Director and the Director, SMAO concerning safety. The basic concept is one of checks and balances; surveillance to assure reasonable, effective, and efficient application of safety policies; and personnel with the technical capabilities required to ensure a safe and healthful environment.

2. Applicability

a. This policy is applicable to all employees at LaRC and activities performed by LaRC.

3. Authority

a. Executive Order 11612, "OSHA Programs for Federal Employees."

b. NPD 1800.2, "NASA Occupational Health Program."

c. Occupational Safety and Health Act of 1970.

4. Applicable Documents

a. LAPD 1150.2, "Boards, Panels, Committees, Councils, and Teams."

b. LAPD 1700.2, "Safety Assignments."

5. Responsibility

a. Detailed responsibilities for the personnel and committees outlined in the policy section are contained in LAPD 1700.2 and LAPD 1150.2.

6. Delegation of Authority

a. The Center Director has the overall Center safety responsibility and is responsible for the Safety Program through the Executive Safety Council. The Director, SMAO is delegated functional responsibility for ensuring that programmatic efforts that will provide a safe and healthful work environment are made and implemented.

7. Measurement/Verification

a. Measurement and verification of the effectiveness of this policy is accomplished by conducting internal safety audits and safety audits by external groups (e.g., OSHA) as well as by monitoring the Total Case Incident Rate and Days-Away From Work Restricted Time Rate.

8. Cancellation

LAPD 1700.1, dated October 3, 2004.

Original signed on file, September 9, 2009

Lesa Roe
Center Director

Distribution: Approved for public release via the Langley Management System; distribution is unlimited.

Responsible Office: **Safety and Mission Assurance Office**

SUBJECT: Safety Assignments and Responsibilities

1. POLICY

This policy directive sets forth organizational and functional safety assignments and specifies the authorities and responsibilities of each.

2. APPLICABILITY

This directive is applicable to all Government, contractor, or other organization employees at LaRC, in accordance with the terms expressed in their respective agreements, joint operating procedures, or contracts with LaRC.

3. AUTHORITY

a. 29 CFR 1960, "Basic Program Elements for Federal Employee Occupational Safety and Health Programs and Related Matters."

b. NPD 9710.2, "NASA Safety and Health Program Policy."

4. REFERENCES

a. NPR 1040.1, “NASA Continuity of Operations (COOP) Planning Procedural Requirements.”

b. NASA STD 8719.11, "Safety Standard for Fire Protection."

c. LAPD 1040.1, "NASA Langley Duty Officer."

d. LAPD 1700.1, "Safety Program."

e. LPR 1046.1, "NASA Langley Research Center Emergency Plan."

f. LPR 1710.11, "Fire Protection Program."

g. LPR 1710.40, "Safety Regulations Covering Pressurized Systems."

h. LPR 1710.41, "Langley Research Center Standard for the Evaluation of Socket and Branch Connection Welds."

i. LPR 1710.42, "Safety Program for Maintenance of Ground Based Pressure Vessels and Pressurized Systems."

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j. LPR 1740.3, "Facility Safety Head and Facility Coordinator Guide."

k. LMS-CP-4760, "Reporting Injuries, Illnesses, Compensation Claims and Unsafe Working Conditions.

l. Langley Form 1, "Appointment of Facility Coordinator(s)/Facility Safety Head(s) (FC/FSH)."

m. Langley Form 260, “Orientation Survey for New Facility Safety Head and Facility Coordinator.”

n. Langley Form 261, “Documentation Review for New Facility Safety Heads and Facility Coordinators.”

5. RESPONSIBILITY

5.1 CENTER EMPLOYEES

All LaRC employees, civil service and contractor, shall be charged with the responsibility for ensuring a safe and healthful workplace. Every employee, without fear of disciplinary action or any form of retaliation, shall be required to notify a line Manager/Supervisor or the Safety and Facility Assurance Branch (SFAB), Safety and Mission Assurance Office (SMAO), of any hazardous condition that may cause or result in employee injury/illness or that may cause equipment and/or property damage. When an unsafe condition or work practice presents imminent danger to personnel or equipment/property, all civil service and contractor employees are vested with the right and shall be obligated to stop the work and then contact a line Manager/Supervisor or the SFAB.

5.2 LINE ORGANIZATION

5.2.1 Organizational Unit Managers (OUM’s)

As Organization Unit (OU) leaders, OUM’s shall have the ultimate responsibility for ensuring the safety of all employees in the OU and ensuring all facilities occupied and operated by the OU are safe for occupancy, maintained properly, and activities (e.g., research operations, etc.) conducted in the OU's facilities are performed in a safe manner. The agents through whom OUM’s shall accomplish this are Managers/Supervisors in the "chains of command" in the OU and the Facility Safety Heads (FSH’s) and the Facility Coordinators (FC’s) appointed by the OUM.

OUM’s shall:

a. In accordance with LPR 1740.3, "Facility Safety Head and Facility Coordinator Guide," ensure a Principal FSH and FC is appointed for each facility, including office facilities, the OU occupies and operates by submitting a Langley Form 1, "Appointment of Facility Safety Head/Facility Coordinator (FSH/FC)." Ensure an Alternate and/or Organizational FSH and FC is appointed as deemed necessary in facilities housing multiple research operations, operating on multiple shifts, and/or occupied by multiple organizations.

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b. Resolve conflicts between a Manager/Supervisor and a FSH/FC associated with a safety issue, acquiring assistance from the SFAB when necessary.

c. Meet the requirements for Managers/Supervisors as stated in paragraph 5.2.2 of this LAPD.

NOTE: The same individual shall be allowed to serve in the roles of Principal FSH/FC, Alternate FSH/FC or Organizational FSH/FC of an office building. For non-office buildings, having the same individual serve in these roles shall require the approval of the Head, SFAB.

5.2.2 Managers/Supervisors (including OUM's)

It shall be the responsibility of each Manager/Supervisor in the OU to ensure the safety of the employees who report to them directly.

All Managers/Supervisors shall:

a. Ensure their direct employees obtain the appropriate safety training and the safety certifications required to perform their job.

b. Ensure all FSH's and FC's complete the training requirements as identified and instructed on Langley Form 260, "Orientation Survey for New Facility Safety Head and Facility Coordinator," and Langley Form 261, "Documentation Review for New Facility Safety Heads and Facility Coordinators."

c. Ensure their direct employees perform hazardous activities in accordance with all applicable LAPD's and LPR's.

d. Report and investigate any injury/illness incurred by a direct employee in accordance with LMS-CP-4760, "Reporting Injuries, Illnesses, Compensation Claims and Unsafe Working Conditions."

e. Resolve any safety concern raised to them by direct employees, the SFAB, or any other Center employee or organization.

f. Resolve any safety concern associated with a direct employee (e.g., an employee performing a task he/she is not trained/certified to perform) when brought to their attention by a FSH/FC, the SFAB, or any other Center employee or organization.

g. Conduct a monthly safety inspection of all areas occupied by their direct employees.

h. Conduct an annual safety meeting for their organization in office facilities and monthly in industrial work areas (shops, laboratories, tunnels, etc.).

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Managers/supervisors with direct ownership responsibility of a facility shall work with the facility's FSH and FC to ensure operations, maintenance and modifications are conducted in a safe manner and in accordance with applicable LAPD's and LPR's.

5.3 FACILITY SAFETY HEADS AND FACILITY COORDINATORS

5.3.1 Principal, Alternate, and Organizational Facility Safety Heads

Principal, Alternate, and Organizational FSH's shall act as agents of their OUM's/Managers/ Supervisors and the SFAB to ensure the safety of their assigned facility/facilities by providing oversight of facility day-to-day operations, maintenance, and modifications. (These FSH roles may be held by a contractor employee upon approval from the SFAB and the employee's Contract Manager.)

Principal, Alternate, and Organizational FSH's shall:

a. Complete the training requirements as identified and instructed on Langley Forms 260 and 261 within 6 months of appointment or within 6 months of this LAPD's effective date.

b. Ensure all operations in their assigned facility/facilities are in compliance with all applicable LAPD's and LPR's.

c. Ensure modifications of their assigned facility/facilities are performed in accordance with all applicable LAPD's and LPR's.

d. Understand Principal, Alternate, and Organizational FSH responsibilities and perform duties as defined in applicable LAPD's and LPR's.

e. Resolve facility-related safety concerns brought to their attention by a Manager/Supervisor, the SFAB, or any other Center employee, facility or organization.

f. Bring to the attention of the appropriate Manager/Supervisor any safety concern associated with an employee performing work in their assigned facility/facilities.

g. Keep their OUM, Manager/Supervisor abreast of safety issues that need the OUM's, Manager's/Supervisor's attention.

5.3.2 Principal, Alternate, and Organizational Facility Coordinators

Principal, Alternate, and Organizational FC's shall assist FSH's in the oversight of their assigned facilities to ensure the safety of day-to-day operations, maintenance, and modifications of their assigned facility/facilities. (These FC roles may be held by a contractor employee upon approval from the SFAB and the employee's Contract Manager.)

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Principal, Alternate, and Organizational FC's shall:

a. Complete the training requirements as identified and instructed on Langley Forms 260 and 261 within 6 months of appointment or within 6 months of this LAPD's effective date.

b. Ensure proper maintenance and repairs are performed in their assigned facility/facilities.

c. Coordinate with other FC's and LaRC organizations or facilities activities (e.g., modifications, repairs, utility interruptions, etc.) conducted in their assigned facility/facilities to ensure safety throughout the Center.

d. Work with their respective FSH to ensure all operations in their assigned facility/facilities are in compliance with all applicable LAPD's and LPR's.

e. Work with their respective FSH to ensure all modifications of their assigned facility/facilities are performed in accordance with all applicable LAPD's and LPR's.

f. Understand Principal, Alternate, and Organizational FC responsibilities and perform duties as defined in applicable LAPD's and LPR's.

g. Work with their respective FSH to resolve facility-related safety concerns brought to their attention by a Manager/Supervisor, the SFAB, or any other Center employee, facility or organization.

h. Bring to the attention of their respective FSH any safety concern associated with an employee performing work in their assigned facility/facilities.

i. Keep their OUM, Manager/Supervisor abreast of safety issues that need the OUM's, Manager's/Supervisor's attention.

5.4 FUNCTIONAL ORGANIZATIONS

5.4.1 Safety and Mission Assurance Office (SMAO)

The Safety and Mission Assurance Office (SMAO) shall be responsible for the management of this Center's Safety Program, excluding Aviation Safety.

SMAO shall:

a. Serve as the LaRC focal point for safety resources planning and acquisition.

b. Provide the LaRC safety point of contact between NASA Headquarters, other NASA installations, other Government agencies, and industry. This includes safety-reporting requirements placed on the Center.

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5.4.2 Safety and Facility Assurance Branch (SFAB)

The Head, SFAB, shall function as the LaRC Safety Manager and shall be responsible for ensuring that the SFAB shall:

a. Function as the "authority having jurisdiction" (AHJ) over Center areas of design, maintenance, repair, and operations. SFAB approval shall be obtained from Center personnel, facilities, and support service contractors prior to performing work involving the addition, deletion, upgrade or modification of facilities, systems, or equipment.

b. Provide a SFAB point-of-contact for each facility, including office buildings, at LaRC.

c. Maintain a list of SFAB point-of-contacts, Principal, Alternate, and Organizational FSH's and FC's.

d. Provide assistance to OUM's, Managers/Supervisors, FSH's, and FC's in discharging their safety duties and responsibilities.

e. Participate in the formulation and implementation of LaRC occupational safety and health and facility assurance policies, including updating and maintaining LaRC safety-related LAPD's and LPR's.

f. Provide a member for each project review meeting and Executive Safety Council safety committee. This member may be a civil servant or a contractor as circumstances warrant.

g. Provide programmatic oversight of LaRC's occupational safety and health program to ensure all Center activities are conducted in accordance with applicable LAPD's, LPR's, Agency, OSHA and other applicable regulations and standards.

h. Provide occupational safety and health services for civil service employees, including a safety training/certification program.

i. Maintain and review safety records and metrics.

j. Assist Contracting Officers in determining the adequacy of contractors' safety programs, including off-site programs.

k. Serve as the Center's interface with OSHA in maintaining the Center as an OSHA Voluntary Protection Program (VPP) STAR site.

l. Provide programmatic oversight of LaRC's safety and facility assurance program as delineated in applicable LAPD's, LPR's, Agency, OSHA and other applicable regulations and standards.

m. Ensure configuration management services are provided for facilities designated as high-risk.

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n. Ensure system safety services are provided for designated high-risk facilities and other identified research equipment systems.

o. Provide programmatic oversight of LaRC's Pressure Systems Safety Program as delineated in LPR 1710.40, "Safety Regulations Covering Pressurized Systems;" LPR 1710.41, "Langley Research Center Standard for the Evaluation of Socket and Branch Connection Welds;" and LPR 1710.42, "Safety Program for Maintenance of Ground Based Pressure Vessels and Pressurized Systems."

p. Provide programmatic oversight of all aspects of the fire protection and engineering program in accordance with LPR 1710.11, "Fire Protection Program," and NASA STD 8719.11, "Safety Standard for Fire Protection."

q. Provide programmatic oversight of inspection, testing, and maintenance (IT&M) activities involving fire protection, fire alarm and detection systems, emergency communication systems, Center evacuation alarm system, Emergency Dispatch Office, and Emergency Operations Center in accordance with LPR 1710.11 and NASA STD 8719.11.

r. Provide emergency response activities, including, but limited to, those involving fire suppression, emergency medical response, rescue, weapons of mass destruction, hazardous materials response and mitigation, and inclement weather.

s. Provide an individual to serve as the LaRC Fire Chief who shall also be designated the "authority having jurisdiction" at Langley Research Center for matters involving compliance with safety-related portions of regulations in accordance with LPR 1700.1, "Safety Program," including current building codes, National Fire Protection Association regulations, Life Safety Codes, American Society of Mechanical Engineers elevator codes, NASA Pyrotechnics and Explosives documents, and as well as other related NASA-specific criteria.

t. Provide an individual to serve as the Emergency Preparedness Officer (EPO), who shall be the Head, SFAB or his/her designee, responsible for the implementation of LPR 1046.1, "NASA Langley Research Center Emergency Plan."

u. Provide safety status reports to the Executive Safety Council (ESC).

v. Appoint a Continuity of Operations (COOP) Coordinator for the Center in accordance with section 2.4.1 of NPR 1040.1, "NASA Continuity of Operations (COOP) Planning Procedural Requirements."

5.4.3 Office of Human Capital Management

The Office of Human Capital Management (OHCM) shall be responsible for LaRC's medical services and workers compensation programs. The OHCM shall provide an individual to serve as LaRC's Occupational Health Officer (OHO). This individual shall be responsible for implementation of the requirements set forth for the OHO below. The LaRC OHO shall also perform OHO specific requirements as defined in all applicable LAPD's and LPR's:

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OHO shall:

a. Provide first aid service for all Center employees (civil service and contractor).

b. Provide for job-related physical protocols and examinations for civil service employees.

c. Provide medical and injury/illness data to the SFAB as described in LMS-CP-4760.

d. Provide an individual to serve as a member of the Institutional Review Board.

e. Provide occupational health status reports to the ESC.

5.4.4 Center Operations Directorate

The Center Operations Directorate shall be responsible for providing a NASA Langley Duty Officer, who shall be responsible for the duties as indicated in LAPD 1040.1, “NASA Langley Duty Officer." The NASA Langley Duty Officer shall be the official Center point-of-contact for securing systems after normal working hours, including evenings, weekends and holidays. The NASA Langley Duty Officer shall be notified whenever a safety problem arises after normal duty hours and when notified of such a problem shall immediately notify the LaRC Safety Manager.

5.4.5 Flight Systems Safety Office, Flight Research Services Directorate

The Flight Systems Safety Office (FSSO), Flight Research Services Director, shall be responsible for LaRC’s aviation research and operational support activities. The FSSO shall provide an individual to serve as LaRC’s Aviation Safety Officer (ASO). This individual shall be responsible for implementation of the requirements set forth for the ASO below.

The ASO shall be appointed by the Chairperson of the Executive Safety Council. The ASO shall ensure that the Chairperson of the Executive Safety Council is kept fully and currently informed of concerns relative to the safe conduct of the Center's aviation research and operational support activities.

The ASO shall:

a. Provide technical guidance on safety aspects of flight programs.

b. Maintain surveillance of aviation activities for conformance with prescribed directives, standards, and procedures, and propose corrective action when required.

c. Review aviation training and assess qualifications to ensure safety of operations.

d. Serve as a member of the Airworthiness and Safety Review Board.

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e. Provide a minimum of one annual status report to the ESC.

6. DELEGATION OF AUTHORITY

None

7. MEASUREMENTS

The safety performance of the individuals' responsibilities, as assigned in this directive shall be measured in the annual reports required to be submitted to the ESC by the SFAB, OHO, and ASO.

8. CANCELLATION

LAPD 1700.2, dated May 20, 2005.

Original signed on file

Lesa B. Roe
Director

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Langley Research Center

LPR 1740.4

Effective Date: May 19, 2010

Expiration Date: May 19, 2015

FACILITY SYSTEM SAFETY ANALYSIS AND CONFIGURATION MANAGEMENT

National Aeronautics and Space Administration

Responsible Office: Safety and Mission Assurance Office

PREFACE

P.1 PURPOSE

This Langley Procedural Requirement (LPR) implements the requirements of NASA Procedural Requirement (NPR) 8715.3C, “NASA General Safety Program Requirements (w/Change 4 dated 7/20/09).” and is part of the Langley Management System (LMS). This LPR sets forth procedural requirements for the Langley Research Center (LaRC) Facility System Safety and Configuration Management (CM) Programs for the Center’s ground-based research facilities. It defines the requirements of the Center’s Facility System Safety Analysis and CM Programs. It also provides guidance for government personnel in performing their responsibilities for these programs.

P.2 APPLICABILITY

This LPR is applicable to all Langley employees.

P.3 AUTHORITY

NPR 8715.3C, “NASA General Safety Program Requirements”

P.4 APPLICABLE DOCUMENTS

a. NASA-STD-8719.7, "Facility System Safety Guidebook"
b. LAPD 1700.2, Safety Assignments and Responsibilities
c. LAPD 7000.2, Review Program for Langley Research Center (LaRC) Facility Projects
d. LPR 1710.42, Safety Program for Maintenance of Ground-Based Pressure Vessels and Pressurized Systems
e. LPR 1740.2, Facility Safety Requirements
f. LPR 1740.3, Facility Safety Head and Facility Coordinator Guide
g. LPR 1740.7, Process Systems Certification Program
h. LPR 8717.1, Job Hazard Analysis Program
i. LMS-CP-4710, Configuration Management for Facilities
j. LMS-CP-4890, Construction and Change Assurance for High Risk Facilities
k. LMS-CP-5528, Software Planning, Development, Acquisition, Maintenance, and Operation
l. LMS-CP-5529, Software Configuration Management Planning for Low-, High-, and Critical-Control Software
m. LMS-CP-7151, Obtaining Waivers for Langley Management System (LMS) Requirements
n. LMS-OP-8715, Identifying Facility Risk Indicators
o. LF 27, NASA LaRC Asbestos Safety Permit,
p. LF 127, Change Notification Sheet
q. LF 445, Facility Risk Indicator (FRI) Identification Form

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P.5 MEASUREMENT/VERIFICATION

None

P.6 CANCELLATION

CID 1740.4, dated November 17, 2008

Original signed on file

Lesa B. Roe
Director

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Chapter 1

1. FACILITY SYSTEM SAFETY PROGRAM

1.1 INTRODUCTION

1.1.1 The LaRC Facility System Safety Program exists to ensure the safe and continuous operation of ground-based LaRC facilities. It is composed of two major elements:

a. A safety analysis which takes the form of either:
   1) a Facility System Safety Analysis (FSSA) or
   2) a Langley Risk Evaluation

b. and configuration management that includes:
   1) Facility Configuration Management (CM) Program,
   2) Pressure Systems Configuration Management (PSCM),
   3) Software Configuration Management (SCM),
   4) Langley Risk Evaluation Program (LREP), and
   5) Asbestos Configuration Management Program (ACMP).

1.1.2 LaRC research facilities included in the Facility CM Program have been designated with a Facility Risk Indicator (FRI) of 1, see Appendix C for details of FRI classification, and have had a safety analysis conducted in accordance with the Facility System Safety Analysis process. The Safety Manager shall appoint a Safety and Facility Assurance Branch (SFAB) Facility System Safety Engineer (FSSE) to be the safety point of contact for each of these facilities. Each research facility assigned an FRI 1 also has a unique number, called an Effort Code (EC), to aid in tracking configuration controlled documentation (CCD). The present FRI 1 research facilities and FRI 1 systems EC numbers are listed in Figure 1-1, “Effort Code Summary.”

1.1.3 SFAB utilizes the FRI in determining whether a research facility or piece of research equipment is placed in the Facility Configuration Management Program, Langley Risk Evaluation Program, or under a Safety Permit. All research facilities at LaRC are given a FRI. The assessment criterion for assigning a FRI to a facility is located in Appendix C. The operational procedure to assign a FRI in a facility may be found in LMS-OP-8715.

1.1.4 Details on the Facility System Safety Analysis process, LREP, and the various CM programs are found in the remainder of this document as described below:

a. Chapter 2 addresses the Facility System Safety Analysis process,
b. Chapter 3 addresses the Facility CM Program,
c. Chapter 4 addresses the PSCM Program,
d. Chapter 5 addresses the SCM Program,
e. Chapter 6 addresses the LREP, and
f. Chapter 7 addresses the ACMP.

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EC	BLDG	FACILITY NAME
01	1247E	West Area High Pressure Air System
02	1275	20-Inch Mach 6 CF_4 Tunnel
03	1265	8-Foot High Temperature Tunnel
05		Hypersonic Blowdown Tunnels:
05-01	1247D	* 20” Mach 6 Tunnel
05-02	1247D	* Nozzle Test Chamber
05-07	1247D	* Supersonic Low Disturbance Tunnel
05-08	1247D	* High Pressure Air and Vacuum Systems
05-09	1247D	* 20” Supersonic Wind Tunnel
05-10	1247D	* Probe Calibration Tunnel
05-11	1247D	* Grazing Flow Impedance Tube
05-12	1247D	* Curved Duct Test Rig
13	1268A	Visual Motion Simulator
16	1251A	31-Inch Mach 10 Tunnel
17	1251A	15-Inch Mach 6 High Temperature Tunnel
18	648	Transonic Dynamics Tunnel
19	1212C	14- X 22-Foot Subsonic Tunnel
21	1234	Jet Exit Test Facility
22	1208	Acoustic Research Laboratory
23	1148B	Hypersonic Materials Test Apparatus
24	1251B	Unitary Wind Tunnel
25	1247B	Arc-Heated Scramjet Test Facility
29	1257/1262	Aircraft Landing Dynamics Facility
33	1297	Landing and Impact Research Facility
34	1242	0.3-Meter Transonic Cryogenic Tunnel
36	1221A	Jet Noise Apparatus
37	1221B	Thermal Acoustic Fatigue Apparatus
53	1268A	Lunar Flight Deck
54	1268A	Developmental and Test Simulator
55	1268D	Cockpit Motion Facility
61	644	12-Foot Low Speed Tunnel
62	645	20-Foot Vertical Spin Tunnel
66	1268A	Differential Maneuvering Simulator
71	1221D	Direct Connect Supersonic Combustion Test Facility, Test Cell #2
75	1256	Combined Loads Test System (COLTS) – Test Machine
80	1221D	Combustion Heated Scramjet Test Facility, Test Cell #1
84	1244	Hangar Foam Deluge System
85	1232A	Heavy-Duty Brazing Vacuum Furnace
86	1293B	16-Meter Thermal Vacuum Chamber
91	1238B	Composite Shop Autoclave
97	1293	Space Systems Structures Research Laboratory
98	1215	Steam Distribution System
99	1236	National Transonic Facility (NTF)
100	1241	Liquid Nitrogen Plant
300	1233	Switching Diagrams
301	Various	Manhole Drawings
302	Various	Low-Voltage One-Line Drawings
303	Various	Stratton Substation Control Diagrams
400	1205	Materials Research Laboratory
401	1225	Advanced Development Lab
402	1233	Stratton Road Substation
403	1250	Systems Integration & Test Branch
404	1267	Component Verification Facility

Figure 1-1, Effort Code Summary.

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1.2 OBJECTIVES

1.2.1 The objectives of LaRC's Facility System Safety Program are to:

a. Ensure that the appropriate safety analysis has been conducted,
b. Ensure that designated facilities/systems are placed under the appropriate level of configuration management, and
c. Document and communicate the risk of facilities and equipment to management and employees.

1.2.2 The objectives of a safety analysis, whether a Facility System Safety Analysis or Langley Risk Evaluation, are:

a. To identify hazards,
b. To determine the risk of hazards in terms of severity and probability,
c. To assess the controls for those hazards, and
d. To recommend controls that will eliminate the hazard or reduce the risk of the hazard.

1.2.3 The objectives of the Facility CM program are:

a. To record and maintain safety analysis documentation,
b. To document and maintain standard operating procedures for use by operating personnel,
c. To ensure SFAB reviews changes that affect safety, and
d. To establish and maintain a baseline for designated systems (e.g., electrical systems) and the relevant documentation (e.g., drawings).

1.2.4 The objective of the Pressure Systems Configuration Management Program is to maintain the configuration of Pressure System Documents (PSD)

1.2.5 The objectives of the Software Configuration Management Program are:

a. To document and maintain configuration control of software and,
b. To ensure SFAB reviews changes that affect safety

1.2.6 The objectives of the Langley Risk Evaluation Program are:

a. To record and maintain the risk evaluation,
b. To document and maintain Langley Operating Procedures (LOPs)for use by certified operating personnel

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1.2.7 The objectives of the Asbestos Configuration Management Program are:

a. Increase safety awareness and minimize the risk of asbestos exposure to personnel
b. Institute controls to prevent the release of asbestos fibers, restrict future asbestos use, and develop surveillance and control of known, existing asbestos applications in LaRC facilities.

1.3 DEFINITIONS

1.3.1 The glossary in Appendix A lists and defines the terms unique to the Facility System Safety and CM Programs.

1.4 WAIVERS

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

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Chapter 2

2. FACILITY SYSTEM SAFETY ANALYSIS

2.1 PROGRAM SUMMARY

2.1.1 A Facility Systems Safety Analysis (FSSA) is a systematic approach toward:

a. Identifying credible hazards associated with the operation of a facility,
b. Defining the hazards in terms of severity and probability,
c. Assessing the controls for those hazards,
d. Making recommendations toward reduction of the severity and/or probability of occurrence, and
e. Identifying documentation to place under configuration control.

2.1.2 A FSSA shall be performed prior to the start of research activities at a new facility, prior to the start of research activities at an existing facility that has undergone a Construction of Facility (CoF) modification or prior to any existing facility being brought into the Facility CM Program. The final documents of this effort, all of which shall be placed in the Facility CM Program, are

a. Standard Operating Procedures (SOPs) and Checklists,
b. Safety Analysis Report (SAR),
c. Configuration Control Documentation (CCD),
d. Other special items identified by the Facility Team.

2.1.3 The SAR documents the results of the FSSA. The remaining items support the FSSA and ensure hazard controls (e.g., procedures, interlocks) have been documented and placed under configuration control. This ensures the long term safe operation of the facility.

2.1.4 The overall responsibility for conducting the FSSA lies with the Safety and Facility Assurance Branch (SFAB); however, the analysis is a group effort conducted by a Facility Team. A Facility Team includes:

a. Facility Manager (FM)
b. Facility Systems Engineer (FSE)
c. Organizational Facility Safety Head (OFSH) (henceforth called FSH),
d. Facility Coordinator (FC),
e. Facilities Configuration Coordinator (FCC) from the Project and Engineering Branch (PEB), Center Operations Directorate (COD),
f. Facility System Safety Engineer (FSSE) from SFAB, and
g. Configuration Management (CM) Engineer from CM contractor.

2.1.5 The above members of a Facility Team are permanent members who also assist with meeting the requirements of the Facility CM Program. For new facilities or CoF

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projects, the Project Manager (PM) from the PEB is also a member of the Facility Team during performance of the FSSA.

2.2 PLANNING AND EXECUTION

2.2.1 For an existing facility that will be added to the Facility CM Program, the assigned SFAB FSSE will notify the responsible FSH about the initiation of a FSSA. The FSH, with the assistance of the facility staff, will assemble and provide to the SFAB FSSE all existing documentation that reflects the “as-is" facility configuration. These documents include:

a. The appropriate facility electrical and mechanical drawings (redlined if necessary);
b. Draft SOPs and/or checklists;
c. Vendor manuals, maintenance plans and engineering reports/analyses; and
d. Any other item that may be of value toward the system safety analysis such as operational logs, failure mode histories, and specific areas of concern.

2.2.2 These documents form the foundation of the FSSE’s formal analysis of the facility's hazards and other conditions appropriate to the issue of safety. Details of how to develop a SAR, SOPs, and identify CCD are discussed in the following paragraphs.

2.2.3 For new facilities or CoF projects, it is very important that the SFAB FSSE be involved during all phases of design, construction, and shakedown. For these projects, the FSSA shall be an integral part of the design process as outlines in Section 3.4.4, “Change Controlled by Design Review Process.” At the start of any new project, the PM or FSH shall contact the SFAB FSSE, who shall initiate the FSSA.

2.3 SOPS AND CHECKLISTS

2.3.1 Instructions for the development of SOPs and Checklists are found in the following paragraphs. Facility complexity and operational risks dictate the requirement for the degree of structured operations, which shall be controlled by SOPs and/or Checklists.

2.4 SOP Development Requirements

2.4.1 SOPs are detailed, written, formal instructions for certified operators to use during operation of the facility. The requirements to be followed in the preparation of SOPs are listed below.

a. SOPs shall provide for a complete cycle of operation (dormant to run back to dormant). This cycle will be presented in three separate sections: Pre-Operational Procedures (PR), Operational Procedures (OP), and Post-Operational Procedures (PO).

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b. SOPs shall be developed in accordance with Appendix D, Requirements for Developing SOPs/Checklists.
c. SOPs for the complete cycle shall be demonstrated and approved prior to being included in the CM Program.
d. Initially, demonstrations shall be "dry runs" to avoid unnecessary exposure to hazards.
e. SOPs shall be approved by the preparer, reviewer, Safety Manager and FSH.

2.4.2 Checklist Development Requirements

a. Checklists may be utilized by facilities to provide an avenue for certified operators to complete their work for routine, day-to-day operations of a facility.
b. Based upon the facility and the task to be performed by the certified operator, checklist may take the form of:
    1) An abbreviated, 1 to 1,less-detailed instruction of the SOP,
    2) An appendix to an SOP, which identifies a series of steps to be completed before moving to the next step in the SOP (e.g., Valve or Circuit Breaker Line-up),
    3) Or, routine facility tasks which do not require the level of detailed offered by an SOP..
c. Checklists are not required for a facility in the CM Program; however, if a facility chooses to have checklists they must be demonstrated, approved, and brought under CM prior to their use.
d. Checklists shall be developed in accordance with Appendix D, Requirements for Developing SOPs/Checklists.
e. Checklists shall clearly identify what is included.
f. Checklists are often reproduced within the facility and a copy used for each operational run. In such cases, the entire Checklist shall be reproduced and no part of the original omitted.

2.4.3 SOP/Checklist Organization

SOPs/Checklists will be divided into three sections: Introductory Matter, Text, and Emergency Procedures.

2.4.3.1 Introductory Matter

a. The Introductory Matter consists of the Title Page, Revision Record, General Introduction, and Safety Information.

b. The **Title Page** contains the SOP/Checklist title, the name of the facility for which the document was completed, the facility number in which the facility is housed and the statement **“THIS DOCUMENT CONTAINS HAZARDOUS OPERATIONS PROCEDURES”**.

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c. The **Revision Record** reflects all SOP/Checklist document changes as well as who prepared, reviewed, and accepted those changes. These shall be:

1) The “Prepared By" column shall be signed by the person who prepared the change.
2) The "Reviewed By" column shall be signed by the designated reviewing authority.
3) The "Reviewed By Safety Manager" column shall be signed by the Safety Manager or designee.
4) The "FSH Cognizance" column shall be signed by the FSH.

e. A **General Introduction** page addresses the purpose, personnel, equipment, support and safety services, initial conditions, references, remarks appropriate to the procedures/checklist being presented.

1) PURPOSE - A short description of what the task/subtask(s) is to accomplish.
2) PERSONNEL - A listing of the minimum number of persons and their certification/qualification required to perform the task/subtask(s).
3) EQUIPMENT- A list of the tools, test instruments, and the like needed to perform the task/subtask(s).
4) SUPPORT AND SAFETY SERVICES- Identification of organizational elements and facilities required to support the operation (e.g. Air Control, Power Distribution, Safety, Security).
5) INITIAL CONDITIONS- A description of assumptions made prior to beginning the tasks/subtask(s), for example, Pre- Operational Procedures have been completed.
6) REFERENCES - Where to find other information needed for system operation.
7) REMARKS - Any information needed to clarify the task/subtask (s).

f. The **Safety Information** section contains information regarding any condition, event, operation, process, or item of whose proper recognition, control, performance, or tolerance is essential to safe system operation or use. The SAFETY INFORMATION section shall immediately follow the general introduction page and shall contain the following:

1) HAZARDS – A statement for the certified operator(s) to see Facility Resume and SAR for potential conditions that may be hazardous to personnel executing the procedure or to government property. Occupational hazards that are not listed in the facility SAR shall be listed here.
2) COUNTERMEASURES – A statement for the certified operator(s) to see Facility Resume and SAR for a list of safety devices, interlocks, etc. that are employed to reduce the risk to personnel or equipment from the hazards specified above.
3) HAZARDOUS MATERIAL(S) - A statement for the certified operator(s) to see Facility Resume, SAR, Material Data Sheet Book or log into the Chemical Tracking System Log for a list of hazardous materials that may be encountered during execution of this procedure.

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4) PERSONAL PROTECTIVE EQUIPMENT – List the personnel protective equipment (PPE) required to safely and effectively accomplish the procedure.

2.4.3.2 Text

The Text section begins immediately following the Introductory Matter and consists of a Sequence Flow Chart, which shows the safe order in which the preoperational (PR), operational (OP), and post operational (PO) procedures can be executed, followed by the actual, step-by-step SOP/checklist.

2.4.3.3 Emergency Procedures

The Emergency Procedures section shall specify certified operator actions to be taken during plant emergencies (e.g., Emergency contact information, routes of exit, fire alarms and extinguishers). This section is not intended to provide personnel with information to take a corrective action to restore a failing system or to attempt to control the source of the emergency. This section shall always be at the end of the SOP, regardless of any additional appendices used by individual SOPs.

2.4.4 Changes to SOPs/Checklists developed before LPR Effective Date

SOPs/Checklists developed before the effective date of this LPR, requiring only an administrative change, shall not be required to be updated in accordance with the requirements set forth in this document.

2.4.5 SOPs/Checklists Changes and Distribution

Because SOPs/Checklists are CCDs, they shall be changed and distributed in accordance with the requirements set forth in Chapter 3 of this document.

2.5 SAFETY ANALYSIS REPORTS (SARS)

A SAR is the formal documentation of the FSSA and shall be prepared in accordance with Section 2.5.2. It shall be a CCD document and any change to the facility will be considered for possible SAR impact.

2.5.1 SAR Organization

The SAR is divided into three main sections — Introductory Matter, Text, and Appendices. The Text is further subdivided into subsections common to all facilities although, on a case-by-case basis, additional special-item subsections (for example, a Critical Items List (CIL)) can be added). The common subsections of the Text are the Introduction, the Facility Description and the Safety Analysis Summary. The following is a discussion of each section.

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2.5.1.1 Introductory Matter

a. The Introductory Matter consists of the Title Page, Revision Record, and Table of Contents.

b. The **Title Page** contains the report title, the name of the facility for which the report was completed, the building number in which the facility is housed, and the Effort Code (EC) associated with the facility.

c. The **Revision Record** reflects all changes to a SAR; who prepared, reviewed, and accepted the report/changes; and the date issued. The required signatures are as follows:

1) The “Prepared By" column shall be signed by the FSSE who prepared the report/change.
2) The “Reviewed By" column shall be signed by the designated reviewing authority.
3) The “Reviewed By Safety Manager" column shall be signed by the Safety Manager or designee.
4) “FSH Cognizance” column shall be signed by the FSH.

d. The **Table of Contents** lists the major subsections of the SAR and the page number on which each begins.

2.5.1.2 Text

a. The Text section of the SAR consists of the Introduction, the Facility Description, and the Safety Analysis Summary.

b. The **Introduction** identifies the facility, states the purpose and philosophy of the analysis, and explains the Risk Assessment logic.

c. The **Facility Description** provides a brief overview of the subject facility and describes the major facility capabilities, the nature of research conducted, the subsystems, and any special facility features appropriate to the safety analysis. It also includes a Facility Block Diagram that shows the general relationships among the various subsystems.

d. The **Safety Analysis Summary** contains two sections: General Observations & Recommendations and Tabular Summary. General Observations and Recommendations address the hazards that are general in scope as opposed to specific to a particular subsystem and documents any other fact the FSSE feels is relevant to the SAR but does not belong in an Appendix. The Tabular Summary subsection lists and discusses the identified undesired events and the associated risks. The Tabular Summary presents a synopsis of the safety analysis of each major subsystem, which is given in detail in the appendices.

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Each Hazard/Undesired Event shall be assigned an alphanumeric Risk Level, before and after hazard controls are implemented, in accordance with the philosophy and guidelines established in Section 2.5.4.

2.5.1.3 Appendices

The appendices of the SAR provide a detailed discussion of the Hazards, Undesired Events, and Risk Assessments. There is a separate appendix for each major subsystem identified on the Facility Block Diagram.

2.5.1.4 Critical Items List (CIL)

The SAR includes a Critical Items List (CIL) for any facility that has a Critical Item. A Critical Item is any item, the single order failure of which would likely result in death or damage to equipment/property equal to or greater than $1.0M. Section 2.5.2 provides more details about preparing a CIL.

2.5.1.5 SAR Changes and Distribution

Because SARs are CCDs, they shall be changed and distributed in accordance with the requirements set forth in Chapter 3 of this document.

2.5.2 SAR Preparation

a. The Safety Manager shall appoint a SFAB FSSE to be responsible for the preparation of a SAR. The actual preparation is performed by either the SFAB FSSE or a FSSE from a support contractor. Any SAR prepared by a support contractor shall be reviewed and approved by the SFAB FSSE.

b. The following definitions provide a uniform understanding of the terms related to SAR preparation:

1) **Hazard.** A condition which has the potential to result in damage to equipment and/or personnel injury/death.
2) **Undesired Event.** An event (or series of events) which unleashes the potential inherent in a hazard, and either directly or indirectly results in equipment damage and/or personnel injury/death.
3) **Cause.** The stimulus or triggering mechanism/act which precipitates the Undesired Event.
4) **Effect.** The consequence of the Undesired Event in terms of equipment damage and/or personnel injury/death.

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2.5.2.1 Phases

a. The phases of SAR preparation is outlined in Figure 2-1, “SAR Preparation Sequence.” A description of each phase follows.

b. The first phase is the **System Definition Phase**. During this phase, the FSSE uses facility provided documentation to define the system. The facility is divided into manageable subsystems. Examples of such subsystems are high pressure air, vacuum, model injection, cooling water, test section, nitrogen, hydrogen, and so forth. How these subsystems are identified in any given facility depends on the methodology used by the FSSE in organizing the SAR to cover every aspect of the facility. For example, in one instance, the model injection component may be a separate subsystem; whereas, in another instance, it may be included as part of the test section subsystem. The important thing is to ensure that all components of the facility are analyzed. Also at this time, a Facility Block Diagram is generated to show the interrelationships among the chosen subsystems.

c. Next, the FSSE performs a **Preliminary Hazard Analysis (PHA)** to identify all the possible Hazards and the Undesired Events that could result from those Hazards. This phase represents an initial safety assessment of the facility. The Hazards and Undesired Events established here will be expanded as the safety analysis progresses. There may be none or any number of Hazards in each of the subsystems. Upon completion of this phase, copies of the products will be sent to the Facility Team for initial review and clarification of the facility Hazards and Undesired Events.

d. Upon completion of the PHA the **Initial Facility Team Review** is conducted. The Facility Team conducts an initial review of the effort by examining the System Definition and Preliminary Hazard Analysis products and provides the FSSE additional information and comments.

e. With input from the Facility Team, the FSSE performs a **Detailed Hazard Analysis (HA).** The HA ensures that a deductive approach is taken in the assessment of the safety implications of the facility and it documents that thought process. The approach taken is reflected in Figure 2-1. Details of how to perform a HA are provided in Section 2.5.3.

f. With the subsystems, Hazards, and Undesired Events defined, the FSSE prepares a **Critical Items List (CIL)**, if required. A Critical Item is any item, the single order failure of which would likely result in death or damage to equipment/property equal to or greater than $1.0M. A Critical Item must have the design analyses, in-service inspection/preventive maintenance procedures, installation procedures, and nondestructive testing required to establish and maintain an acceptable probability of occurrence. The requirement for design calculations can be waived for Critical Items which are proprietary or part of a

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company's standard product line providing that the item has been designed to industry consensus codes, a history of acceptable operations of the same or similar products is available, and the use is in compliance with the manufacturer's ratings and recommended applications. Examples of proprietary items that meet the design waiver criteria are large rotating machinery for wind-tunnel compressor or drive systems. Critical Items listed in a SAR shall be tracked throughout their lifetime for compliance with design, maintenance, and inspection requirements. Pressure components that are standard product lines and built to national consensus codes or standards are not considered Critical Items. However, these items are covered under LaRC's Pressure System Recertification Program to assure system integrity.

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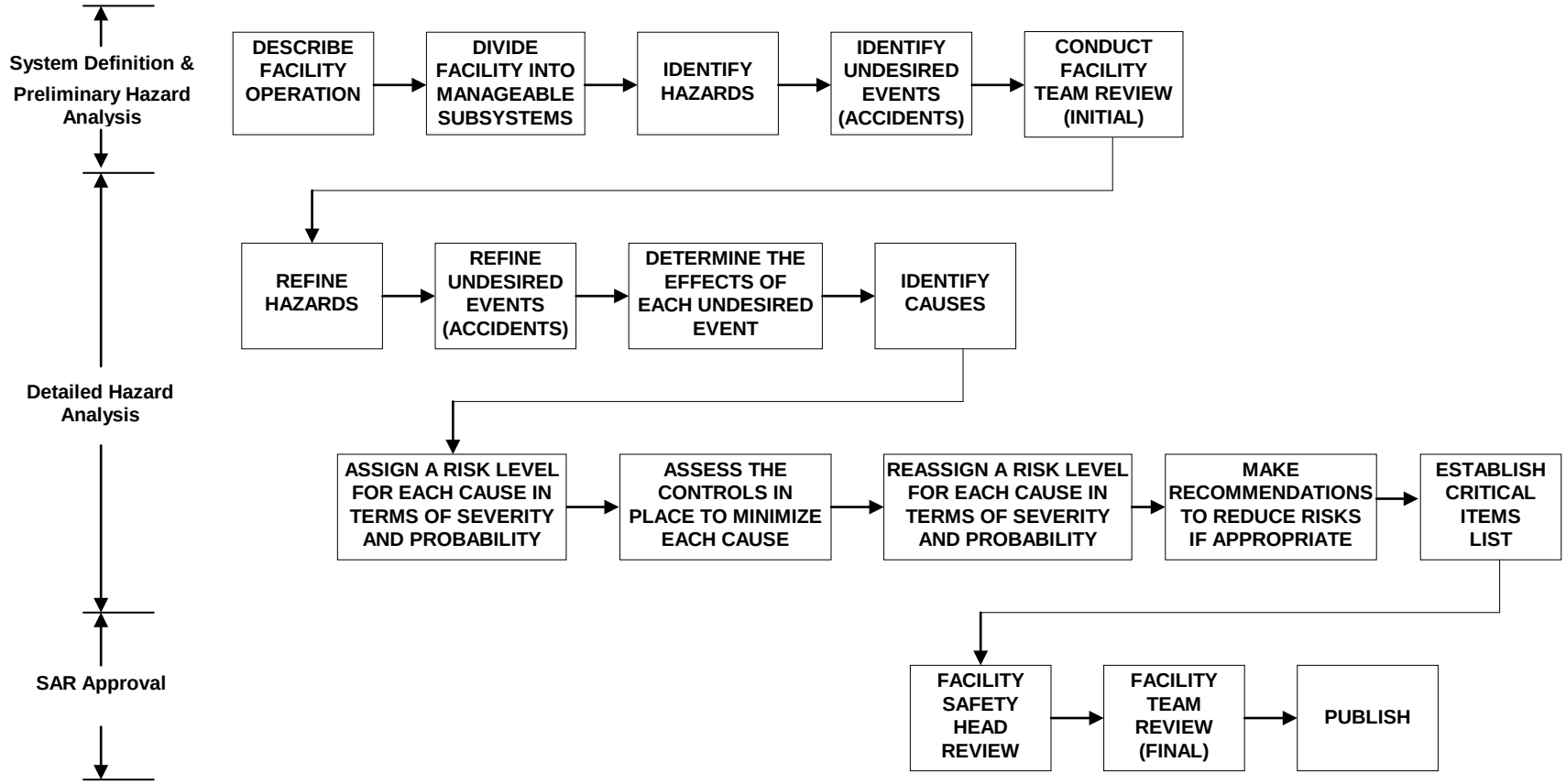

Figure 2-1, SAR Preparation Sequence.

g. At this point, a complete SAR is ready for a **Facility Safety Head Review.** The FSH conducts a thorough and independent review of the SAR.

h. Once the FSSE and FSH agree that the SAR is complete a **Final Facility Team Review** is conducted. During this phase, the remaining members of the Facility Team review the SAR.

i. Finally, the SAR is **Published.** After all of the issues are resolved and the SAR is prepared in final format, it shall be formally approved by the Safety Manager and FSH. Finally, it shall be incorporated into the CM Program.

2.5.3 Hazard Analysis

a. The HA begins with a detailed exploration of each of the identified Hazards (an example of one might be hot surfaces). Considering that Hazard, the FSSE establishes what event(s) could occur that would result in the Hazard causing damage, injury, and/or death (for example, personnel in contact with hot surfaces). Those events become the Undesired Events. There could be multiple Undesired Events resulting from each identified Hazard. The analyst then quantifies the Effects of each Undesired Event in terms of damage, injury, and/or death (for example, serious injury to personnel). When numerous effects result, only the most severe is noted.

b. Next, the FSSE establishes what could cause an Undesired Event to occur, and these become the Causes (for example, personnel error). There could be one or multiple causes for the same Undesired Event. The next step in the analysis is the Risk Assessment. An individual assessment is made without the consideration of any hazard controls in place to prevent the undesired event. A Risk Assessment Code (RAC) is assigned to each of the identified Causes using the guidance provided in Section 2.5.4. To determine a facility's ability to avoid the occurrence of an Undesired Event, the FSSE assesses the safety devices and procedures that are in place to minimize the probability of occurrence of each Cause. This assessment takes the form of an investigation of the design and operational features that reduce the probability of each individual Cause from occurring.

c. In the interest of plausibility, the Undesired Events, Causes, and Effects are to be confined to “credible" as opposed to “conceivable" events. They should reflect only those things that could reasonably be expected to occur.

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d. After the SFAB FSSE has assessed the current hazard controls, the RAC is re-evaluated using the guidance provided in Section 2.5.4. If an assigned RAC is unacceptable, as outlined in Section 2.5.4, recommendations are made, which would reduce that RAC to acceptable limits, if implemented. These recommendations can take the form of additional safety devices, design changes, or changes in the SOP.

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HAZARD SEVERITY

The Hazard Severity Categories provide a relative measure of the worst possible consequences resulting from personal error, environmental conditions, design inadequacies, procedural deficiencies, or system or component failure/malfunction, with no consideration being given to abatement techniques. They are:

CATEGORY I - CATASTROPHIC. May cause death, permanent disability, the hospitalization of three or more people, and/or system/equipment damage in excess of $1,000,000.

CATEGORY II - CRITICAL. May cause loss time injury or illness, and/or system/equipment damage between $250,000 and $1,000,000.

CATEGORY III - MARGINAL. May cause minor injury or illness, and/or system/equipment damage between $1000 and $250,000.

CATEGORY IV - NEGLIGIBLE. Will not result in injury, illness, or system/equipment damage in excess of $1000.

HAZARD PROBABILITY

Hazard probability is the likelihood that a hazard will occur during the planned life expectancy of the system. The probability level is quantitative, based on engineering judgment, with appropriate guidelines as follows.

LEVEL A - FREQUENT. The level assigned when neither a safety feature nor approved procedures exist to prevent the Undesired Event from occurring.

LEVEL B - OCCASIONAL. The level assigned when a safety feature does not exist, but the use of approved procedures should prevent the Undesired Event from occurring.

LEVEL C - POSSIBLE. The level assigned when approved procedures do not exist, but an existing safety feature should prevent the Undesired Event from occurring.

LEVEL D - REMOTE. The level assigned when both a safety feature and approved procedures, or two independent safety features exist that collectively should prevent the Undesired Event from occurring.

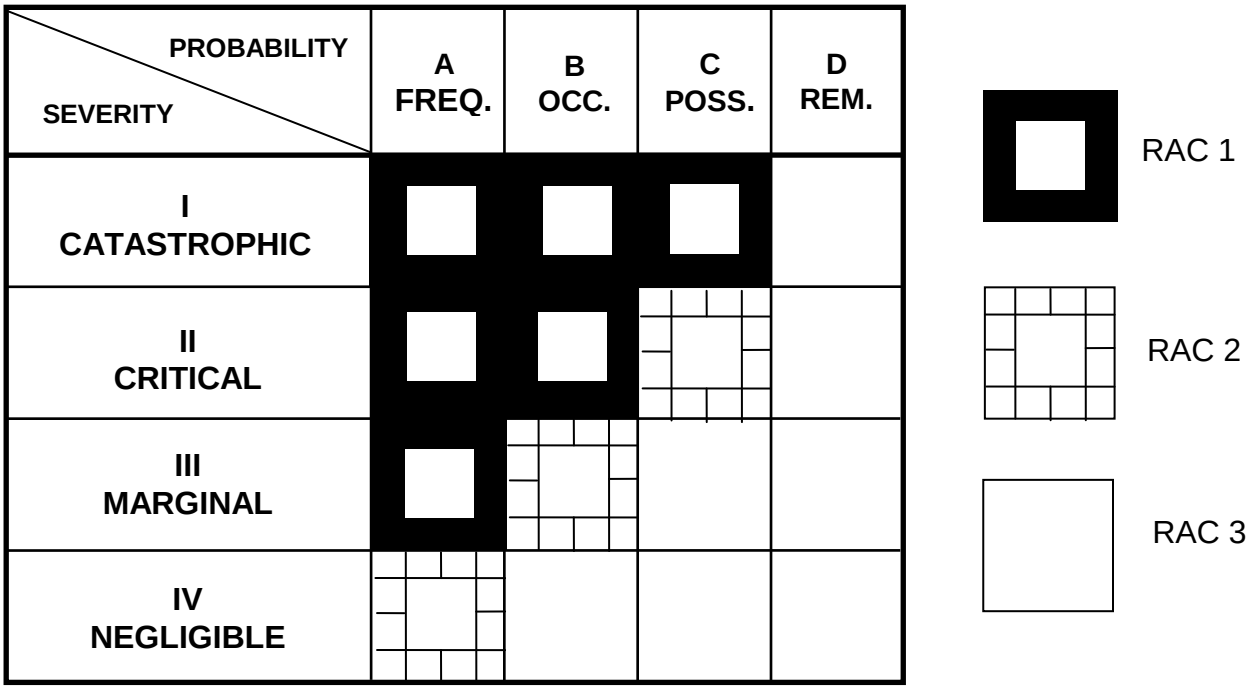

Figure 2-2, Risk Assessment Matrix.

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2.5.4 Risk Assessment

a. An alphanumeric risk level, based on both Severity and Probability of Occurrence, shall be assigned to each Cause, before and after hazard controls are in place, of an Undesired Event. The following paragraphs address how those risk levels are converted into a RAC using LaRC's risk matrix, which is depicted in Figure 2-2, "Risk Assessment Matrix."

2.5.4.1 Severity Category

a. A Severity shall be assigned to each Undesired Event assuming it will occur. In this analysis, the worst possible result is to be assumed with no consideration being given to abatement techniques incorporated in the system design or to the use of procedures. The Severity Category provides a relative measure of the worst possible consequences resulting from personnel error, environmental conditions, design inadequacies, procedural deficiencies, and subsystem or component failure/malfunction. The Severity Categories are:

1) **Category I - Catastrophic** - May cause death, permanent disability, the hospitalization of three or more people, and/or system/equipment damage in excess of $1,000,000.
2) **Category II - Critical** - May cause lost time injury or illness, and/or system/equipment damage between $250,000 and $1,000,000.
3) **Category III - Marginal** - May cause minor injury or illness, and/or system/equipment damage between $1,000 and $250,000.
4) **Category IV - Negligible** - Will not result in injury, illness, or system/equipment damage not in excess of $1,000.

2.5.4.2 Probability of Occurrence Level

a. A Probability of Occurrence shall be assigned to each Cause of an Undesired Event before and after hazard controls are in place. The Probability of Occurrence provides a measure of system safety by evaluating the system design in conjunction with abatement techniques, inspections, tests, and operating procedures. The Probability of Occurrence is the probability that a failure will occur sometime during the planned life of the system. The probability level shall be qualitatively based upon engineering judgment with appropriate guidelines. Those guidelines are:

1) **Level A - Frequent** - The level assigned when neither a safety feature nor approved procedures exist to prevent the Undesired Event from occurring.
2) **Level B - Occasional** - The level assigned when a safety feature does not exist, but the use of approved procedures should prevent the Undesired Event from occurring.
3) **Level C - Possible** - The level assigned when approved procedures do not exist, but an existing safety feature should prevent the Undesired Event from occurring.

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4) **Level D - Remote** - The level assigned when both a safety feature and approved procedures, or two independent safety features, exist that collectively should prevent the Undesired Event from occurring.

2.5.4.2 Establishing a Risk Assessment Code (RAC)

a. First, the Effect of an Undesired Event is evaluated in terms of Severity (I, II, III, or IV).
b. Next, the Probability of Occurrence (A, B, C, or D) is determined for each Cause of the Undesired Event. Using the severity of the Undesired Event, each cause is assigned its own unique alphanumeric Risk Level (e.g - IA, IIB, IIIC).
c. Finally, using the two-dimensional risk matrix, Figure 2-2, each risk level is translated into one of three Risk Assessment Codes (RACs) - RAC 1, RAC 2, or RAC 3. They are pattern-coded on the matrix to distinguish each from the other. RAC 1's include blocks IA, IB, IC, IIA, IIB, and IIIA. RAC 2's include blocks IIC, IIIB, and IVA. All other blocks are RAC 3's. After the in place hazard controls are assessed, the above assessment is repeated using the newly established probability of occurrence.

2.5.4.3 Implications of a Given RAC

a. A RAC is a measure of the severity of an Undesired Event verses the probability that the event will occur. As such, its value has implication of what shall be done prior to operation of a facility.

b. **RAC 1's** are the most serious of the three levels of Risk Assessment. Accordingly, it is in the best interest of all concerned to eliminate them through redesign, safety devices, special operating procedures, or combinations of such methods. The implications of a RAC 1 shall be as listed below and depend on whether the FSSA is being conducted on a new facility, CoF Project, or existing facility.
   1) **New/CoF Project** - RAC 1's for new facilities, and those associated with a major Construction of Facilities (CoF) project in an existing facility, are of major safety concern and require resolution (reduction of the RAC from 1 downward to 2 or 3) before the facility can initiate/resume operations.
   2) **Existing** - RAC 1's for existing facilities not undergoing a major CoF are a major safety concern and require one of the following before the facility can resume operations: (1) resolution (i.e., reduction of the RAC from 1 to a 2 or 3), (2) an abatement plan approved by the Safety Manager, or (3) approval by the Executive Safety Council (ESC) before the facility can resume operation. Failure to meet one of these requirements could result in facility shutdown.

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c. **RAC 2's** are the second most serious of the three levels of Risk Assessment. The implications of a RAC 2 shall be as listed below and depend on whether the FSSA is being conducted on a new facility, CoF Project, or existing facility.

1) **New/CoF Project** - RAC 2's for new facilities and those associated with a major CoF in existing facilities are also of concern and require special attention. The FSH of the facility in question, with Safety Manager concurrence, shall by letter, inform the Organizational Unit Manager who oversees the facility of the nature of the RAC 2 and request approval to conduct operations. Operations shall not begin in that facility until the Organizational Unit Manager, with the concurrence of the Safety Manager and Chairperson of the final design review board has responded by letter authorizing such action.
2) **Existing** - RAC 2's for existing facilities not undergoing a major CoF require no such approval. Acceptance of the risk is acknowledged by the SFAB FSSE, Safety Manager, and FSH by signing the SAR. Plans and programs to correct existing RAC 2 UEs, as time and resources permit, are considered sound management practice.

d. **RAC 3's** are at a risk level that only needs to be accepted by the SFAB FSSE, Safety Manager, and FSH. Acceptance of the risk associated with these undesired events is acknowledged by signing the SAR.

2.6 LARC INTERLOCK PHILOSOPHY

a. In order to conduct business at LaRC, large power sources, pressurized gases, vacuums, hazardous materials, heavy machinery, and many other potentially dangerous conditions are present. The integration of safety into such an operation ensures the protection of the community, operating personnel, equipment, and the environment. LaRC's cornerstone strategy to achieve safety is its Interlock Philosophy, which is described below.

1) A credible single order failure that can jeopardize personnel or major equipment requires an interlock or protective device to prevent its occurrence.
2) A safety interlock or protective device must be independent of the failure mode and cannot be compromised by occurrence of the credible single order failure.
3) When an independent safety interlock or device cannot be provided due to the utilization of a common component or path, then an independent component and/or path is necessary (for example, hardwired backup of a software safety interlock or device).
4) The safety interlock or device, unless it is verified automatically during startup (as a permissive), shall be periodically verified for operation. Period of performance shall be established by the safety analysis and specified in the SAR.

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5) Safety interlocks and devices, either software or hardware, must be under configuration control at the project level both before and during shakedown. Commencing at the Operational Readiness Review (ORR), these safety interlocks and devices shall come under CM in accordance with Chapter 3 of this handbook. At no time shall software changes be made while the facility is on line (in operation).
6) Forcing of safety interlocks or devices during facility operation (temporary changes to complete a run or troubleshoot a problem) must be in accordance with an approved procedure and have the permission of the FSH or a designated alternate.
7) Failures of catastrophic proportions identified by the FSSA shall be assessed individually in the safety analysis and redundant safety interlocks or devices provided.

b. The above philosophy must be pursued regardless of the type of process control or complexity of the research facility. Several techniques can be used to achieve these aims to permit the necessary research to be accomplished. These techniques are discussed in the following paragraphs, in order of effectiveness, beginning with the most effective.

2.6.1 Design

The first line of safety is the initial design of a research facility. Safety and interlock policies must be of equal and simultaneous consideration with research aims in the initial design phase of a facility. It is at this point that the best and the most cost-effective safeguards can be incorporated into a system.

2.6.2 Engineered Safety Features

Once a facility is constructed, additional safety margins can be attained by ad hoc, engineered safety features. Such devices are an integral, permanent part of the facility and its routine operation. Like design features above, they are to be passive in nature and require no special action to cause them to be effective.

2.6.3 Safety Devices / Personal Protective Equipment

Adjunct devices, such as goggles, hard hats, and safety bars, enhance safety. However, they require a conscious act on the part of the certified operator to become useful. Although they may appear cost effective, their effectiveness is moot if they are not employed.

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2.6.4 Warning Devices

Visual and audible means to alert personnel to hazards are economical, but they are not barriers. Many of the techniques in the previous paragraphs are barriers. The term “barriers” implies that such devices prevent the occurrence of Undesired Events. Warning devices are effective only when personnel are aware of them in sufficient time to react; and do, in fact, react.

2.6.5 Procedures/Training

The introduction of the human element into a perfectly designed and controlled hardware system brings with it a potential for unexpected results. To ensure that the occurrences of operator errors are minimized, a thorough training program shall be developed (ref. LPR 1740.7, “Process Systems Certification Program” for more details). The process shall be controlled by SOPs. If operator training and procedure compliance are to be completely effective in lowering the probability of an Undesired Event to an acceptable level, they must be coupled with some, if not all, of the foregoing abatement techniques.

2.7 CRITERIA FOR DESIGNATING DRAWINGS AS CCDS

a. The hazard analysis is a detailed analysis that identifies hazards and the appropriate controls. This ensures the facility is safe at the start of operation, but it does not ensure a safety review of future changes to a facility. This is accomplished by designating the appropriate documents as Configuration Control Documentation (CCD) and placing these documents in the Facility CM Program. CCD documents will include the SAR, the SOPs and/or Checklists, any pressure systems documents, and the key facility mechanical, weld, and electrical engineering drawings and schematics. The SFAB FSSE, FSH, and PM shall be responsible for designating a drawing as CCD. Drawings designated as CCD are any that:

   1) Supports the conclusions of the safety analysis, and/or
   2) Useful for troubleshooting electrical systems.

b. Members of the Facility Team may include other drawings as CCD, if desired.

c. The Safety Manager shall have the responsibility for resolving any differences of opinion and making final decisions regarding the disposition of all drawings chosen for inclusion in the CM Program.

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Chapter 3

3. FACILITY CONFIGURATION MANAGEMENT (CM) PROGRAM

3.1 PROGRAM SUMMARY

a. The LaRC Facility CM Program includes the facilities in Figure 1-1, "Effort Code Summary." LaRC's CM Program provides for the ability to:

1) Record and maintain safety analysis documentation,
2) Document and maintain standard operating procedures (SOPs) for use by operating personnel,
3) Ensure the Safety and Facility Assurance Branch (SFAB) reviews changes that affect safety, and
4) Establish and maintain a baseline for designated systems (e.g., electrical systems) and the relevant configuration control documentation (e.g., drawings).

b. In addition, the Facility CM Program provides for risk reviews that consist of Annual CM Meetings, Procedure Demonstrations, and continual Facility System Safety Engineering Analyses.

3.2 CHANGE CONTROL

a. The cornerstone of LaRC's Facility CM Program is the Change Notification Sheet (CNS) process. Any change to facility hardware that affects safety, CCD drawings, a SAR and/or SOPs shall be processed through the CNS process. Changes to pressure systems documents (PSD) shall also be processed using the CNS process. This process ensures notification of the change to the affected parties, verification that no protective measures have been degraded or defeated, and that no new hazards have been introduced.

b. The CNS process requires the Facility Coordinator (FC), the Facility Safety Head (FSH), the Facilities Configuration Coordinator (FCC), and the Safety Manager, or designee, to approve a CNS prior to any hardware changes. A safety and/or third party review shall be conducted for all modifications except those that are strictly administrative in nature. All affected documents (e.g. SARs, SOPs, checklists, drawings) are redlined prior to implementation of the change.

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c. The CNS process shall be conducted in accordance with one of two Langley Management System (LMS) Center Procedures (CP) - LMS-CP-4710, “Configuration Management for Facilities” and LMS-CP-4890, “Construction and Change Assurance for High Risk Facilities.” LMS-CP-4710 shall be used for minor changes, such as replacing a high-pressure valve with an equivalent component or a change that does not affect safety. More complex changes, such as adding a new system or a change that impacts safety shall be conducted in accordance with LMS-CP-4890. Additional information to determine which LMS process shall be used is provided in Section 3.4.

d. SOPs/Checklists that have had red-lines approved by the FSH shall be submitted to the CNS process within thirty (30) days of approval.

3.3 UPDATING AND DISTRIBUTING CCDS

a. All CCDs shall be updated in accordance with the redlined documents submitted through an approved CNS. Updating CCDs shall not occur until after the changes proposed by the CNS have been completed. All updated CCDs shall be distributed as outlined in this section.

b. For each CNS completed, a distribution package will be generated. The package includes a cover letter that includes the statement "this is a completion of CM update and delivery CCD revision package" and includes at least the following information: CNS Number, EC, Facility Name and Building Number. Each updated CCD shall be included as enclosures to the package. The FSH shall receive a package that includes the enclosures marked "Working Master”. A cover letter without enclosures shall be sent to the FC and Safety Manager, or designee.

3.4 TYPES OF CHANGE

a. Modifications to facilities at LaRC under the CM Program can be one of four types:

1) Administrative change,
2) No safety impact,
3) Safety impact and construction not required, and
4) Safety impact and construction required.

b. The CNS process required depends upon which of these four types of changes is occurring. The four methods are discussed in the paragraphs that follow.

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3.4.1 Administrative Change

Facility modifications that are simply administrative in nature and do not affect safety can be implemented without a CNS. An example of such changes is the replacement of a mechanical or electrical component with an equivalent component or a typographical error in a SOP/Checklist or SAR. A CNS shall be required to update Pressure Systems Documents (PSDs) when like for like replacements are made in a high-pressure system, and the CNS process shall be conducted in accordance with LMS-CP-4710.

3.4.2 No Safety Impact

Changes that require updating CCD but are initiated as no safety impact shall be processed in accordance with LMS-CP-4710. Even though the CNS has been marked “safety not affected,” LMS-CP-4710 requires a safety review to ensure no safety impact.

3.4.3 Safety Impact

a. For those facility modifications that affect safety, the CNS process shall be conducted in accordance with LMS-CP-4890. The primary objective of this process is to ensure the appropriate safety analysis is conducted and that existing CCD documents are updated and, if required, new CCD documents are identified. There are two possible “paths” through this process. The path chosen depends if the change is being conducted in accordance with LAPD 7000.2, “Review Program for Langley Research Center (LaRC) Facility Projects,” or not. Changes that are governed by LAPD 7000.2 are conducted as outlined in Section 3.4.4.

b. For changes that are not governed by LAPD 7000.2, a CNS shall be initiated and submitted through the CMOL system. Affected redlined CCD documents supporting the change shall be appended to the CNS and the electronic package forwarded through the FSH to the Safety Manager, or designee. Prior to the Safety Manager’s approval, the SFAB FSSE responsible for the facility shall conduct a safety analysis. After approval by the Safety Manager, or designee, the package shall be forwarded to the FCC for approval. When the change is completed, the final redlined "as built" documents and field verified drawings shall be submitted via the CNS for document/drawing update.

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3.4.4 Change Controlled by Design Review Process

a. This method is used for major modifications that are governed by LAPD 7000.2, "Review Program for Langley Research Center (LaRC) Facility Projects." For changes in this category, the information below pertains.
   1) Prior to the Preliminary Design Review (PDR) the PM, in coordination with the FSH and FC, shall ensure that the affected portions of all existing drawings, including interface drawings, impacted by the project are field verified (FV) and redlined to reflect the true configuration of the facility.
   2) At the PDR, the SFAB FSSE shall report on the FV status of the above mentioned drawings and present the results of the safety analysis.
   3) Following the PDR, the SFAB FSSE shall initiate a CNS that covers the project. This CNS shall identify all existing CCD drawings, or other documents, and any new drawings/documents that are to be CCDs.
   4) Prior to the Critical Design Review (CDR), all existing and proposed CCD documents shall be redlined to accurately reflect the intended configuration of the facility. Also, the PM shall have a Field Verification Plan to assure all CCD drawings are field verified prior to the Integrated System Review (ISR).
   5) At the ISR, the FSSE shall attest that all drawings previously identified as CCDs have been FV and present the results of the safety analysis.
   6) At the Operational Readiness Review (ORR), the FSSE shall provide the final, approved redlined SAR. The PM shall also provide a complete set of "as built" redlined drawings signed off and approved as FV.
   7) At the completion of the ORR, the above-mentioned redlined documents shall be forwarded via the CNS for incorporation into the CM Program.

3.5 CONFIGURATION CONTROL DOCUMENTATION – DRAWINGS

This section describes several unique aspects of drawings incorporated into the CM Program and designated as CCD. Section 2.7 provides guidelines for which drawings should be placed under configuration control.

3.5.1 Drawing Field Verification

a. All engineering drawings currently in the CM Program shall be classified as either field verified (FV) or unverified. Additionally, no new drawing shall be brought into the CM program (i.e., designated as CCD) unless it is first FV.

b. The field verification process shall be a hands-on verification of the validity of the drawing conducted by facility, SFAB, Project and Engineering Branch (PEB), or contractor personnel. A drawing which has been FV shall display a "FIELD VERIFIED" statement authenticating that action. That statement shall be signed by the person attesting to the field verification. It shall also be signed and dated as approved by the Project Manager (PM), FSH, or FC. If FV drawings are found discrepant, they shall lose their FV status and shall be identified as unverified. A sample of the FV statement is as shown below.

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FACILITY BASELINE DRAWING
FIELD VERIFIED BY: _____
APPROVED BY: _____
LATEST DATE: _____

c. Drawings that are in the CM Program but are not FV shall display a "WARNING! UNVERIFIED" statement alerting the user that they are not field verified. A sample of that warning label is as shown below.

WARNING!
UNVERIFIED

d. All drawings that are currently in the CM Program and not FV are subject of an ongoing field verification effort by facility and PEB personnel as time and resources permit.

3.5.2 Changes to CCD Drawings

When drawings in the CM Program require change, the drawing shall be redlined. New items are added in green ink or in black ink highlighted in yellow marker. Existing items are deleted by marking over them in red ink. Redlined drawings shall be processed using the CNS process. The new original drawings shall be delivered to Engineering Drawing Files (EDF) and new WORKING MASTER copies delivered to the facility.

3.5.3 Working Masters

a. For each CCD drawing, the facility shall be provided a current revision of the drawing marked “WORKING MASTER” in red ink. The intent of this procedure is to identify the drawing as a copy of the current configuration of the facility as described by the Master (reproducible) drawing. These WORKING MASTER drawings are to be kept in a central location at the facility and closely controlled to ensure availability to facility personnel.

b. In those cases where there are a number of CCD drawings which detail systems that affect more than one facility, each of the affected facilities will be listed, by EC, on the CCD sticker applied to the drawings. In addition, each of the affected facilities shall receive a new drawing marked WORKING MASTER in red ink. In this manner, each facility shall maintain a complete file of WORKING MASTER

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drawings that reflect the current configuration. With multiple copies of a WORKING MASTER, the situation can exist where one facility may have modified a system, including the redlining of the affected drawings, without informing the other facility having a WORKING MASTER of the same drawing. To preclude any adverse impact of changing a drawing with multiple ECs, the FSH shall ensure that a CNS has been approved before modifying their facility.

c. Adherence to the following additional guidelines promotes accountability and use of WORKING MASTER drawings:
   1) A WORKING MASTER drawing shall always reflect the true ("as-built") configuration of the facility, which it represents.
   2) Proposed changes to a facility which impact a CCD drawing shall be redlined on a separate copy of the affected drawing, not on the WORKING MASTER.
   3) Changes, which reflect “as-built” configurations, shall be marked on the WORKING MASTER of each affected CCD drawing.
   4) The current WORKING MASTER (or a copy of it) shall always be present at the facility.

3.6 FACILITY BASELINE LIST (FBL) AND SUPPORTING FACILITY DOCUMENTS

A Facility Baseline List (FBL) can be generated for each facility in the CM Program using Configuration Management On-line (CMOL). The FBL represents a list of all CCD documents for the Facility. For those facilities that choose, a list of Supporting Facility Documents (SFDs) will be maintained on CMOL. SFDs are documents/drawings that are affiliated with the facility but not under CM control. It shall be the responsibility of the FSH or FC to update the list of SFD and submit any changes to CMOL. SFDs are not CCDs, and their configuration is not maintained as part of the CM Program. Revision of SFD drawings is the responsibility of the facility since they are not CCD.

3.7 FILING SYSTEMS FOR CCDS

The documents in the CM Program are stored as described in the following paragraphs.

3.7.1 Engineering Drawing Files (EDF)

EDF shall be the repository for all original (reproducible) configuration controlled drawings and for the electronic historical records of configuration controlled drawings and other CCDs. EDF will preserve these historical records and all subsequent changes. Only a Configuration Management Engineer, with the Configuration Management contractor maintaining CMOL, shall be permitted to withdraw CCD original drawings from EDF. Analyses, drawings, and nondestructive engineering information for systems that have been recertified or identified in the CIL shall also be stored in EDF.

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3.7.2 Facility Files

Each facility shall maintain its own filing system of current WORKING MASTER CCDs. Facilities must ensure that updates to WORKING MASTERs are posted and centrally stored so as to be of use when needed.

3.8 RISK AND CM REVIEW

The risk and CM review aspect of the CM Program consists of Annual CM Meetings, Procedure Demonstrations, and continual Facility System Safety Engineering Analyses.

3.8.1 Annual CM Meetings

Annual CM Meetings shall be held for each LaRC facility in the CM Program to review facility documents and status, plans, and program effectiveness. These meetings shall be scheduled by the SFAB FSSE. Attendees include the FM, FSE, FCC, FSH, FC, SFAB FSSE, and CM Engineer. SFAB FSSE shall issue a letter summarizing the meeting and delineating "action items." The minutes shall be permanently maintained by SFAB FSSE as documentation that the CMOL documents have been reviewed and re-approved.

3.8.2 Procedure Demonstrations

a. Procedure demonstrations shall be conducted annually by CM contractor to validate the integrity of existing procedures. The following individuals shall be present during the procedure demonstration

   1) Facility Safety Head
   2) LaRC Safety Manager, or designee
   3) CM Engineer
   4) Certified Operator(s)

b. Procedures which have not been verified or used within the last 12 months, shall be verified by a Procedure Demonstration. At the completion of a Procedure Demonstration, the CM engineer shall notify all participants which procedures were demonstrated and the CNS numbers associated with any required changes.

3.8.3 Continual Facility System Safety Engineering Analyses

All configuration changes submitted by CNS are subject to a Facility System Safety Engineering Analyses by the designated SFAB FSSE. During this process, the CM documents (e.g. SARs, SOPs, Checklists, and engineering drawings) are analyzed to assess the safety impact of the proposed changes.

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3.9 CONFIGURATION MANAGEMENT ON-LINE (CMOL)

CCDs in the LaRC Facility System Safety Program are accessible electronically and the CNS process is implemented electronically. The CMOL system provides for searching and viewing CCDs and provides for electronic CNS processing (i.e., CNS Workflow).

3.9.1 Access and Database Maintenance

a. Access to CMOL shall be by authorized personnel at "https://cmol.ndc.nasa.gov/." Entry into the CMOL system shall be controlled by use of an employee's Agency User ID (AUID) and associated password. SFAB shall approve any request for an account that requires authority to approve a CNS.

b. New documents shall be entered into the CMOL database within 10 working days of final approval. If there is a question concerning the currency of a particular document, contact a representative from SFAB for assistance and/or confirmation.

3.9.2 CNS Initiation/Processing

At the CMOL homepage, the user selects the "LF 127, Change Notification Sheet (CNS) WorkFlow System" to initiate, approve, or view a CNS. The CNS workflow screen allows for three options from which to select. The first option allows the user to create a new CNS Work Package on line, and the second allows for searching for a particular CNS Work Package that is already in the system. The third option allows the user to view the status of CNS Work Packages over which the user has authority or requires the user's attention (i.e., review and approval).

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Chapter 4

4. PRESSURE SYSTEMS CONFIGURATION MANAGEMENT (PSCM)

4.1 PROGRAM SUMMARY

a. As part of LaRC's Pressure Systems Recertification Program, a Pressure Systems Document (PSD) is developed for ground-based high-pressure systems. For additional information about the Pressure Systems Recertification Program refer to LPR 1710.42, "Safety Program for Maintenance of Ground-Based Pressure Vessels and Pressurized Systems." The Pressure Systems Configuration Management (PSCM) program maintains the configuration control of all PSDs using the CNS process outlined in Chapter 3 of this document.

b. Any change, whether administrative in nature or not, to a high pressure system covered by LaRC's Recertification Program shall be documented using the CNS process. Changes that are administrative in nature, such as replacing a high-pressure valve with an equivalent component, shall be performed in accordance with LMS-CP-4710, "Configuration Management for Facilities." Other changes shall be conducted in accordance with LMS-CP-4890, "Construction and Change Assurance for High Risk Facilities".

c. After a change has been approved and the work has been completed, all affected documentation shall be field verified and updated in CMOL. Any discrepancies found during the field verification shall be appropriately redlined and reviewed by the Standard Practice Engineer (SPE) for Pressure Systems and the FSH prior to incorporation into the CCD.

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4.2 PRESSURE SYSTEMS DOCUMENT (PSD)

a. The SPE for Pressure Systems shall ensure that PSDs are produced for all ground-based high-pressure vessels/systems in accordance with LPR 1710.42, "Safety Program for Maintenance of Ground-Based Pressure Vessels and Pressurized Systems." The PSD is a compendium of component information and sketches and consists of:

1) **Title Page** - Identifies the document as a PSD, the facility number and name, the system name and designation, and the PSCM document number.
2) **PSCM Revision Record** – Reflects the approval of all issues of the PSCM.
3) **Table of Contents**.
4) **Introduction** - Discusses the development, purpose, and uses of PSCM.
5) **Definition of Symbols**.
6) **Key to Recertification Sheets** (Component Inventories).
7) **System Description**.
8) **Isometric Drawings**.
9) **Recertification Status Sheets**.
10) **Footnotes**.
11) **Document Reference Sheet**.

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Chapter 5

5. FACILITY SOFTWARE ASSURANCE AND CONFIGURATION MANAGEMENT

5.1 GENERAL

The use of automated control systems, for example programmable logic controllers (PLC) and PC's, by LaRC research facilities has generated the need for configuration control of software, including PLC logic. This chapter outlines the requirements for the Software Configuration Management (SCM) Program at LaRC research facilities.

5.2 PROGRAM OVERVIEW

a. The development/acquisition of software products for LaRC research facilities shall be in accordance with LMS-CP-5528, "Software Planning, Development, Acquisition, Maintenance, and Operation." The required level of configuration control during development shall be in accordance with LMS-CP-5528 and meet the requirements of LMS-CP-5529, "Software Configuration Management Planning for Low-, High-, and Critical-Control Software."

b. Each research facility using an automated control system that is responsible for performing safety functions (e.g., correct valve sequencing, shutdown the facility in an over temperature condition) shall develop a Software Configuration Management Plan (SCMP). Programmable logic controller (PLC) logic is considered software for facilities that use a PLC to control facility systems and/or perform safety functions.

c. The SCMP shall be developed in accordance with LMS-CP-5529, and placed under configuration control in CMOL. In addition, the plan shall define a process to identify and review changes that directly affect safety prior to implementation. Changes that modify a hazard control (e.g., interlocks, valve sequencing) of an Undesired Event identified in the Safety Analysis Report (SAR) or affect the safety of the facility shall be processed using a Change Notification Sheet (CNS). This ensures a safety review by the FSH, the FC, a SFAB FSSE, and a PEB representative. The CNS also ensures other CCD documents (e.g., SAR) are updated as required. The Software Configuration Manager (SCM), who shall be defined in the SCMP, shall initiate the CNS. If the SCM has any question about the safety impact of a change, the FSH or an SFAB FSSE shall be consulted.

d. For a facility with a SCMP developed prior to the first release of LMS-CP-5529, a new SCMP that meets the requirements of LMS-CP-5529 is not required until new software is developed/acquired. However, if the existing SCMP does not clearly define a process to review changes that impact safety, a new SCMP shall be developed.

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Chapter 6

6. LANGLEY RISK EVALUATION PROGRAM (LREP)

6.1 PROGRAM SUMMARY

a. The Langley Risk Evaluation Program (LREP) has been established to provide a systematic review of the energy sources utilized by research equipment and operations at LaRC which are not in the CM Program and not covered with a Safety Permit. This review mechanism allows SFAB to identify any potential hazards associated with these energy sources and identify the proper controls for the energy sources. As shown in Figure 6-1, equipment/operations using energy sources at or above the identified levels which are not in the CM Program and not covered with a Safety Permit shall be reviewed by SFAB for inclusion into LREP before the equipment is purchased and installed on Center.

Equipment/Operations Required for Review		
Electrical • Permanently installed, operating at or above 50 VAC/VDC. <u>Example:</u> Wind-tunnel motor, 240-volt, 3-Phase.	**Thermal** • External surfaces in excess of 130 °F. • Internal temperatures in excess of 212°F. • Utilizing cryogenic fluids <u>Example:</u> Vacuum Furnace, Operates internally to 3000°F	**Pressure** • All pressurized/vacuum systems <u>Example:</u> MTS test stand, hydraulic pressure at 3000psi
Human Interactions • Requires the use of an external piece of equipment (e.g. – laptop, pendant) to operate. <u>Example:</u> MTS test stand with personal computer workstation; provides main user-interface.	**Chemical Reactions** • Utilized to initiate chemical reactions or a byproduct of operations <u>Example:</u> Plasma flow control apparatus, generates ozone and other pollutants as a byproduct	

Figure 6-1, Equipment/Operations LREP Energy Source Levels.

b. Facilities that are not in the CM Program and not covered with a Safety Permit and have been identified with an FRI of 2 shall be included in the LREP program, (see Appendix C2.2 for more information) and any other system which has been determined by SFAB to be included in LREP.

c. Equipment/Operations held under the former Laboratory Risk Evaluation Program are excluded from the requirements of this Chapter until an update is required. At the time an update is required, the equipment/operations shall be evaluated under this Chapter.

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d. The elements associated with the LREP program are a Langley Risk Evaluation and a Langley Operating Procedure. These documents shall be maintained in the Facility Resume.

6.2 LANGLEY RISK EVALUATIONS (LRES)

a. The term Langley Risk Evaluation (LRE) was established to identify the Safety Analysis efforts associated with the LREP. A LRE documents the hazard analysis performed on equipment installed on Langley property. In most cases, the analysis is based on data from manufacturers' handbooks, discussions with certified operator and maintenance personnel, visual inspections, maintenance factors, and procedures. Management personnel shall take the steps necessary to implement any recommendations identified in the LRE.

b. A LRE consists of a Title Page, Revision Record, and a series of tables: Identification of Equipment, Energy Source (s), Hazard Controls, Identified Langley Operating Procedures, and General Observations/Recommendations. Below each section is described in further detail.

1) **Title Page** – Identifies the document as an LREP product, states the name of the equipment, and provides the facility number in which the equipment is located.
2) **LREP Revision Record** – Reflects the approval signatures for the initial issue and all LRE changes.
3) **Identification of Equipment -** Gives the name of the equipment, purpose or nature of research/operation that can be conducted with the equipment, installation date, and the number of certified operators required to utilize the equipment.
4) **Energy Source (s) –** All the energy sources associated with the operation of the equipment are identified (e.g. – for Electrical, state the voltage and amps used by the equipment; for Pressure, state the medium and pressure).
5) **Energy Controls –** Provides for the identification and location of all controls which will isolate the energy from the equipment and bring the equipment into a dormant state.
6) **Langley Operating Procedures (LOPs) –** Identifies the associated LOPs, which have been developed in accordance with Appendix D of this LPR and are utilized by certified operators while operating the equipment
7) **General Observations / Recommendations -** Provides an assessment of the equipment's operational environment to address any existing conditions that may be impacted by the new/changed equipment. Also, investigates the new/changed equipment effects on the facility and nearby operations (e.g.,. noise levels, power demands, effects of equipment malfunction). Establishes recommendations, if any identified new/existing conditions present unacceptable risk to personnel or equipment.

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6.3 LANGLEY OPERATING PROCEDURES (LOPS)

a. Langley Operating Procedures (LOPs) shall be developed in accordance with Chapter 2.4 of this LPR with the following exceptions:

1) Unique identifying number for LOPs shall be derived simply by adding a “P" to the identifying number of the LRE which the procedures support (e.g., 1148-lP, 1148-2P).

6.4 LRE AND LOP CHANGES AND DISTRIBUTION

a. LREs and LOPs shall be reviewed during the annual Facility Resume review by the FSH. If the review determines that changes are necessary to the LRE and/or LOP, the following actions shall be completed:

1) FSH shall red-line the LRE and/or LOP and submit the requested change to their assigned SFAB FSSE.
2) SFAB FSSE shall review/approve the proposed red-lined LRE and/or LOP.
3) SFAB FSSE shall revise the original LRE and/or LOP based upon the approved red-lined documents.

b. After the LRE and/or LOP has been revised, the SFAB FSSE shall forward the LRE and/or LOP to the FSH for review/approval. Original revised LRE and/or LOP shall be kept by SFAB and a copy of the revised LRE and/or LOP placed into the facility resume.

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Chapter 7

7. ASBESTOS CONFIGURATION MANAGEMENT

7.1 PROGRAM SUMMARY

a. The objectives of LaRC's Asbestos Safety and Configuration Management Programs are:

1) Enable LaRC to comply with the myriad of clean air emission regulations established by the Environmental Protection Agency (EPA), the Occupational Safety and Health Administration (OSHA), and the Commonwealth of Virginia;
2) Increase safety awareness and minimize the risk of asbestos exposure to personnel; and
3) Institute controls to prevent the release of asbestos fibers, restrict future asbestos use, and develop surveillance and control of known, existing asbestos applications in LaRC facilities.

b. The safety requirements for asbestos removal are addressed in LPR 1740.2, "Facility Safety Requirements." In summary, prior to any operation involving removal and repair of known asbestos or any other procedure that may release airborne asbestos, an inspection must be performed by an inspection team. The team shall include a SFAB Industrial Hygienist (IH). In addition, operational and control procedures shall be documented, and prior to the start of operations, approved by the SFAB.

c. This chapter addresses the configuration management of known, existing asbestos applications in a facility. Each facility has been inspected to identify friable and nonfriable asbestos containing building material (ACBM) and written inspection reports were provided to the FSHs. These inspection reports were the baseline documents used to generate the Asbestos Configuration Management Reports (ACMR).

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7.2 ASBESTOS CONFIGURATION MANAGEMENT REPORTS

a. An ACMR provides facility personnel, especially the FSH and FC, a document that identifies known asbestos applications. The report consists of:

1) **Title Page** – Identifies the document as a configuration controlled document, identifies the facility by number and name, and identifies the current document revision.
2) **Revision Record** – Reflects the approval signatures for the initial issue and all subsequent changes.
3) **List of Page Revisions** – Enumerates each page in the document and the current revision letter of each page.
4) **Introduction** – Provides the purpose and philosophy of the document.
5) **Facility Asbestos Summary** – Describes in narrative form the asbestos status of the facility.
6) **Facility Diagram** – Depicts the actual location of positive samples where asbestos is located in the facility.

7.3 ASBESTOS CM CHANGES

Upon receipt of Langley Form 27, “NASA LaRC Asbestos Safety Permit”, and completion of an Asbestos abatement project, the SFAB Industrial Hygienist shall submit a CNS for revision to the facility ACMR with the completed LF 27 as an attachment to CMOL. The revised ACMR shall be approved through CMOL utilizing LMS-CP-4710.

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Appendix A

A. GLOSSARY OF KEY TERMS

Asbestos CM Program (ACMP). A program designed to ensure NASA Langley Research Center (LaRC) compliance with asbestos-related EPA, OSHA, and Commonwealth of Virginia clean air emission regulations. This program generates and maintains current records of the location and status of all known asbestos at the Center.

Cause. The stimulus or triggering mechanism/act that precipitates an Undesired Event (accident).

Change Notification Sheet (CNS). NASA Langley Form 127, "Change Notification Sheet," prepared by LaRC personnel and processed by contractor personnel. The CNS action is processed electronically via the LaRC Configuration Management On-Line (CMOL) system. It is used in the LaRC Facility System Safety Program to request approval of and record all changes in the affected facility and to its supporting CCDs.

Checklist. Utilized by facilities to provide an avenue for certified operators to complete their work for routine, day-to-day operations of a facility. Checklists are developed and maintained under the CM Program.

Configuration Controlled Documents (CCDs). Those facility baseline documents that are considered critical to describing how a facility is configured, how it is to be operated, and what risks are associated with its operation. As such, CCDs are revised only through a formal change process under the CM Program. Examples of CCDs include, but are not limited to, Safety Analysis Reports (SARs), SOPs and Checklists, certain Pressure System Documents (PSDs), and selected engineering drawings.

Configuration Management (CM). A discipline that establishes a baseline for facilities, selects technical and administrative documents, and exercises administrative control of all approved changes to that baseline.

CM Contractor. The CM Contractor is the Non-personal Services Contractor who supports the LaRC Facility CM Program.

Configuration Management On Line (CMOL). A web-based server which enables users to access LaRC facility CCDs electronically via their desktop computer.

CM Update. The process of reviewing and documenting changes on a continuing basis. During this process, the reproducible masters (originals) of the affected documents are revised to incorporate the changes as shown on redlined documents. Revisions are initiated and tracked by the use of the CNS Form.

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Critical Items List (CIL). A Critical Item is any item, the single order failure of which would likely result in death or damage to equipment or property equal to or greater than $1.0M. A CIL is a listing of such items for the affected facility.

Effect. The consequence of an Undesired Event/Accident in terms of equipment damage and/or personnel injury/death.

Effort Code (EC). A number that identifies a specific facility or group of facilities in the Facility CM Program. For the life of the facility, all CCDs will bear this number regardless of any facility name changes and/or hardware modifications.

Facility Baseline List (FBL). A list of all CCD documents that can be generated using CMOL.

Facility Configuration Coordinator (FCC). An individual appointed from the Project and Engineering Branch (PEB) who coordinates the support to the LaRC Facility System Safety Program. The FCC is also one of the approving officials for CNSs prior to any CM facility hardware changes which affect CCD documentation.

Facility Coordinator (FC). An individual appointed to coordinate the overall day-to-day operations of a LaRC facility. This individual uses assigned facility personnel, and additional support personnel as available, to accomplish the FC requirements listed in this handbook.

Facility Manager (FM). An individual who ensures safe and efficient utilization of the facility in support of research programs internal and external to NASA.

Facility Risk Indicator (FRI). An initial safety assessment used to help determine the level of system safety effort required for a facility to meet NASA-LaRC safety requirements.

Facility Safety Head (FSH). An appointed individual who is responsible for providing the Facility Team direction, obtaining required support from knowledgeable research personnel, and approving all CCDs affecting the facility.

Faciility Systems Engineer (FSE). A representative of the facility, designated by the directorate who operates the facility, who performs system engineering analyses and/or reviews existing analyses and supports the CM activity for the facility.

Facility System Safety Analysis. A continuing analysis throughout all phases of the facility's life cycle involving the identification and control of hazards and the assessment of risks in operating that facility.

Facility System Safety Engineer (FSSE), A representative of SFAB, SMAO, or a support contractor who performs an initial Facility System Safety Analysis, and/or an upgrade of an existing one, and supports the CM activity for a particular facility.

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Facility Team. Personnel assigned to establish and prepare the Configuration Controlled Documents (CCDs) for a LaRC facility during the initial Systems Safety Analysis or any subsequent upgrade effort. The team is composed of the FSH, FC, FCC, SFAB FSSE assigned to the System Safety effort, and the Configuration Management (CM) Engineer from CM contractor.

Field Verified (or Field Verification). The process by which the accuracy of a CCD or any other drawing is verified. That accuracy is attested to by affixing a “Field Verified” statement, signed by the person doing the verification, and signed and dated by the Project Engineer, FSH, or FC. NOTE: For Field Verified or Field Verification relating to electrical work refer to LPR 1710.6, “Electrical Safety,” Definitions 1.2.9 and 1.2.10.

Hazard. A condition which has the potential to result in damage to equipment and/or personnel injury/death.

Job Hazard Analysis (JHA). A safety assessment technique that separates the job into steps, identifies the hazards associated with each step, and provides steps to eliminate or control identified hazards in each step (see LPR 8717.1, Job Hazard Analysis Program).

Langley Risk Evaluation (LRE). A safety analysis completed under the authority of the Langley Risk Evaluation Program (LREP).

Langley Risk Evaluation Program (LREP). A program designed to provide Langley Risk Evaluations (LRE;s) and Langley Operating Procedures (LOPs) to selected equipment at LaRC which are not in the CM Program and not covered with a Safety Permit.

Langley Operating Procedures (LOPs). Detailed, written, step-by-step instructions to be routinely followed in operating a facility. LOPs contain all of the information considered pertinent to safe and efficient operation of the facility. LOPs are the basis, in part, for the Langley Risk Evaluation (LRE). LOPs may also be used for training operator personnel. LOPs are under the control of the CM Program.

Project Manager (PM). The engineer assigned by PEB to manage repairs, rework, or modifications to an existing research facility or construction of a new facility.

Pressure Systems Configuration Management (PSCM) Program. A program to continuously update the In-service Inspection/Recertification effort.

Redlining. The process of identifying changes on facility documentation by making color-coded annotations on the documents themselves. Deletions to be made are lined through with red markings; additions are shown in green ink, or in black ink with yellow highlighting. Redlining of drawings may indicate proposed changes, or changes to show the "as is" condition.

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Research Facility (Facility). A ground-based apparatus or equipment directly associated with research operations, and sufficiently complex or hazardous to warrant special safety analysis and control.

Safety Analysis Report (SAR). A report under the control of the CM Program which documents the formal Facility System Safety Analysis of a particular research facility.

Safety Manager, SFAB, SMAO. This individual reviews and approves all System Safety Analyses and reviews all changes to the SARs, SOPs, and Checklists under the CM Program.

Single Point Failure. A discrete system element and/or interface, the malfunction and/or failure of which, taken individually, would cause failure of the entire system.

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 CM Program.

Standard Practice Engineer (SPE) for Pressure Systems. An agent of the Pressure Systems Committee responsible for ensuring ground based pressure systems comply with this document.

Supporting Facility Documents (SFDs). Those documents identified on the SFD list that are considered as part of the baseline documentation, but do not meet the criteria for CCDs.

Undesired Event. An event (or series of events) that unleashes the potential inherent in a hazard and, either directly or indirectly, results in damage and/or personnel injury/death.

Undesired Events List. A listing in the SAR of system failures/malfunctions derived from the preliminary hazard analysis that could, if not adequately controlled, result in personnel injury, unacceptable equipment/facility damage, and/or loss of productivity.

Working Masters. Copies of the latest-revision CCDs (SARs, SOPs, drawings, and so forth) which are stamped "WORKING MASTER" in red and kept at the facility.

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Appendix B

B. ACRONYMS

ACBM	Asbestos Containing Building Material
ACMP	Asbestos Configuration Management Program
ACMR	Asbestos Configuration Management Reports
CCD	Configuration controlled documentation
CDR	Critical Design Review
CIL	Critical Items List
CM	Configuration Management
CMOL	Configuration Management On-Line
CNS	Change Notification Sheet
EC	Effort Code
EDF	Engineering drawing files
EPA	Environmental Protection Agency
FBL	Facility Baseline List
FC	Facility Coordinator
FCC	Facilities Configuration Coordinator
FM	Facility Manager
FSE	Facility Systems Engineer
FRI	Facility Risk Indicator
FSH	Organizational Facility Safety Head
FSSA	Facility Systems Safety Analysis
FSSE	Facility System Safety Engineer
FV	Field Verified
HA	Detailed Hazard Analysis
ISR	Integrated System Review
LOPs	Langley Operating Procedures
LRE	Langley Risk Evaluation
LREP	Langley Risk Evaluation Program
OP	Operational Procedures
ORR	Operational Readiness Review
PEB	Project & Engineering Branch, Center Operations Directorate
PHA	Preliminary Hazard Analysis
PLC	Programmable Logic Controllers
PO	Post-Operational Procedures
PR	Pre-Operational Procedures
PSCM	Pressure Systems Configuration Management
PSD	Pressure Systems Document
RAC	Risk Assessment Code
SAR	Safety Analysis Report
SCM	Software Configuration Management
SCMP	Software Configuration Management Plan
SCR	Software Change Request
SFD	Supporting Facility Documents
SOP	Standard Operating Procedures

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Appendix C

C. FACILITY RISK INDICATOR (FRI)

C.1 Purpose of LaRC FRIs

a. The LaRC FRI is the initial safety assessment used to help determine the level of system safety effort required for a facility to meet NASA-LaRC safety requirements. The primary objective of the FRI for a facility is to qualitatively identify potential hazards associated with the facility and to ensure that the proper system safety effort is performed for that facility. By considering the size and complexity of the facility and the hazards associated with the facility, this assessment will help identify the system safety activities which should be accomplished in order to ensure the safety of public, personnel, and property at LaRC. There are four FRIs ranging from a FRI of 1 to a FRI of 4. The potential hazards inherent to the facility are evaluated using the following criteria as evaluation factors:

1) Public Safety – hazards that could potentially harm the public in any form or manner.
2) Life Safety - hazards that could potentially cause death or serious injury to personnel.
3) Facilities Protection - failures that could cause serious damage to facilities or equipment resulting in significant financial loss.

C.2 FRI Assessment Classification

All LaRC facilities shall be assigned a FRI from 1 to 4, based on identified potential hazards present in the facility, and their impact on Public Safety, Life Safety, and Facilities Protection. A FRI shall be given to a new facility prior to the start of research activities in that facility. Also, FRI shall be re-evaluated prior to the start of research activities at an existing facility that has undergone a Construction of Facility (CoF) modification or prior to any existing facility being re-occupied by Langley employees. Buildings strictly used for office work are considered a facility in their entirety. The following definitions shall be used to classify LaRC facilities and the suggested safety activities warranted after the assignment of the FRIs. Refer to LMS-OP-8715 for the operational procedure in determining a FRI.

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C.2.1 FRI 1 (High Risk)

a. Definition- There is a HIGH risk that identified potential hazards in this facility can cause loss of life, permanent disability, the hospitalization of three or more people, a lost-time injury to one or more persons, an occupational injury or illness resulting in a restricted workday or OSHA recordable incident, a first aid incident, or damage to equipment or property in excess of $1,000,000, or any injury/property damage to the public.

b. Suggested Safety Program Requirements:
   1) Placement in the Facility Configuration Management Program.

c. All utility facilities (e.g. – substations, sewage plants) are classified with a FRI of 1. Any other facility which has been determined by SFAB to have an inherent high risk associated with it may also be classified with a FRI of 1.

C.2.2 FRI 2 (Moderate Risk)

a. Definition- There is a MODERATE risk that identified potential hazards in this facility can cause loss of life, permanent disability, the hospitalization of three or more people, a lost-time injury to one or more persons, an occupational injury or illness resulting in a restricted workday or OSHA recordable incident, a first aid incident, or damage to equipment or property from $250,000 to $1,000,000.

b. Suggested Safety Program Requirements:
   1) Placement in the Langley Risk Evaluation Program.

c. Any other facility that has been determined by SFAB to have an inherent moderate risk hazard associated with it may also be classified with a FRI of 2.

C.2.3 FRI 3 (Low Risk)

a. Definition- There is a LOW risk that identified potential hazards in this facility can cause loss of life, permanent disability, the hospitalization of three or more people, a lost-time injury to one or more persons, an occupational injury or illness resulting in a restricted workday or OSHA recordable incident, a first aid incident, or damage to equipment or property from $1,000 to $250,000.

b. Suggested Safety Program Requirements:
   1) Perform a Job Hazard Analysis for all hazardous facility operations.
   2) Adherence to applicable codes, standards, and regulations.

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c. Any facility that contains some form of a shop (e.g., machine, pipe fitting, HVAC) is classified with a FRI of 3. Cooling towers at LaRC are considered to have a FRI of 3. Any other facility that has been determined by SFAB to have an inherent low risk hazard associated with it may also be classified with a FRI of 3.

C.2.4 FRI 4 (Very Low Risk)

a. Definition- There is a VERY LOW risk that identified potential hazards in this facility can cause loss of life, permanent disability, the hospitalization of three or more people, a lost-time injury to one or more persons, an occupational injury or illness resulting in a restricted workday or OSHA recordable incident, a first aid incident, or damage to equipment or property less than $1,000.

b. Suggested Safety Program Requirements:
   1) Adherence to applicable codes, standards, and regulations.

c. Any facility that is solely used for office space is classified with a FRI of 4. All vacated and abandoned facilities are classified with a FRI of 4. Any other facility that has been determined by SFAB to have an inherent very low risk hazard associated with it may also be classified with a FRI of 4.

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Appendix D

D. REQUIREMENTS FOR DEVELOPING SOPS/CHECKLISTS

D.1 INTRODUCTION

D.1.1 The purpose of this instruction is to establish the procedures for the development, implementation, and revision of Standard Operating Procedures (SOPs) in a standardized format.

D.1.2 This instruction establishes the requirements for developing, implementing, and updating SOPs into a standard format. With NASA LaRC facility/ system certified operators frequently being certified operators of several different facilities/ systems, standard format SOPs are desirable in an effort to decrease the potential of an accident or incident due to operator error.

D1.3 This instruction should be closely followed when developing SOP for new facilities. Deviations from this instruction may be permitted to enhance clarity but must be approved by the Facility Safety Head (FSH), the Facility Coordinator (FC), the Certified Operators, and the Safety and Facility Assurance Branch (SFAB).

D.1.4 It is not the intent of these instructions to require a re-write of all existing SOPs. A total re-write of SOPs for existing facilities could cause unnecessary confusion for s and may increase rather than decrease risk associated with facility operations.

D.2 GENERAL

D.2.1 For the purpose of this instruction, SOPs are defined as detailed, written, formal instructions for certified operators to use during operation of the facility. SOPs are to include all tasks necessary to bring the facility/ system from a dormant state or safe condition to an operational state and then return to a dormant state or safe condition.

D.2.2 Checklists which have been developed by abbreviating a SOP, shall have the SOP that was abbreviated listed on the Title Page of the checklist. SOPs which have had an abbreviated checklist developed to perform the same task shall have the Checklist listed on the Title Page of the SOP.

D.3 PRE- OPERATIONAL

The Pre-Operational section includes all activities required to bring systems/ subsystems from a dormant or safe condition to a condition ready for operation and may include pre-op maintenance and safety checks. This section can

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include list(s) such as a Valve List or a Circuit Breaker List. These list(s) describe the equipment condition or position required for proper facility/ system operation and may or may not require operator action for facility/system operation. These lists are intended to reduce the number of “verify” statements used in SOPs where equipment is normally left in the position needed for operation. The equipment list(s) may also provide(s) a trouble- shooting guide that would be used to verify the proper condition or position for equipment in the event that the facility/system failed to operate.

D.4 OPERATIONAL

The Operational section includes all activities required during active operations of the facility/system. This also includes all activities required to turn- around or re- cycle the facility/ system for additional runs.

D.5 POST-OPERATIONAL

The Post-Operational section includes all activities required to bring the facility from an operational condition to a dormant or safe condition.

D,6 TASK AND/ OR SUB- TASKS

D.5.1 The complexity of the system dictates the detail and number of tasks and sub- tasks required. A flow sequence diagram is developed to provide a summary of the order that tasks must be performed, at the facility safety head’s discretion.

D.5.2 The subdivisions of a document should be numbered in a way that reflects the organization of the document. This can be accomplished by: (a) assigning consecutive numbers to the major divisions of the document, beginning with 1 for the first, 2 for the second, and so on, (b) following this number with a period, (c) assigning consecutive numbers beginning with one to each subdivision, if any, of each major division and appending this number to that of the preceding division, (d) following this number with a period, and (e) continuing this process with any additional subdivisions until the paragraph level is reached. The final number should not be followed with a period (e.g., 1. Introduction, 1.1 Safety Features, 1.1.1 Personal Protective Equipment).

D.6 LINE ITEMS OR STEPS

Line items or steps define actions that must be performed to accomplish a task or sub-task. Each facility/ system has a logical sequenced step-by-step order of actions that if performed as described, will afford safe and reliable operation. The steps are to be presented in a chronological order and will be sufficiently detailed to permit a certified operator (per LPR 1740.7) to safely operate the facility/ system. Each line item or step shall be signed-off/initialed by the certified

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operator perfoming that step. Steps which have been deemed “Not Applicable”, by a certified operator, shall be signed-off/initialed by the Facility Safety Head; including the date of the approval.

D.7 FLOW SEQUENCE DETERMINATION

The Sequential Flow Chart will specify a safe order for task performance that will result in reliable operation, i.e., tasks and/or sub- tasks that can be performed concurrently or must be performed in sequence. The chart may vary extensively depending on the complexity of the facility/system. The facility team will discuss the Sequential Flow Chart with the certified operators of the facility/system to ensure proper flow. A single task procedure does not require a flow chart.

D.8 STANDARDIZATION

D.8.1 TASK IDENTIFICATION

D.8.1.1 Each Task or Sub-Task shall have an identification designation. An example of an identification designation for a Task or Sub-Task in a set of SOPs is 22-PR-1-A. Each of the parts of the identification designation is defined below.

a. 22- Identifies the facility/ system by EC number. This number is assigned by CM Program..

b. PR- Identifies the task as a Pre- Operational Procedure (PR), an Operational Procedure (OP) or a Post-Operational Procedure (PO). Other supporting procedures may be utilized and their titles identified in this location (e.g., at the National Transonic Facility (NTF) existing designations used: MOP (Maintenance Operating Procedure), MIP (Maintenance Instruction Procedure), IOP (Integrated Operating Procedure), PMP (Preventative Maintenance Procedure), SEP (Safety and Emergency Procedure), AIP (Alarm/Alarm/Response Policy), and IDSP (Instrumentation and Data System Procedure).

c. 1 – Identifies the sequential flow task(s) of the SOP task and may be omitted if there is only one task. Generally, series listed must be done in order, i.e. PR-1 must be completed prior to the beginning of PR-2. Parallel listed tasks are tasks that may not be done in every run condition and require the certified operator to determine which tasks need to be performed for the particular run.

d. A - Identifies sub- tasks (s) in the sequential flow of the SOP. The sub- task (s) may be done in any order but all sub- tasks (e.g., A, B, C) of a numbered task must be done before continuing to the next numbered task, i.e. PR-1-C may be done before PR-1-A but all PR-1 tasks must be completed before beginning PR-2.

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D.8.1.2 PAGE IDENTIFICATION

a. The Task Identification shall be entered in the upper right hand corner of each page.

b. Page numbers shall be entered at the bottom center of each page.

c. Revision identification shall be entered in the bottom right hand corner (e.g., Rev. A).

d. The statement, “Configuration Controlled Document”, shall be entered at the top center of each page. Page number shall be bottom centered followed by revision right justified. A mandatory statement, concerning requirement for use, shall be at the bottom of the page and read as follows “The procedural steps in this document are requirements and, as such, shall not be deviated from without the express consent of the cognizant FSH.”

D.8.1.3 STEP FORMAT

D.8.1.3.1 The following instructions are to be used when writing steps in the tasks or sub- tasks of SOPs. In unique or unusual circumstances, the facility team may deviate slightly from these instructions to enhance step clarity.

a. Steps that must be performed sequentially are to be identified numerically and must be performed in order (e.g., Step 1 must be completed before beginning Step 2, or Step 1.2 must be completed before beginning Step 1.3).

b. Steps that may be performed in any order are to be identified alphabetically (e.g., Step 3 (b) may be performed prior to or concurrently with Step 3 (a) and is at the discretion of the certified operator.

c. A step normally consists of three major entities: a command, the equipment commanded, and the final state and/ or reaction of the equipment:

d. The command should describe the action required to complete the step (e.g., verify, position, inspect). The command is to be written in lower case letters.

e. The equipment commanded will identify the switch, light, push-button, circuit breaker, disconnect switch, or component that is to be

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operated. If the equipment commanded has a label, the label should be entered into the step just as it appears on the control panel or piece of equipment and then underlined. The underlining of labels may be omitted if the team concurs that step clarity is enhanced.

f. The final state and/ or reaction of the equipment will be stated in capital letters (e.g., ILLUMINATED, EXTINGUISHED, CLOSED, OPEN). If the final state of the equipment is also the label on the equipment, then the label should be entered into the step as it appears on the equipment and underlined (e.g., "Position the switch to ON." ON is the label on the switch). If the final state of the equipment is given in general terms and applies to a group of equipment, all capital letters may not be required (e.g., "Clear the test chambers of all personnel, close the test chamber door, and secure all dogs on the test chamber door.").

g. The color of a light or component will have the first letter capitalized only (e.g. - Green, Red, Clear).

h. Steps which identify a value to be recorded shall identify the allowable tolerance for the recorded value.

i. Waivers shall be requested in accordance with Section 1.4.

D.8.1.4 NOTES, CAUTIONS, AND WARNINGS

D.8.1.4.1 Notes, Cautions, and Warnings are used to delineate steps as follows:

a. NOTES may be used when all sequences in the steps cannot be clearly defined.

b. A NOTE is a step delineator; it is not a step replacement.

c. A NOTE may precede a step or series of steps in order to explain the required action.

d. A NOTE may be used to identify the location where step (s) is performed.

e. A NOTE may precede a step that, if performed erroneously, would invalidate previous system tests or acceptance.

f. A NOTE may precede a step that requires specific instructions.

g. A NOTE WILL NOT BE USED TO IDENTIFY HAZARDS TO PERSONNEL OR EQUIPMENT. SEE CAUTION AND WARNINGS BELOW.

h. A NOTE will be enclosed in a manner as shown below.

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NOTE

This operating procedure requires special emphasis for successful completion of the task

i. A CAUTION statement will precede any step or series of steps that if performed improperly, as defined in the safety analysis report, could damage equipment. A CAUTION statement will be enclosed in a manner as shown below:

CAUTION

This operating procedure requires special emphasis for successful completion of the task

j. A WARNING statement will precede any step or series of steps that if performed improperly, as defined in the safety analysis report, will endanger personnel. A WARNING statement will be enclosed in a manner as shown below:

WARNING

This operating procedure requires special emphasis for successful completion of the task

D.8.1.5 CHECKLISTS

D.8.1.5.1 A checklist may be an abbreviated, 1 to 1, less-detailed instruction of the SOP; an appendix to an SOP which identifies a series of steps to be completed before moving to the next step in the SOP (e.g., Valve or Circuit Breaker Line-up); or a list of routine facility tasks which do not require the level of detailed offered by an SOP. The need for a checklist is a joint decision between the FSH, FC, and the Safety and Facility Assurance Branch. A checklist is not required for all facilities/systems; HOWEVER, if a checklist exists in an SOP, it must be CCD and used every time the facility/ system is operated.

D.8.1.5.2 A checklist may be used to document system parameters required by research or may be used as a tool that requires the certified operator to ensure that a level of operation is complete and the system is ready to continue to the next level of operation.

D.8.1.5.3 An example of a complicated task would be the preheat of the 20” SWT. In this task, the preheat pressure is close to the pressure that will lift relief devices. If the SOPs are not expressly followed, the pressure may overshoot and cause the relief devices to lift. Although lifting safety devices

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is not a safety problem, it is not desirable. The checklist for this task would likely be an abbreviated, 1 to 1, less-detailed instruction of the SOP.

D.8.1.5.4 An example of a routine task would be establishing cooling water flow to a piece of equipment. In this task, the many steps to open valves may be omitted from the checklist and replaced with a single step. The step may read "Verify Cooling Water established." Verification could be observing an indicator light that is activated by a flow switch.

D.8.1.5.5 The following list further establishes instructions for generation of checklists:

a. A checklist is a CCD document and requires generation of a CNS for modification.

b. Checklist Format

1) SOP steps that are included in a checklist are abbreviated to reduce verbiage and entered in the checklist. Example: The step in the SOP reads "Depress and Release the HYD. POWER lighted push button and verify that the OFF light is EXTINGUISHED and the ON light becomes ILLUMINATED." The step could be abbreviated in the checklist to "Start rotovalve hydraulic pump and verify ON light becomes ILLUMINATED." in the checklist.

2) WARNINGS that are in the SOP shall be in the checklist and may be abbreviated to reduce the verbiage as long as the meaning remains clear.

3) CAUTIONS that are in the SOP shall be in the checklist and may be abbreviated to reduce the verbiage as long as the meaning remains clear.

4) NOTES in the SOP that are only explanatory in nature may be included in the checklist at the facility's discretion and also may be abbreviated to reduce the verbiage as long as the meaning remains clear.

5) Steps which identify a value to be recorded shall identify the allowable tolerance for the recorded value.

6) A checklist line item or step shall be signed-off/initialed by the certified operator performing that line item or step.

7) Mature systems may have "placard" type checklists that are conveniently posted at equipment to be operated.

c. Completed checklists are to be presented to, and retained by, the FSH. The period of time for retaining completed checklists will vary from facility to facility and is determined by the FSH, FC, and FM. The Safety and Facility Assurance Branch does not retain completed checklists.

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Appendix E

E. RECORDS

E.1 All Federal employees are required by law and Agency policy to maintain and preserve records. Documents listed in E.2 have been identified as meeting the statutory definition of Federal records as contained in 44 U.S.C. Section 3301, referred to in the National Archives and Records Administration (NARA) Regulations: 36 CFR Part 1220.14 and 1222.12, and NASA Policy Directive (NPD) 1440.6F, NASA Records Management.

E.2 Identified documents:

a) Standard Operating Procedure(s)
b) Checklist(s)
c) Safety Analysis Report(s)
d) Configuration Controlled Documentation
e) Engineering Drawing File(s)
f) Software Configuration Management Plan(s)
g) Pressure Systems Document(s)
h) Langley Risk Evaluation(s)
i) Asbestos Configuration Management Report(s)

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Langley Research Center

LPR 1710.10

Effective Date: February 26, 2010

Expiration Date: February 26, 2015

LANGLEY RESEARCH CENTER ENERGY CONTROL PROGRAM (LOCKOUT/TAGOUT)

National Aeronautics and Space Administration

Responsible Office: Safety and Mission Assurance Office

PREFACE

P.1 PURPOSE

a. This Langley Research Center Procedural Requirements (LPR) establishes a Lockout/Tagout (LOTO) program for controlling hazardous energy sources where the unexpected 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 responsibility for safety.

P.2 APPLICABILITY

a. This program is applicable to all persons including all contractors at Langley Research Center (LaRC) performing maintenance, repair or servicing activities as covered in the Occupational Safety and Health Administration (OSHA) standards 29 CFR 1910.147, 29 CFR 1910.333(b)(2), and 29 CFR 1910.269 (d).

(1). **Servicing and/or maintenance.** Workplace activities such as constructing, installing, setting up, adjusting, inspecting, modifying, and maintaining and/or servicing machines or equipment. These activities include lubrication, cleaning or unjamming of machines or equipment and making adjustments or tool changes, where the employee may be exposed to the **unexpected** energization or startup of the equipment or release of hazardous energy.

b. Noncompliance with the requirement 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.

P.3 AUTHORITY

a. NPR 8715.3, “NASA General Safety Program Requirements.”

P.4 APPLICABLE DOCUMENTS

a. Occupational Safety and Health Administration (OSHA) regulations, 29 CFR 1910, “Occupational Safety and Health Standards”
b. NASA Langley Procedural Requirement LPR 1710.6, “Electrical Safety”
c. NASA Langley Form 287, “Lockout/Tagout Procedures/Records Inspections”
d. NASA Langley Form 363, “Red Lock/Red Tag” (RL/RT)
e. NASA Langley Form 403, “Craft Specific (CS) Blue Identification Card”
f. NASA Langley Form 416, “LaRC Energized Electrical Work Permit”
g. NASA Langley Form 425, “Shop Machine (SM) Yellow Identification Tag”
h. NASA Langley Form 451, "Safety Operator Appointment Form"
i. NASA Langley Form 453, "NASA Langley Safety Operator's Permit"
j. NASA Langley Form 493, "Lockout/Tagout Release"
k. NASA Langley Form 495, "Energy Control Procedure"

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l. NASA Langley Form 496, "Lockout/Tagout Records"
m. NASA Langley Form 497, “Red Tag Receipts Record”
n. NASA Langley Form 519, "Employee Safety Operator Field Verifier Appointment Form"

P.5 MEASUREMENT/VERIFICATION

None

P.6 CANCELLATION

LPR 1710.10, dated January 14, 2005, is rescinded and should be destroyed.

Original signed on file

Steve G, Jurczyk
Deputy Director

Distribution is limited to NASA Langley Research Center Employees, Civil Servants and Contractors

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Chapter 1

1. INTRODUCTION

1.1 SCOPE

1.1.1 The potential for energy related injury or property damage when servicing machines, equipment or systems at LaRC is ever present. The degree of risk is directly related to the work to be performed and the complexity of the controls required. Compliance with the requirements of this LPR will provide adequate protection; however, these procedures only provide a minimum standard. Responsible employees should always strive to improve upon this standard by assessing risk on a continuous basis.

1.2 APPLICATION

1.2.1 The requirements of this “Energy Control Program” are applicable anytime the unexpected release of hazardous energy may result in injury to personnel or damage to property during servicing or maintenance activities.

1.2.2 These requirements do **not** apply to:

a. An “Administrative” control, see LPR 1740.2 ”Facility Safety Requirements” examples include:
   (1) A locked fence around high-voltage switching station to prevent unauthorized access.
   (2) A lock on an overhead crane disconnect switch. (to prevent unauthorized operation).
   (3) A locked door to a laser or chemical laboratory station to prevent unauthorized access.
   (4) Locked equipment that is out of use for an indefinite period of time.
   (5) A locked facility or a system that is deactivated or mothballed.

   (Note: Locks used in the Administrative applications above shall not be the same type used for this LOTO Program.)

b. Work during normal operation of a machine, equipment or system unless a person is required to remove or bypass installed guards or safety devices or required to place any part of his or her body in the danger zone or point of operation of any machine or equipment that may exist during the normal operating a cycle. In such cases, controls must be provided to ensure the safety of exposed personnel to a level consistent with this LPR. (See 29 CFR1910.147(a)(2)(ii))

c. Work on energy generating facilities or the transmission and distribution lines and equipment for electricity, natural gas, liquid nitrogen, water, steam or any other

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energy that is under the **exclusive** control of the respective commercial utility owner.

d. Work on “cord and plug connected”” electrical equipment where the hazard of the unexpected energization or startup is controlled by removing the plug from the energy source and by the plug remaining in the exclusive control of the employee performing the maintenance, repair or servicing activity. (**Note**: exclusive control only applies to plug and cord connected equipment and means the plug is within arm’s reach and sight of the employee performing the servicing and maintenance activity).

e. Energized electrical work where de-energizing equipment introduces additional or increased hazards or is infeasible due to equipment design or operational limitations. The limitations include:
   (1) Life support equipment
   (2) Testing of circuits that can only be performed while the circuit is energized
   (3) Work on circuits that form an integral part of a continuous process that otherwise needs to be completely shut down to work on one circuit This exception requires issuance of a NASA LF 416, “LaRC Energized Electrical Work Permit” in accordance with LPR 1710.6, “Electrical Safety Program”

f. New Construction Activities with special approval – In special circumstances the Safety and Facility Assurance Branch (SFAB), with the concurrence of the appropriate Standard Practice Engineer, may allow the use of the Contractors LOTO process in lieu of LPR 1710.10. It is always preferred to use LPR 1710.10 and this special approval is intended for situations under the contractors’ control (before delivery to the government) during the commissioning or start-up phase. The request shall be submitted to SFAB from the Civil Servant responsible for the Contract. Approval from the SFAB Manager will be granted on a case-by-case basis if the Contractor’s LOTO process meets minimum 29 CFR 1910.147, LOTO requirements and after considering issues such as:
   (1) Well defined physical and functional boundary between existing Center operations and or facilities (control of energy sources between existing LaRC facilities and the new facility under construction).
   (2) Personnel that are best qualified to understand and control the energy at the new facility during the construction project.

1.3 REQUIREMENT

1.3.1 This LPR establishes compliance with Lockout/Tagout requirements of 29 CFR 1910.147, "The Control of Hazardous Energy (Lockout/Tagout)," Paragraph 333 (b) (2) of 29 CFR 1210.331 – 335 Electrical “Safety-Related Work Practices”, and Paragraph (d) of 29 CFR 1910.269, “Electric Power Generation, Transmission and Distribution” and NPR 8715.3C “NASA General Safety Program Requirements.”

1.4. WAIVERS

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

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Chapter 2

2. GENERAL POLICY

2.1 INTRODUCTION

2.1.1 At LaRC the majority of the energy isolation devices are electrical switches or mechanical shut off valves. It is rare to find an energy source that cannot be isolated and locked and for this reason, the LaRC policy is to lock and tag an isolation device. If an isolation device cannot be locked, then a tag with alternative means of control as described in 29 CFR 1910.147 (c)(3)(ii), must be approved by SFAB. There are other forms of energy that should be considered, and the following is a limited list that does not include all possible energy sources and hazards:

a. The energy associated with large springs, lifting devices, rotating parts, or large roll-up garage doors.
b. Corrosive chemicals.
c. Toxic chemicals/materials.
d. Asphyxiates – oxygen deficiencies.
e. Materials/compounds/equipment that burn (temperature exceeds150° F.).
f. Cryogenic liquids/systems.
g. Hydraulic/pneumatic or similar systems that may need to be controlled by unique devices.
h. Injuries caused from sudden pressurization/depressurization.
i. Electrical

2.2 LOCKING and TAGGING (LOTO)

2.2.1 Anytime an employee performs maintenance, repair or service tasks on machines, equipment or systems 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 by locking the appropriate energy-isolating device(s). Specific procedures are contained in Chapter 3 of this LPR.

2.2.2 *At LaRC only Safety Operators (SO) or shop machine operators are authorized to lockout machines, equipment or systems. The SO shall determine the hazards, energy sources, and the energy isolation devices (such as valves or switches) that need to be operated to provide a safe environment. The SO shall make the determination, in conjunction with other knowledgeable and experienced personnel, by review of drawings, piping and instrumentation documentation, specifications, or other means and by a physical inspection of the machine, equipment or system.*

2.2.3 If an SO has insufficient knowledge or experience with the system they have been asked to lockout, the SO has the authority and responsibility to disqualify themselves from performing the LOTO.

2.3 TAGOUT WITHOUT LOCKING

2.3.1 If an energy isolating device is not capable of being locked, it shall be the responsibility of the applicable organization, with the approval of 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).

2.4 LOTO METHODS

2.3.1 The three lockout methods approved for use at LaRC are:

a. Red Lock/Red Tag (RL/RT) – this requires using the red identification tag, NASA LF 363, with the red lock.
b. Craft Specific (CS) – this requires using the blue identification card, NASA LF 403, with the red lock.
c. Shop Machine (SM) – this requires using the yellow identification card, NASA LF 425, with the red lock.

2.4.2 The following apply to the use of these three methods:

a. The RL/RT method is acceptable for locking out any machine, equipment or system. The lockout shall be performed by an authorized SO and documented on NASA LF 496 “LOTO Records”, which is a register used to establish the status, isolation, procedure, responsible employees and other useful information about a lockout. See Section 3.5.2 for details.
   (1) A RL/RT lockout is identifiable by the red identification tag affixed to the lockout device with the red lock.

b. The CS method is acceptable for servicing and maintenance activities, such as building HVAC or electrical work that can be completed in one work shift. It shall only be used if:
   (1) **All of the exception elements** of paragraph 2.5.1 of this LPR are met.
   (2) The employee(s) applying the lockout is an authorized Craft Specific Safety Operator (CSSO) and the only employee(s) performing the servicing or maintenance. See Section 3.3 for procedures.
   (3) The CS lockout is identifiable by the CSSO Blue identification card, NASA LF 403, affixed to the lockout device with the red lock.

c. The SM method shall only be used when locking out permanently installed shop machines if:
   (1) **All of the exception elements** of paragraph 2.5.1 of this LPR are met.
   (2) The employee(s) applying the lockout is an authorized Shop Machine Operator (SMO) and the only employee(s) servicing the machine. See Section 3.4 for details.
   (3) The shop machine has a LOTO procedure posted on or near the machine.
   (4) The SM lockout is identifiable by the SMO Yellow identification card, NASA LF 425, affixed to the lockout device with the red lock.

2.5 ENERGY CONTROL PROCEDURE EXCEPTION

2.5.1 The RL/RT method requires that a written procedure for each lockout event be documented on NASA LF 495 per Section 3.5.1 of this LPR unless **all of the following elements exist**:

a. **The machine or equipment does not operate at a potential exceeding 600 volts**.

b. **The machine or equipment has no potential for stored or residual energy** (or re-accumulation of stored energy after shut down).

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

d. The isolation and lockout of that energy source will **completely deenergize and deactivate** the machine or equipment.

e. An electrical isolation device must be locked out by an electrical SO, not by a mechanical SO authorized to perform electrical lockouts for non-electrical work.

f. The machine or equipment is **isolated from that energy source and locked out** during maintenance, repair or service.

g. **A single lockout device** will achieve a locked-out condition.

h. **The lockout device is under the exclusive control** of the employee performing the work. (The employee working under the LOTO must be the one to apply the LOTO device to the energy isolation device.)

i. The work does not create hazards for other employees.

j. The organization and/or SO utilizing this exception, has had no accidents involving the unexpected activation or re-energization of the machine, equipment or system during maintenance, repair or servicing.

2.6 DEVICE/HARDWARE STANDARD

2.6.1 In accordance with 29 CFR 1910.147(c) (5), the locking hardware (e.g., locks, identification tags, isolation control devices) shall be durable, standardized, substantially constructed and readily identifiable and shall not be used for any other purpose. For this reason, the SFAB shall either purchase or approve the purchase of all lockout hardware. The identification tags will normally be attached through the eye of the tag and the lock shank. The locks and identification tags used at LaRC shall meet the following:

a. RL/RT method
   (1) Red Lock
   (2) Red Identification Tag

b. CS method
   (1) Red Lock
   (2) Blue Identification Card, NASA LF 403

c. SM method
   (1) Red Lock
   (2) Yellow Identification Card, NASA LF 425

2.7 RESPONSIBILITIES

2.7.1 SAFETY AND FACILITY ASSURANCE BRANCH (SFAB) shall:

a. Develop and maintain the procedural requirements of this LPR.

b. Conduct periodic inspections of lockout records, using NASA LF 287, to ensure the "Energy Control Procedures" NASA LF 495, are reviewed, at least annually, in accordance with 29 CFR 1910.147 (c)(6).

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

d. Provide annual LOTO training relating to this LPR.

e. Assure all new equipment installed or major repair, renovations or modifications after January 2, 1990 is capable of being locked out. (See 29 CFR 1910.147(2)(2)(iii)).

2.7.2 ORGANIZATIONAL UNIT MANAGERS (OUMs) shall:

a. Provide employees the opportunity to attend training related to this LPR.

b. Investigate any violations of this LPR and implement corrective and disciplinary action as appropriate.

2.7.3 SUPERVISORS shall:

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

b. Initiate requests for SO and Field Verifier (see paragraph 5.4) appointments associated with this LPR.

c. Provide for and document technical training related to the machine, system and energy sources that are requested to be locked out.

d. Periodically, at least annually, inspect (and maintain a record of the inspection, using NASA LF 287) the Energy Control Procedures, NASA LF 495, and associated documents.

e. Attend required annual supervisors refresher training.

2.7.4 FACILITY COORDINATORS (FC) for industrial facilities and SUPERVISORS responsible for maintaining/repairing institutional services, such as air conditioning/heating and electrical, may requisition LOTO hardware, locks and red identification tags from SFAB. These FCs, and supervisors shall:

a. Control the requisitioned hardware, locks and identification tags and designate an area where employees have access to lockboxes and lockout documentation during a lockout.
b. Maintain the lockout documentation during and after a lockout has occurred.
c. Understand the equipment in their facilities and how lockouts affect other occupants so that they may communicate warnings as appropriate (see section 2.8 COMMUNICATIONS).
d. Assure that the Energy Control Procedure, NASA LF 495, is prepared, approved by the SO's and verified by the protected employees and that information is inputted into NASA LF 496, "Lockout/Tagout Records".
e. Be responsible for communicating with all employees in the area and those employees involved with the lockout.
f. Attend required annual LOTO training.
g. Ensure records/documentation is independently (an inspection by a knowledgeable person other that the SO that applied the LOTO) inspected at least annually.

2.7.5 LaRC DUTY OFFICER shall:

a. Maintain lockout hardware and NASA LF 496, "Lockout/Tagout Records," for use after hours and for facilities that do not maintain hardware and record forms.

b. In an emergency, have the authority to apply an administrative lock to safe the system/equipment. Before repair maintenance can begin the system/equipment must be locked and tagged by a SO.

c. Notify the appropriate FC of any lock placed in their facility after normal duty hours. This will normally be done at the beginning of the next duty day.

d. Attend annual LOTO training.

2.7.6 FACILITY SAFETY HEAD shall:

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

b. Attend annual LOTO training.

2.7.7 SAFETY OPERATORS (SO) shall:

a. Possess a current permit, and have it on-hand or readily accessible, as proof of their authorization, while performing lockouts.

b. Lockout equipment or systems in accordance with the requirements of this LPR.

c. Fully understand hazardous energy associated with the equipment and systems they are authorized to lockout.

d. Meet the SO's qualification requirements from Section 4.3 of this LPR.

e. Disqualify themselves from performing the LOTO if they feel they lack the knowledge or experience to safely lock out a system. SO's have the authority and responsibility to do so.

f. Attend required LOTO training.

g. Re-apply for certification every 4 years.

h. When requested participate in the inspection of a lockout performed by another SO.

i. Approve the Energy Control Procedure, NASA LF 495, relating to the locking and tagging of equipment or systems they are authorized to lockout.

j. Document pertinent information onto the Red Identification Tag and NASA LF 496.

k. Issue the red identification tag stub with the key, to the RE after:
   (1) Providing the RE instructions/training: about the hazards, controls and any other safety concerns associated with the lockout and the process for removing the locked out condition
   (2) Allowing the RE to verify that the isolation and de-energization has been accomplished.

l. Communicate with other employees involved with lockout about the hazards, controls and any other safety concerns that may affect them.

2.7.7.1 Special Instructions for Electrical Safety Operators

a. Verification
   (1) When verifying electrical isolation, the SO shall place the electrical disconnect switch that isolates the electrical power from the desired circuit, in the open position and observe that an air gap exists between the line and load contacts of the switch.

   (2) If the required air gap between the line and load contacts of the switch cannot be observed, the SO shall first start the facility, equipment, system, or apparatus, in a normal or manual operating mode, and then de-energize by opening the breaker or disconnect switch that supplies electrical power. The SO shall perform appropriate measurements to verify electrical isolation.

(3) On manually controlled equipment, the qualified SO shall start the facility, equipment, system, or apparatus, open either the disconnect switch or branch circuit breaker, and verify shut down. The SO shall use test equipment to perform appropriate measurements to verify that the energy source has been isolated from the facility, equipment, system, or apparatus.

(4) When the facility, equipment, system, or apparatus, has malfunctioned and cannot be restarted, the SO shall open either the disconnect device or circuit breaker that feeds the facility, equipment, system, or apparatus, and use test equipment to perform appropriate measurements to verify that the energy source has been isolated from the equipment.

b. When applying a LOTO to electrical circuits/devices, the SO shall comply with safety clearance procedures delineated in LPR 1710.6, "Electrical Safety."

2.7.7.2 Special instructions for Mechanical Safety Operators

a. Before starting to work under a mechanical or fluid systems LOTO, the apparatus, valves, or systems shall be secured in a safe condition with appropriate vents, pins, or other devices, as follows:

(1) Pressurized or vacuum systems shall be properly vented to completely relieve any differential pressure.

(2) Isolation supply valve(s) shall be locked and tagged in the closed position. Vent valve(s) shall be locked and tagged according to the specific LOTO procedure, NASA LF 495.

(3) Where dangerous gas or liquid systems are involved or in areas where the environment may be oxygen deficient, systems or areas shall be purged, adequately ventilated, or otherwise made safe.

(4) The SO and the RE/protected person shall assure that the venting system shall remain intact so that pressure cannot build up in the system during progress of the work.

a) LaRC preferred method of safing a pressure system is to implement a double block and bleed. If this cannot be accomplished a safety assessment shall be approved by the Safety Engineer.

(5) The SO shall ensure that hazardous material is not vented into the environment.

b. LOTO of Electrical Isolation Devices

(1) Mechanical SO's may apply and be certified to place a lockout device and a red tag, NASA LF 363, on electrical isolation devices, in accordance with an established procedure, NASA LF 495, for the purpose of performing non-electrical type work on electrical systems, mechanical systems, fluid systems, equipment, or apparatus, if all of the following are true:

a) The equipment operates at less than 600 volts.

b) There is an approved "Energy Control Procedure", NASA LF 495, for the specific non-electrical type work to be performed and it specifies that the LOTO of the electrical isolation device may be performed by a mechanical SO.

c) The isolation device(s) controlling the power to the equipment are easily correlated and clearly marked.

c. It is the responsibility of the SO to know the limits of his/her LO/TO authority.

2.7.8 RESPONSIBLE EMPLOYEE shall:

a. Assume overall responsibility for a LOTO lockout when two or more employees are performing a lockout activity.

b. Have complete knowledge of the Energy Control Procedure, NASA LF 495, being implemented.

c. Have their name registered in the “Lockout/Tagout Record,” NASA LF 496 and on both parts of the Red Identification Tag.

d. Be knowledgeable of the roles of the SO(s) applying the lockout.

e. Accept the red identification tag stub with the key from the Safety Operator after reviewing the Energy Control Procedure, NASA LF 495, verifying that the isolation and de-energization has been accomplished and after receiving instructions/training from the SO about the hazards, controls and any other safety concerns associated with the lockout including the requirement removing the lockout.

f. Place the red identification tag stub with the key in the lock box and lock it with his/her personal lock.

g. Know the location, assignments and exposure status of all the Protected Employees (PE) for whom responsibility has been assumed. For large groups this will require maintaining a list of the PE(s), their work location and status of their personal locks.

h. Communicate with the SO(s), FCs, to ensure that their roles and responsibilities for this lockout are understood.

i. Ensure the PE(s) has received instruction/training about the Energy Control Procedure, NASA LF 495, and this LPR (Program) as it pertains to their personal safety and protection.

j. Ensure the PE(s) are given the opportunity to verify that isolation and de-energization has been accomplished.

2.7.9 PROTECTED EMPLOYEE shall:

a. Meet the applicable requirements of the RE when he/she is the only employee that is being protected under the lockout procedure.

b. Receive instructions/training from the SO or RE about the Lockout process, the PE’s responsibilities, the hazard controls and any other safety concerns associated with the lockout before beginning work.

c. Ensure that his/her personal lock is in place on the lock box before commencing work.

d. Verify that all hazardous energy has been isolated and controlled.

e. Ensure that his/her personal lock remains in place until protection is no longer required.

2.7.10 SHOP MACHINE OPERATORS shall:

a. Possess a current yellow authorization card, NASA LF 425, issued by SFAB.

b. Only protect themselves under the locked out condition.

c. Ensure the shop machine has LOTO procedures posted on or near the shop machine.

d. Ensure the posted procedures have been reviewed and signed within a year of the current lockout.

e. Locks out the machine following the posted procedures and secures the energy control device with a RED lock.

f. Attach their yellow identification card, NASA LF 425, to the RED lock.

g. Securely maintain the key to the RED lock in their possession.

h. Communicate with other (affected) employees in the area about the hazards and any other safety concerns related to the lockout.

2.8 COMMUNICATIONS

2.8.1 Whether implementing the RL/RT, CS or SM lockout method, the employees involved with the lockout shall initiate discussions and continue to communicate as described below, and as necessary until the lockout condition is lifted. As a minimum, the following communication protocol shall take place:

a. Discussion between the FC or their designee and the SO(s) shall take place prior to initiating the lockout. The FC is expected to be familiar with their facility and may be able to provide additional insight to ensure no additional hazards are created because of the lockout.

b. To promote a safe working environment during lockout it is necessary that the FC and SO understand each other's responsibilities and necessary interactions with the RE/PE.

c. The SOs and FCs shall also warn other employees (*affected employees*) that work in the area but are not directly involved with the lockout about any hazards that exist because of the lockout.

d. Immediate notification to the FC or their designee of any problems that arise during the lockout that will affect operations within the facility.

e. Final communication between the FC or their designee and the SO(s) prior to removing the LOTO.

f. Warning from the FC or designee to all the employees in the area prior to re-energizing the system.

g. Status briefing to the incoming RE and crew when shift work is involved. Shift work may also involve changes in the status of affected employees and may require that additional warnings be made. The FC or RE will determine the need and implement the warnings.

h. Communications in the form of a training briefing shall be provided to the RE and PE(s) from the SO or their designee. The training briefing shall be specific to the hazards and controls for the lockout they will be working under. See Section 3.2.1(i).

2.9 TRAINING REQUIREMENTS

a. All LaRC employees and contractors shall receive the appropriate training and retraining in the “Energy Control Program”, LPR 1710.10. The training content and frequency is determined by the employee’s Lockout/Tagout responsibilities.

2.9.1 All Center employees receive yearly safety awareness training. A portion of that training covers the basic do’s and don’ts of LOTO. It presents the message of when should a machine, equipment or system be locked out, by whom, and what an individual should be aware of if he/she come across a lockout.

2.9.2 Construction and maintenance contractors and their subs receive a safety briefing before they are allowed to work on Center. The briefing is good for six months and a portion of the briefing delivers the following LOTO message:

a. When a lockout should be applied.

b. Only LaRC’s program is applicable on Center, (Exception see 1.2.b (7).

c. Only a LaRC authorized SO can perform and release a lockout (Exception see 1.2.b (7).

d. Individuals that need LOTO protection will require additional training specific to the LOTO they will be working under.

2.9.3 PEs – In addition to either the yearly safety awareness training or the sub-contractor training, Protected Employees must receive instructions/training specific to the LOTO they will be working under. The training will address their responsibilities; see section 2.7.9 of this LPR.

2.9.4 The SOs, FSHs, SMOs and FCs must take yearly LOTO training that cover the requirements of this LPR.

2.9.5 SOs – LaRC's "Energy Control Program," LPR 1710.10, relies on the SOs to identify and control hazardous energy and thus provide protection to employees working under a lockout. For this reason the SO's training requirements are the most demanding. In addition to the yearly training described above in section 2.9.4 above, the SOs shall:

a. Meet the minimum training and or experience requirements specified in section 4.3 of this LPR.

b. Demonstrate competency in accordance with this LPR by passing a written test administered by the SFAB.

c. Demonstrate through field verification the ability to implement the requirements of this LPR, identify hazardous energy sources, isolate and de-energize machines, equipment or systems from those energy sources.

Chapter 3

3. APPLICATION OF PROGRAM CONTROLS

3.1 INTRODUCTION

3.1.1 Standardization of how energy sources are controlled will provide a safer work environment. The following controls, when applied, will reduce energy related risks to an acceptable level at LaRC. Before applying the controls in this chapter one must first determine which method of lockout applies to the work being performed (see paragraph 2.4 of this LPR).

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

3.2.1 Placing the LOTO

a. **ENERGY CONTROL PROCEDURE** - If any one of the elements of paragraph 2.5.1 of this LPR cannot be met an Energy Control Procedure, NASA LF 495, (see paragraph 3.5.1 of this LPR) shall be developed and approved by the SO(s) participating in the lockout and another employee acceptable to the SO as being knowledgeable of the system being locked-out and concurred with by the FC or their designee.

b. **COMMUNICATIONS** - The SO shall initiate discussions with the FC or their designee (see paragraph 2.8 of this LPR).

c. **CONTROLING THE ENERGY** - The SO isolates energy sources; releases stored energy (if any) and installs locks and identification tags. See paragraph 3.5.3 for more information on tags.

d. **VERIFICATION** - Before giving the red identification tag stub with the key to the RE the SO verifies that isolation and de-energization of the machine/equipment or system has been accomplished in accordance with the specific LOTO procedure, NASA LF 495. Another employee acceptable to the SO as being knowledgeable of the system being locked-out shall verify the LOTO when, in the opinion of the SO it is a complex system or for any electrical system operating above 600 volts.

e. **COMMUNICATION & TRAINING** -The SO gives the red identification tag stub with the key to the RE and provides the RE instructions/training about the hazards, controls and any other safety concerns associated with the lockout, the requirement for removing the lockout and allows the RE to verify that the isolation and de-energization has been accomplished

f. **PERSONAL PROTECTION** - The REs shall lock the red identification tag stub with the key in a lock box with their personal lock.

g. **DOCUMENT** - The SO or the FC shall enter the required information on LOTO Records, NASA LF 496. See Paragraph 3.5.2 for more information on this form.

h. **COMMUNICATION TO AFFECTED PERSONNEL** The SO or their designee (the FC or RE) shall notify personnel in the vicinity of the lockout that a lockout is in progress.

i. **PERSONAL PROTECTION, COMMUNICATION & TRAINING** - The SO or RE shall provide a training briefing to PE prior to commencing work. The briefing shall include as a minimum:
   (1) Information about the energy source(s) and the associated hazard(s), the control(s), the location of the controls, and the person that locked-out the isolation control device.
   (2) Information about who is leading (RE) the lockout, who they shall notify with concerns and who they shall notify when they have finished the task and no longer require protection.
   (3) An opportunity to understand and clarify any questions about the Energy Control Procedure, NASA LF 495, and verify that the isolation and de-energization of the machine/equipment and or system have been accomplished.
   (4) The guidance that the PE is required to lock their personal lock on the lockbox and return it to the RE only after they no longer require protection.

3.2.2 REMOVING THE LOTO

a. **WORKSITE VERIFICATION** - After the PE complete their tasks and the RE has inspected the work area to verify that system components have been properly reassembled, the PEs can remove their personal lock from the lock box.

b. **REMOVAL OF PERSONAL LOCKS** - The last personal lock to be removed shall be the RE's. The RE shall take the red tag, NASA LF 363, stub from the lock box and return it to the FC or SO.

c. **WORKSITE VERIFICATION** - The FC or their designee along with the RE shall verify that the system has been properly reassembled, the servicing work is completed and employees no longer need lockout protection.

d. **COMMUNICATION TO AFFECTED PERSONNEL** - The SO or their designee (the FC or RE) shall notify personnel in the vicinity of the lockout that the lockout is being lifted.

e. **VERIFICATION** - Before lifting the lockout the SO shall reunite the red identification tag stub with the key with the corresponding red identification tag on the energy control device to make sure that the lockout is being lifted on the correct energy control device.

f. **COMMUNICATION** - The SO shall remove the lockout hardware and notify the FC that the system is no longer under lockout.

g. **DOCUMENT** - The SO or the FC shall document the lockout release in the LOTO Records, NASA LF 496.

3.2.3 TESTING OR POSITIONING

a. In situations that require removal of the lockout device from the isolating device and the machine/equipment or system energized to test or position the machine, the sequence of actions shall be documented and approved using NASA LF 495, Energy Control Procedure. The following sequence of events shall be documented and followed:
   (1) Release from Lockout as stated above in section 3.2.2.
   (2) Energize and proceed with testing or positioning.
   (3) De-energize the system and reapply energy control measures, in accordance with the RL/RT lockout controls specified above in section 3.2.1.

3.2.4 MULTIPLE SHIFT LOCKOUTS

a. Personal locks may, with agreement from the RE, be left on the lockbox. PE must verify that their lock is still on the lock box prior to starting work on subsequent shifts.

b. The Personal lock of the RE shall remain locked on the lockbox until the work is completed and they are ready to reunite the red identification tag stub with the key with the tag on the energy control device.

c. The crew leader for the out-going shift shall communicate with the on-coming shift to verify the current lockout condition.

d. The RE shall ensure that the PE(s) from the oncoming shift have received PE(s) instruction/training about the Energy Control Procedure, NASA LF 495, and this LPR (Program) as it pertains to their personal safety and protection.

e. The RE shall ensure that the PE from the oncoming shifts are given the opportunity to verify that isolation and de-energization has been accomplished.

3.3 CRAFT SPECIFIC LOCKOUT PROCEDURES

a. The Craft Specific Safety Operator (CSSO) assesses energy risks, identify hazards and determine which isolation control device requires lockout.

b. The CSSO notifies the FC or their designee of the pending lockout and discuss any issues, concerns and schedule.

c. CSSO notifies employees in the vicinity of the lockout that a lockout is in progress.

d. The CSSO shall isolate the energy source; release stored energy and install red lock and blue identification card, NASA LF 403. Each person protected by the CS lockout shall be an authorized CSSO and shall have placed their red lock with the blue identification card, NASA LF 403, on the lockout device.

e. CSSO's verify effectiveness of lockout by attempting to start-up the machine/equipment.

f. Once work is complete, the CSSO shall verify that the system has been properly reassembled and that it is safe to release the locked out condition.

g. The FC or their designee shall be notified that the system is being released from the locked out condition.

h. The CSSO notifies employees in the vicinity of the lockout that a restart is in progress.

i. The CSSO removes the lockout hardware and allows the system to be restarted.

j. Temporary Removal - In situations in which lockout devices shall be temporarily removed from the isolating device and the machine/equipment or system energized to test or position the machine, the following sequence of actions shall be followed by the CSSO:
   (1) Release from Lockout as stated above.
   (2) Energize and proceed with testing or positioning.
   (3) De-energize the system and reapply energy control measures per Paragraph (d) and (e) of this section.

k. The lockout applied by a CSSO(s) shall not extend beyond one work shift. If the servicing cannot be completed in one work shift then the CSSO(s) for the on-coming shift may transfer their blue identification card(s) , NASA LF 403, and lock with that of the out-going CSSO(s) or the lockout shall be transferred to the Red Lock/Red Tag method.

3.4 SHOP MACHINE LOCKOUT PROCEDURES

a. SMO assess energy sources, identify hazards, and verify/review the posted shut down and lockout procedure posted for the machine.

b. The SMO notifies employees in the vicinity of the lockout that a lockout is in progress.

c. The SMO isolates the energy source; releases stored energy and installs red locks and SMO's yellow identification card, NASA LF 425. Each person protected by the SM lockout shall be an authorized SMO and shall have placed their red lock with yellow identification card, NASA LF 425, on the lockout device.

d. The SMO shall verify effectiveness of lockout by attempting to start-up the machine.

e. Once work is complete, the SMO shall verify that the system has been properly reassembled and notifies employees in the vicinity of the lockout that a restart is in progress.

f. The SMO unlocks the red lock and allows the system to be restarted.

3.5 RL/RT LOTO FORMS, IDENTIFICATION TAG and HARDWARE

a. The following are associated with the RL/RT LOTO method.
   (1) NASA Langley Form 493, "Lockout/Tagout Release" (see 3.5.4)
   (2) NASA Langley Form 495, "Energy Control Procedure" (see 3.5.1)
   (3) NASA Langley Form 496, "Lockout/Tagout Records" (see 3.5.2)
   (4) Red Identification Tag (see 3.5.3)
   (5) The NASA Forms can be downloaded from Langley Management System web site and the Red Identification Tags may be requested from the Safety and Facility Assurance Branch Manager.

b. LOTO hardware, locks and red identification tags can be requisitioned from SFAB by FC's, his/her designee or the supervisor(s) responsible for maintaining institutional services such as air conditioning/heating and lighting. Those individuals shall control the requisitioned hardware and identification tags and designate an area where employees have access to lockboxes and the lockout documentation. All documentation relating to a specific lockout event shall be maintained for one year.

3.5.1 NASA LANGLEY FORM 495, ENERGY CONTROL PROCEDURE

a. The Energy Control Procedure and the red identification tag(s) shall be unique to the specific machine, piece of equipment or system and the service or maintenance being performed.

b. NASA LF 495 shall be used to document the Energy Control Procedure. When necessary, NASA LF 495 can reference a continuation sheet but the procedures shall clearly and specifically identify the following:
   (1) A unique identification number and date of review and approval.
   (2) The machine, piece of equipment or system along with the facility location.
   (3) The type and magnitude of the energy to which employees may potentially be exposed.
   (4) The hazard(s) associated with the energy.
   (5) The steps for shutting down or turning off the machine, equipment or system. The procedure may reference an existing Standard Operating Procedure.
   (6) The location of all energy isolation devices that are needed to control the energy shall be noted or referenced in an attached drawing/schematic. For electrical equipment/systems this includes any required safety grounds, that are needed to control the energy.
   (7) The specific sequence (if necessary) in which the control devices need to be deactivated or how they need to be operated.
   (8) Specific requirements for testing the machine/equipment or system to verify that all potentially hazardous stored or residual energy is relieved, disconnected, restrained, and otherwise rendered safe.
   (9) The specific sequence for removing control devices, (if necessary).

(10) Specific procedures to control shift or personnel changes to ensure the continuity of the lockout. If required it shall include provisions for the orderly transfer of locks between off-going and oncoming shifts.
(11) Approving officials by name are the SO(s) participating in the lockout and another employee acceptable to the SO as being knowledgeable of the system being locked-out.
(12) The FC or their designee shall concur with the procedures.

c. The lockout shall only be performed by the SO that reviewed and signed the Energy Control Procedure. The Energy Control Procedure is only valid for 1 year.

3.5.2 NASA LANGLEY FORM 496, LOCKOUT/TAGOUT RECORDS

a. NASA LF 496, "Lockout/Tagout Records," shall be used as a tool by the facility as an ongoing log to indicate the active and historical lockout condition(s) in the facility. Entries recorded in the log shall be kept for a minimum of one year. This form shall be used anytime the RL/RT method is used. Information required on the Lockout Records Log is as follows:
(1) **Tag No.** - The serial number of the red identification tag issued to the SO.
(2) **Date Tag Issued** - The date the Safety Operator gave the red identification tag to the RE.
(3) **Facility Coordinator** – The FC or their designee that issues the RED identification tag to the Authorized Safety Operator.
(4) **Safety Operator** – The authorized SO locking out the system.
(5) **Responsible Employee** – The name of the employee the RED tag, NASA LF 363, is written to. It could be a PE in the case of a single lockout or it could be the RE in the case of a group lockout.
(6) **Location of Tag** – Identify where the locked-out isolation device is located. (Note: be as specific as possible noting the location)
(7) **Personal Locks Out/In** – Number of Personal locks issued to the RE /PE.
(8) **Lock Box** – Number of the lockbox. (Lock boxes shall be identified.)
(9) **Work to be performed and the System** – Briefly describe the system and the servicing being done.
(10) **Procedure No. NASA LF 495** - Record the procedure number (if a documented procedure is required).
(11) **Facility Coordinator** – The FC or their designee authorizing the removal of the lockout device.
(12) **Safety Operator** – The authorized SO removing the lockout device.
(13) **Date Tag lifted** – The date the lockout device is removed.

3.5.3 RED IDENTIFICATION TAGS

a. The SO shall complete the information requested on the red identification tag. The white backing on the top half of the form shall be peeled off and the protection window placed over the information to protect it from the environment. The bottom stub shall be removed at the perforation and given to the RE/PE along with the key to the red lock. Clarification of information required on the red identification tag is as follows:
(1) **Location** - Building/facility name or number.

(2) **Date** - Date when the lockout is applied.
(3) **Equipment** - Name of the machine/equipment or system being locked-out.
(4) **Tagged For:** - Who the tag is issued to.
  a) **Name** - The RE/PE or N/A if applied for yourself
  b) **Section** - Organization responsible for the lockout
  c) **Telephone** - Contact number of the RE
(5) **Time** - Time the lockout was applied.
(6) **Remarks** - Any pertinent notes.
(7) **Locked By** - SO that locked-out the isolation device.

b. The above information is repeated on the bottom half or stub section of the tag along with the name of the RE/PE accepting the stub and the date accepted.
  (1) **Reported Clear** - The time and date the lock and lockout devices were removed from the energy isolation device.
  (2) **Returned to Service** - N/A
  (3) **Cleared By** - The SO that removed the lockout devices.

3.5.4 NASA LANGLEY FORM 493, LOCKOUT/TAGOUT RELEASE (Without Red Tag Stub, NASA LF 363, or Removal of Personal Lock by authorized personnel)

a. Anytime a personal lock is removed from a lock box by someone other than the employee who applied that lock, such removal shall be done with approval documented on the NASA LF 493. When completing the NASA LF 493 and a worker is not available and forgot to remove their personal lock or in an emergency situation, the lock may be removed by documenting the following steps:
  (1) Verify that the employee that applied the lock is not in the facility.
  (2) Make every effort to contact the employee before removing the lock.
  (3) Document what is being done to notify the individual (before he/she returns to area) that their lock was removed and the status of the lockout.
  (4) The employees' Supervisor will approve the removal of a personal lock from the lockbox by someone other than the employee who applied the lock documenting the action on NASA LF 493.

b. Any time a red identification tag stub is not available for the SO's verification for the release of the lockout, the release shall be documented on NASA LF 493. The Supervisor or Facility Manager responsible for the system shall:
  (1) Verify that the equipment, machine or system has been properly reassembled, the servicing work is complete and the employee(s) no longer need lockout protection.
  (2) Document why the red identification tag stub is not available.

Chapter 4

4. AUTHORIZATION OF SAFETY OPERATORS AND SHOP MACHINE OPERATORS

4.1 DOCUMENTATION

a. The documents associated with the authorization of SOs, CSSOs and SMOs are:
   (1) NASA Langley Form 451, "Safety Operator Appointment Form"
   (2) NASA Langley Form 453, “Safety Operators Permit”
   (3) NASA Langley Form 403, “Craft Specific Blue Identification Card”
   (4) NASA Langley Form 425, “Shop Machine Yellow Identification Card”

4.2 AUTHORIZATION PROCESS

a. Candidates for the SO, CSSO or SMO (both civil servants and on site-contractors) shall be recommended by their supervisor by completing NASA LF 451 and forwarding to LaRC Safety Manager.

b. The candidate shall understand the requirements of this LPR.

c. The Supervisor shall ensure the recommendation provides sufficient detail defining type of energy, the maximum energy level, the building(s)/facility(s), and the machine/equipment/or system that the employee will be authorized to lockout. Any one or a combination of the following descriptive examples could be used:
   (1) Authorized to lockout electrical energy 600 volts and above at any LaRC substation.
   (2) Authorized to lockout electrical energy below 600 volts at the National Transonic Facility.
   (3) Authorized to lockout pneumatic pressure systems up to 125 psi in building 1195.
   (4) Authorized to lockout steam pressure systems up to 350 psi in the steam generation facility.
   (5) Authorized to lockout devices controlling electrical energy that is below 600 volts to do mechanical repair, servicing, or maintenance of mechanical components/systems.
   (6) For all the energy sources associated with the laser system for the Aerospace Research Project.
   (7) For any HVAC energy control devices at LaRC limited to 220 volts and 125 psi. (**This would be for CSSO’s appointment**).
   (8) For the Cincinnati Brake machine in building 1232A. (**This would be for SO’s and SMO’s**).
   (9) Authorized to lockout electrical energy below 600 volts for mechanical work.

d. The Supervisor shall document the candidate's qualifications on NASA LF 451 and maintain a record of the candidates training and experience with the machine, equipment or system they are seeking to obtain LOTO certification.

e. The LaRC Safety Manager shall review the candidate's qualifications and process the appointment form.

f. Employees that are recommended to receive authorization to lockout a shop machine shall:
   (1) Be recommended by their supervisor.
      a) The supervisor documents and signs NASA LF 451, indicating that the employee is experienced with the shop machine(s) they are requesting authorization for to ensure they understand the energy source and hazard and the procedure for isolating/controlling the energy.
   (2) Present the signed application to SFAB and receive formal training and testing to:
      a) Ensures they understand their responsibility and limitations of their authorization.
      b) Ensure they understand that the machine they are requesting lockout authorization for meets all the procedural exemptions of 29 CFR 1910.147 (c)(4).
   (3) Be issued a **yellow** laminated (ID) card, NASA LF 425, once they pass the test and their application is reviewed and approved by the Safety Manager.

g. Candidates seeking authorization for SO shall:
   (1) Meet the qualification requirements (section 4.3)
   (2) Successfully demonstrate to a Field Verifier their knowledge of both this LPR and their ability to control and lockout energy on the equipment/systems for which they are seeking authorization.
   (3) Pass a written test administered by the LaRC Safety Manager.

h. Upon satisfying Paragraph (g) above the LaRC Safety Manager shall issue a NASA LF 453, "NASA Langley Safety Operator's Permit," that is valid for 4 years from the date on the permit.

i. The LaRC Safety Manager and Field Verifier shall ensure SO's understand that their safety and the safety of the Protected Employee's depends on their ability to lockout a system safely and they have the authority and responsibility to refuse to lockout a system if they feel they are not qualified to do so or for any reason they think their safety or the Protected Employee's safety will be compromised.

j. The LaRC Safety Manager or his/her designee shall keep NASA LF 451, along with the results of the written test on file.

k. Employees seeking to be CSSO shall:
   (1) Be recommended by their supervisor on a NASA LF 451.
   (2) Be an authorized SO.
   (3) Be briefed by the Safety Office about the responsibilities and limitations of a CSSO.
   (4) Be issued a **blue** laminated (ID) card, NASA LF 403, once their application is reviewed and approved by the Safety Manager.

4.3 SAFETY OPERATOR QUALIFICATIONS

a. A SO shall be a civil servant or an on-site contractor who has experience on the equipment or type of equipment to which RL/RT lockout may be performed. Evidence to support qualification as a SO shall be by one of the following:
   (1) Licensed as a Journeyman Tradesman in the Commonwealth of Virginia or other governmental jurisdiction with licensing requirements equivalent to the Commonwealth of Virginia. In addition to the Journeyman License, a SO shall have one year of relevant experience after the date of first licensing on equipment or type of equipment to which LOTO will be performed. The experience shall be acceptable to the Contract Manager for on-site contractor employees or the Organizational Unit Manager or his/her designee for civil servants and concurred with by the LaRC Safety Manager.
   (2) Completion of a United States Department of Labor apprenticeship as evidenced by a Certificate of Completion of Apprenticeship. In addition to the Certificate of Completion of Apprenticeship, a SO shall have one year of relevant experience after the date of completion of the apprenticeship on equipment or type of equipment to which LOTO will be performed. The experience shall be acceptable to the Contract Manager for on-site contractor employees or the Organizational Unit Manager or his/her designee for civil servants and concurred with by the LaRC Safety Manager.
   (3) Six years of relevant practical experience on the equipment or type of equipment to which LOTO will be performed. The experience shall be acceptable to the Contract Manager for on-site contractor employees or the Organizational Unit Manager or his/her designee for civil servants and concurred with by the LaRC Safety Manager.
   (4) Direct involvement in the development and construction or assembly of a particular research apparatus or facility with appropriate knowledge of the research apparatus or facility that would allow the individual to safely perform lockout/tagout on the particular research apparatus or facility. For contractors direct involvement shall be acceptable to the Contract Manager, or the Organizational Unit Manager or his/her designee for civil servants and concurred with by the LaRC Safety Manager.

(5) Demonstrated knowledge of the characteristics, operation, and hazards of the specific facility, system(s), or class of equipment for which the individual will be authorized to perform lockout/tagout. Supporting documentation shall be attached to the Safety Operator, NASA LF 451. The supporting documentation shall conform with the candidate's:
   a) Ability to locate, read, and understand applicable schematic drawings (list drawing numbers).
   b) Ability to locate and identify key system components in the field (list specific components).
   c) Knowledge of the system or equipment operation (Qualifications as a level 1or level 2 certified to operator or a statement that the candidate has satisfactorily described the operation to his supervisor and the associated FSH).
   d) Ability to safely start-up and shutdown systems or equipment (list of SOP's demonstrated or equipment operated).
   e) Ability to identify hazards associated with the facility, systems, or class of equipment (list of the systems or class of equipment and hazards identified by candidate).

(6) The supporting evidence shall be documented on NASA LF 451 and signed by the candidate's supervisor and associated FSH to confirm that the candidate has demonstrated the listed knowledge and abilities. The documented evidence of the candidate's knowledge and ability shall be acceptable to the Contract Manager for contract employees or the organizational unit manager or his/her designee for civil servants and concurred with by the LaRC Safety Manager.

Chapter 5

5. AUTHORIZATION PROCESS AND QUALIFICATIONS FOR A SAFETY OPERATOR FIELD VERIFIER (FIELD VERIFER)

5.1 DOCUMENTATION

5.1.1 The document associated with the authorization of a Field Verifier is:

a. NASA LF 519, “Safety Operator Field Verifier Appointment Form."

5.2 FIELD VERIFIER AUTHORIZATION PROCESS

a. The procedure for certification as a Safety Operator Field Verifier:
   (1) An employee’s supervisor shall initiate a NASA LF 519, "Safety Operator Field Verifier Appointment Form."
   (2) Both the LaRC Safety Manager and the appropriate Standard Practice Engineer shall concur that the employee’s qualifications are acceptable if they believe that to be the case. If they do not believe the employee’s qualifications are acceptable, they shall nonconcur.
   (3) Recommendations shall be presented to the LaRC Executive Safety Council for appointment.
   (4) The LaRC Safety Manager shall maintain on file the approved NASA LF 519 along with the minutes from the Executive Safety Council meeting.

5.3 FIELD VERIFIER QUALIFICATIONS

a. A Safety Operator Field Verifier shall be a technical subject matter expert in the field in which the Safety Operator Candidates are to be certified. A Safety Operator Field Verifier shall be or have been a NASA Safety Operator. Evidence to support qualification as a technical subject matter expert shall be by one of the following:
   (1) Licensed as a Master Tradesman in the Commonwealth of Virginia or other governmental jurisdiction with licensing requirements equivalent to the Commonwealth of Virginia. In addition to the license as a Master Tradesman in the Commonwealth of Virginia, the Safety Operator Field Verifier shall have 2 years of relevant experience after the date of first licensing on equipment or type of equipment to which SO candidates will be certified to perform RL/RT lockout. The experience shall be acceptable for the employees Contract Manager for support to the Organizational Unit Manager or his/her designee for civil servants and concurred with by the LaRC Safety Manager.

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(2) Completion of a United States Department of Labor apprenticeship as evidenced by a Certificate of Completion of Apprenticeship. In addition to the Certificate of Completion of Apprenticeship, the Safety Operator Field Verifier shall have 3 years of relevant experience after completion of the apprenticeship on equipment for the type of equipment on which SO candidates will be certified to perform RL/RT lockout. The experience shall be acceptable to the Contract Manager for contractor employee or to the Organizational Unit Manager or his/her designee for a civil servant and concurred with by the LaRC Safety Manager.

(3) Ten years of relevant experience acceptable to the Contract Manager for a contractor employees or to the Organizational Unit Manager or his/her designee for a civil servant on the equipment or type of equipment to which SO candidates will be certified to perform RL/RT lockout.

(4) Ten years of a combination of education (30 college credits substituted for one year of relevant experience) and relevant experience on the equipment or type of equipment to which SO candidates will be certified to perform Lockout/Tagout that is acceptable to the Contract Manager for a contractor employee or to the Organizational Unit Manager or his/her designee for a civil servant. The LaRC Safety Manager shall concur with the experience.

5.4 FIELD VERIFIER RESPONSIBILITIES

5.4.1 The Field Verifier shall:

a. Verify that the recommended employee seeking authorization as a SO has a working knowledge of system(s), the energy sources and hazards of those systems and the controls required for effective lockout.

b. Verify that the recommended employee understands requirements of this LPR.

c. Ensure the SO understands that their safety and the safety of the PE's depend on their ability to lockout a system safely and they have the authority and responsibility to refuse to lockout a system if they feel they are not qualified to do so or for any reason they think their safety or the PE's safety will be compromised.

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Appendix A

DEFINITIONS

Capable of Being Locked-Out - 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 devices 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.

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 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 in addition, no pole can be operated independently; a line valve; a block; and any similar device used to block or isolate energy. Push buttons, selector switches and other control circuit type devices are not energy isolating devices.

Energy Source - Any source of electrical, mechanical, hydraulic, pneumatic, chemical, thermal, or other energy.

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

Industrial Facility –Includes but is not limited to facilities that generate energy, their energy distribution system/network and operational facilities that consume large quantities of energy. Facilities such as the Steam Plant and the Compressor Station generate energy for Center consumption. Examples of distribution systems include substations and electrical distribution lines for electrical energy and piping, fittings flanges valves and pumps for distributing steam and air throughout the Center. The National Transonic Facility, Unitary Plan Wind Tunnel, Transonic Dynamics Tunnel, the Aircraft Landing Dynamics Facility and the Hangar are some examples of facilities that consume large quantities of energy.

Lockout - The placement of a lockout device on an energy-isolating device, in accordance with an established procedure, ensuring that the energy isolating device and the equipment being controlled cannot be operated until the lockout device is removed.

Lockout Device - A device that utilizes a positive means such as a lock to hold an energy isolating device in the safe position and prevent the energizing of a machine or equipment. Included are blank flanges and bolted slip blinds.

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Protected Employee - An employee whose duties include servicing or maintenance of machines, equipment of systems that are under a LOTO condition. This is equivalent to an **Authorized** employee as defined by, 29 CFR 1910.147 (b).

Responsible Employee – An authorized employee that accepts primary responsibility for a set number of employees working under the protection of a group lockout.

Safety or Shop Machine Operator or Authorized Employee A person who locks out or tags out machines, equipment or systems in order to perform servicing or maintenance on that machine or equipment.

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

Setting Up - Any work performed to prepare a machine or equipment to perform its normal production operation.

Tagout - The placement of a tagout device on an energy-isolating device, in accordance with an established procedure, to indicate that the energy isolating device and the equipment being controlled may not be operated until the tagout device is removed.

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

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LPR 1710.11

Effective Date: October 3, 2004

Expiration Date: June 21, 2009

Langley Research Center

FIRE PROTECTION PROGRAM

National Aeronautics and Space Administration

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RESPONSIBLE OFFICE: SAFETY AND MISSION ASSURANCE OFFICE

PREFACE

P.1 PURPOSE

This Langley Procedural Requirements (LPR) sets forth procedural requirements for the Langley Research Center (LaRC) Fire Protection Program. It defines the requirements of the Center's Fire Protection Program. This program includes the elements of management; administration; documentation; training; system facility design and construction; fire protection engineering; fire prevention; annunciation; confinement; suppression; fire department; inspection, testing, and maintenance; and quality assurance. This LPR also provides guidance for government personnel in performing their responsibilities for this program.

P.2 APPLICABILITY

This directive is applicable to all employees at LaRC.

P.3 AUTHORITY

a. NPD 8700.1, "NASA Policy for Safety and Mission Success"

b. NPD 8710.2, "Safety and Health Program Policy"

P.4 REFERENCES

a. NPR 8715.3, " NASA Safety Manual"

b. STD 8719.11, "NASA Safety Standard for Fire Protection"

c. NPR 8820.2, "Facility Project Implementation Handbook."

d. 29 CFR Part 1910 Subpart L, Fire Protection

e. STD 8719.7, "Facility System Safety Manual"

f. NFPA 101, "Life Safety Code"

g. NFPA 70, "National Electrical Code"

h. NFPA 1, "Fire Prevention Code"

i. ASME A17.1, "Safety Code for Elevators"

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P.5 CANCELLATION

N/A

original signed on file

Roy D. Bridges, Jr.
Director

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CHAPTER 1

1. INTRODUCTION

1.1 FORWARD

Langley Research Center (LaRC) management is committed to strive for excellence in the conduct of operations to ensure a fire-safe work environment. Work is performed at LaRC only when the risk of fire is as low as is reasonably achievable (ALARA) and when the people are provided with a fire-safe workplace. Facilities shall be designed and operated in a manner to minimize the adverse impacts of fire and its related perils to workers, the public, and the environment. Fire protection support activities are conducted in compliance with fire safety laws, National Aeronautics and Space Administration (NASA) directives, and regulations and general industry practices, and in a manner appropriate for the associated hazards.

The establishment of a comprehensive LaRC fire protection program has as its goal to ensure that an adequate level of fire protection and life safety is maintained for personnel and property. This LPR was developed in order to achieve this goal and maintain a viable and effective fire safety program. Authority for the development and implementation of the LaRC Fire Protection Program is rooted in two NASA-wide policies:

- NPD 8700.1A, "NASA Policy for Safety and Mission Success"
- NPD 8710.2C, "Safety and Health Program Policy"

Guidance for the development of this LPR was provided by:

- NPR 8715.3, " NASA Safety Manual"
- STD 8719.11, "NASA Safety Standard for Fire Protection"
- NPR 8820.2C, "Facility Project Implementation Handbook."

NPR 8715.3 requires each NASA organizations to comply with the most current requirements of the following documents:

- Any applicable Federal Documents
- ICC International Codes (Building, Mechanical, Fire, Plumbing)
- 29 CFR Part 1910 Subpart L, Fire Protection
- Any applicable NASA Documents
- NASA Safety Standard for Fire Protection – STD 8719.11
- Facility System Safety Manual – STD 8719.7
- Any applicable NFPA Codes and Standards and their Appendices
- NFPA 101, Life Safety Code
- NFPA 70, National Electrical Code
- NFPA 1, Fire Prevention Code

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- ASME A17.1, Safety Code for Elevators

STD 8719.11 expands on the policy and guidelines for fire protection listed in NPR 8715.3. STD 8719.11 is a compilation of pertinent requirements from OSHA, NFPA, as well as unique NASA requirements. Compliance with this standard is mandatory for all NASA Field Installations. This Standard establishes fire protection requirements for NASA facilities in addition to those provided in NPR 8820.2C. NPR 8820.2C adds the following documents to the list of those stated previously that must be adhered to:

- Code of Federal Regulations (CFR)
- Factory Mutual (FM) Data Sheets and Approval Guides

LaRC management is responsible for correcting work conditions and employee actions that may contribute to the occurrence of fire. It also is responsible for informing employees, contractors, and relevant authorities of known potential fire hazards encountered in the workplace; for training individuals and making equipment and appropriate job procedures available so that each assignment can be completed in a fire-safe manner; and for ensuring that contractors apply fire protection requirements fully complying with LaRC directives.

1.2 GLOSSARY OF TERMS

Aging: Large-scale deterioration over time, caused by service and the environment.

Approved: Acceptable to the Authority Having Jurisdiction (AHJ).

Approved Materials: Materials approved by Factory Mutual (FM) or listed with Underwriters Laboratories (UL).

Assembly Point: An area identified by the facility owner and/or facility safety head with concurrence from the LaRC Fire Chief for facility personnel to safely gather following an evacuation.

Authority Having Jurisdiction (AHJ): The individual responsible for approving equipment, an installation, or a procedure.

Building: Any structure, enclosure, facility, or ramp used or intended for supporting or sheltering any use or occupancy. The term “building” shall be construed as if followed by the words “or portions thereof.”

Certificate of Beneficial Occupancy: A document signed by the Safety and Facility Assurance Branch (SFAB) Head attesting that an area or facility substantially complies with all fire protection and Life Safety Code requirements, but is not in literal compliance with all fire safety requirements.

Certificate of Final Occupancy: A document signed by the SFAB Head attesting that an area or facility fully complies with applicable Occupational, Safety and Health Administration (OSHA), National Fire Protection Association (NFPA), NASA, and LaRC safety requirements on the date of the issuance of the certificate.

Clean Room: A room in which the concentration of airborne particles is controlled to specific limits.

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Clean Zone: A defined space in which the concentration of airborne particles is controlled to specific limits.

Computer Area: An area of a facility where the computer room is located including support rooms served by the same special air conditioning/air handling equipment as the computer room.

Computer Room: A room within the computer area that contains the electronic computer/data processing equipment.

Construction Projects: New facilities, facility additions, and facility alterations.

Deviation: A variance that authorizes departure from a particular safety requirement where the intent of the requirement is being met through alternate means which provide an equal or greater level of safety.

Exit: That portion of a means of egress that is separated from all other spaces of the facility or structure by construction or equipment as required by referenced documents to provide a protected way of travel to the exit discharge.

Exit Access: That portion of a means of egress that leads to an exit.

Exit Discharge: That portion of a means of egress between the termination of an exit and the public way.

Facility Fire Watch: The monitoring of facility operations during fire protection system impairments and the monitoring of other compensatory measures.

Facility Owner and/or Facility Safety Head: The individual having either the responsibility for all facility related items or processes with the facility or the responsibility for the personnel working in the facility. The responsible manager is the facility owner in instances where the requirement or responsibility pertains to the actual facility or processes in the facility, such as when a light bulb needs to be replaced. The supervisor directly responsible for the employees performing operations or working in the facility is the responsible manager in instances where the requirement or responsibility pertains to the employees performing operations (e.g., when a requirement states that the responsible manager ensures that personnel conduct tasks in a specified manner). In many situations, the responsible manager is both the facility owner and the supervisor of personnel in the facility.

Fire Area: An area bounded by construction with a minimum fire resistance rating of 2 hours, unless otherwise approved by the AHJ, with openings protected by appropriately fire rated doors, dampers, or penetration seals. The boundaries of exterior fire areas (yard areas) are determined by the AHJ.

Fire Hazard Analysis: A comprehensive assessment of the risks from fire within individual fire areas in a facility.

Fire Loss: The dollar cost of restoring damaged property to its prefire condition. In determining loss, the estimated damage to the facility and its contents includes replacement cost less salvage value. Losses will exclude costs of restoring (1) property that is scheduled for demolition, (2) property that is decommissioned and not carried on the books as value, and (3) property that has no loss potential. Personnel performing

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the loss estimate should include the cost of decontamination and cleanup, the loss of production or program continuity, the indirect costs of fire extinguishment (such as damaged fire department equipment), and consequent effects on related areas in all property loss amounts.

Fire Protection: A broad term that encompasses all aspects of fire safety, including facility construction and fixed facility fire protection features, fire suppression and detection systems, fire water systems, emergency process safety controls, emergency fire fighting operations (fire department), Fire Protection Engineer (FPE), and fire prevention. Fire protection is concerned with preventing or minimizing the direct and indirect consequences of fire on people, property, and programs. By extension, fire protection also includes aspects of the following perils as they relate to fire protection: explosion, natural phenomenon, and smoke and water damage from fire.

Fire Protection Engineering Survey: The process of reviewing, inspecting, testing, conducting surveillance, appraising and surveying to determine and document the compliance of facilities and operations with applicable directives, codes, and standards.

Fire Protection Program: A program that establishes the requirements, responsibilities, and organizational interfaces for implementing policy in the areas of fire protection, fire prevention, and life safety.

Fire Protection Review: A review of construction plans prior to contemplated construction for adequacy of fire risk appraisal and protection and for compliance with NASA fire protection criteria.

Fire Protection System: Any system designed and installed to detect, control, or extinguish a fire; to limit fire damage; to alert occupants and/or the fire department that a fire has occurred; or to otherwise enhance life safety.

Fire Protection System Impairment: A shutdown of a fire protection system or portion thereof.

Fire Watch (for hot work activities): The individual(s) who monitor the area around hot work activities for any fires or hot spots caused by sparks or slag. The personnel assigned to this task have received hands-on fire extinguisher training, and the hands-on training is renewed biannually. The personnel performing this task typically are drawn from the organization performing the hot work or possibly the LaRC Fire Department in special hazard situations and with the approval of the LaRC Fire Chief.

Graded Approach: By graded approach, LaRC intends that the depth of detail required and the magnitude of resources expended for a particular action are commensurate with the action's relative importance to safety, environmental compliance, safeguards and security, programmatic importance, and/or other facility specific requirements.

Improved Risk: Generally, an improved risk property is one that would qualify for complete insurance coverage by the Factory Mutual System, the Industrial Risk Insurers, and other industrial insurance companies that limit their insurance underwriting to the best protected class of industrial risk. This term also implies that qualified fire protection engineering judgment has been used to obtain the highest economically justifiable level of industrial loss prevention. The most evident characteristic of an improved risk property is the existence of reliable, automatic fire extinguishing systems

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throughout all facilities of combustible construction or content where the facility is vital to operational continuity or may experience a large property loss from fire in the absence of an automatic extinguishing system.

Maximum Credible Fire Loss: The property damage that would be expected from a fire, assuming that (1) all installed fire protection systems function as designed; and (2) the effect of emergency response is omitted except for post fire actions such as salvage work, shutting down water systems, and restoring operations.

Maximum Possible Fire Loss: The value of property, excluding land, within a fire area, unless a fire hazards analysis demonstrates a lesser (or greater) loss potential. This assumes the failure of both automatic fire suppression systems and manual fire fighting efforts.

Means of Egress: A continuous and unobstructed way of exit travel from any point in a facility or structure to a public way, consisting of three separate and distinct parts: the exit access, the exit, and the exit discharge.

Products of Combustion: Heat, smoke, sparks, and firebrands generated by burning.

Public Way: Any street, alley, or other similar parcel of land essentially open to the outside air that is dedicated or otherwise permanently appropriated to the general employee for Center use. The public way has clear width and height of not less than 10 feet.

Pyrophoric Material: A material that ignites spontaneously when exposed to air.

Redundant Fire Protection: Fire protection measures implemented to mitigate the effects of fires or related perils in the event of a partial or total failure of the primary fire protection measures (e.g., two independent fire suppression systems to protect a high risk facility).

Safety Class Equipment: A system or component that by not performing as intended could lead to loss of life, severe injury, or major property damage.

Safety Related Area: A system, equipment, or facility that, by not performing as intended, causes a hazardous condition that may lead to loss of life, severe injury, or major property damage.

Shop Welding Area: A permanently identified and fixed location in which hot work operations take place to support specific projects or facility operations.

Structure: That which is built or constructed. The term “structure” shall be construed as if followed by the words “or portion thereof."

Temporary: Not to exceed a period of 45 days.

Transient Fire Load: A fire load that is not permanently installed or stored in a designated storage area. This includes items such as combustible shipping containers, packing, stored paper, etc. This does not include hand carrier items directly under an individual's control such as toolboxes, work documents personal protective equipment, and instrumentation devices.

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Variance: Documented and approved permission to perform some act different than established requirements.

Waiver: A variance that authorizes departure from a specific safety requirement where an increased level of risk has been accepted.

Wear: Local deterioration that is expected based on previous experience.

Work Order: A written request for maintenance work submitted on a work order form.

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CHAPTER 2

2. PROGRAM MANAGEMENT

2.1 FIRE PROTECTION STATEMENT

2.1.1 PURPOSE

This LPR outlines the procedural requirements necessary for the LaRC fire protection program to meet the NASA fire protection criteria and NASA-mandated fire protection codes and standards.

2.1.2 SCOPE

This directive shall apply to the implementation of the fire protection program in all organizations at LaRC and to all contractors.

2.1.3 REQUIREMENTS

The LaRC fire protection program shall include the following elements: management; administration; documentation; training; system and facility design and construction; fire protection engineering (FPE); fire prevention; annunciation; confinement; suppression; fire department organization; inspection, testing, and maintenance; and quality assurance. The functional/organizational structure of the LaRC Fire Protection Program is shown in Figure 2.1.

The fire protection program shall provide and maintain a level of fire protection at LaRC which shall meet and/or exceed the objectives and criteria stated in NASA STD 8719.11, "NASA Safety Standard for Fire Protection". The objectives and the approach of the program shall entail the following:

1. Complete facility survey/risk analysis to identify fire protection and life safety deficiencies within the LaRC facilities. This shall be accomplished by the performance of comprehensive FPE surveys on a periodic basis and more detailed fire hazard analyses (FHA's) of facilities and hazards as warranted.
2. Reporting and tracking of fire protection deficiencies. This shall be accomplished by the fire protection organization maintaining a database of all FPE deficiencies, recommended corrections, and status of corrections.
3. Appropriate review and correction of fire safety violations. This shall be accomplished by a formal fire protection design review process to facilitate fire protection and life safety deficiency resolution in the earliest design phases. This process shall aid in preventing vital programs or projects from suffering unacceptable delays as a result of fire or its perils.
4. Submittal of Construction of Facilities (CoF) projects to correct fire protection deficiencies. This shall be addressed by periodic submission of deficiencies to LaRC management in an effort to have funding allocated for correction of the fire protection problem areas identified at LaRC.

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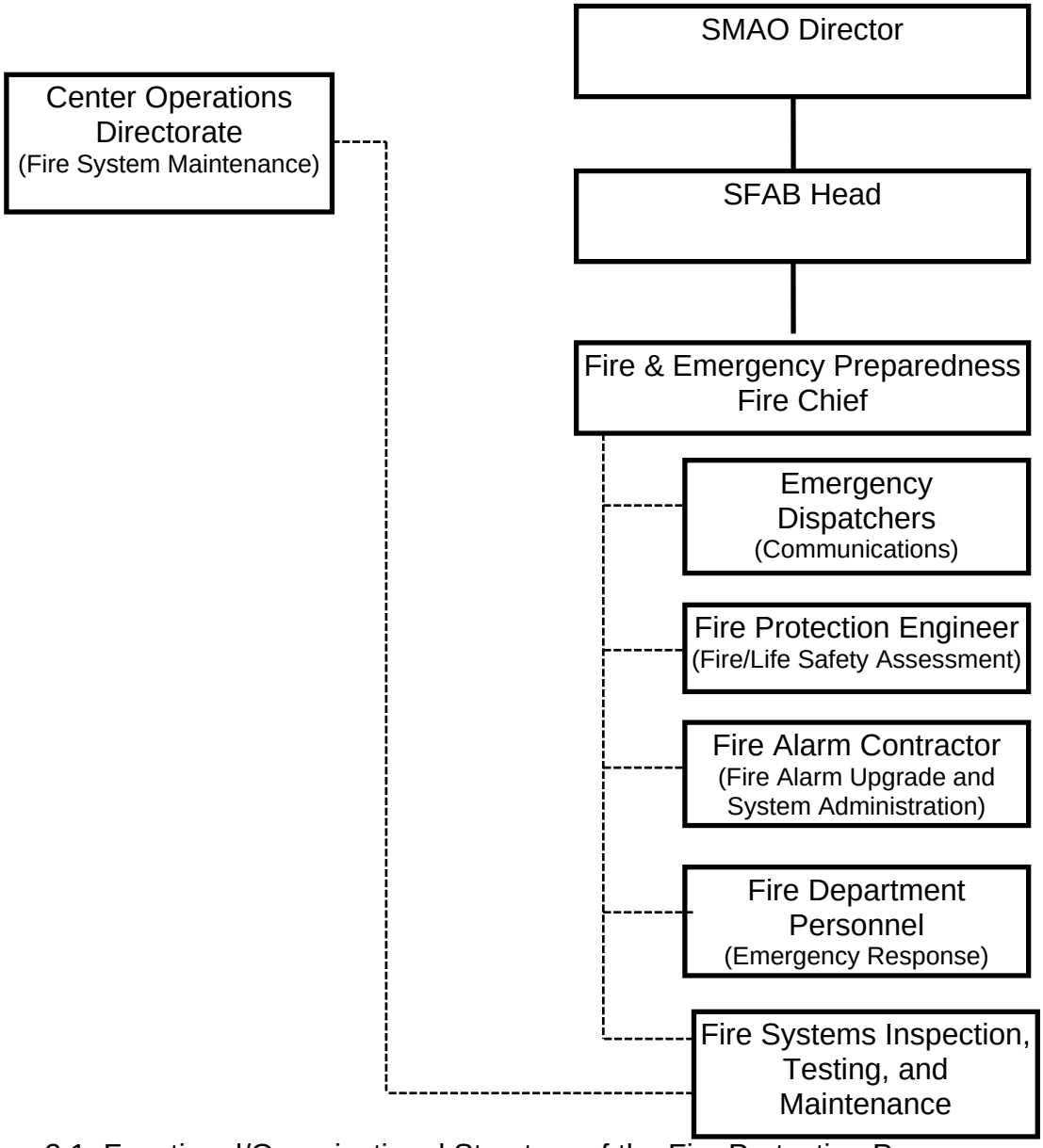

Figure 2.1, Functional/Organizational Structure of the Fire Protection Program.

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5. Control of flammable materials and hazardous operations to ensure that fire does not cause an on-site or off-site release of hazardous material that may threaten public health and safety or the environment. This shall be addressed through the design review process, the FPE survey program, and an aggressive fire prevention and housekeeping program.
6. Review of maintenance programs for fire protection equipment and systems. This shall be accomplished through an aggressive and documented inspection, testing, and maintenance program of fire protection systems and equipment, as well as a documented impairment system to follow fire protection system outages and to ensure complete and on-line operations.
7. Facility fire inspection and fire safety training. Inspections shall be accomplished through an aggressive inspection program with responsibility lying in the structure of LaRC Fire Department operations. Fire protection training shall be accomplished through a variety of employee training opportunities, as well as an aggressive fire prevention program for the control of housekeeping, combustible loading, hot work operations, hazardous materials, and ignition sources such as smoking and portable heating devices.
8. Proper functioning of the field installation fire department and/or coordination with the responsible local fire department. Fire department emergency response shall be coordinated through an agreement between the City of Hampton, Virginia; Langley Air Force Base; and LaRC. The objectives are to provide fully staffed, trained and equipped fire response forces for fire suppression, aircraft emergencies, emergency medical services, prefire planning, inspection services, and specialized fire safety training.
9. Investigation and reporting of fires. This shall be accomplished through LaRC Fire Department operations and the LaRC Fire Chief.
10. Development of emergency action plans and a field installation fire protection program plan and policy statement.
11. Designation of an authority having jurisdiction (AHJ). The responsibility of the AHJ is identified in Section 3.7
12. Compliance with local, state, and federal law and national codes and criteria for fire protection, as well as ensuring implementation of operational fire protection devices. This shall be addressed through the design review process, FPE survey program, more detailed Fire Hazard Analyses as warranted, and direct fire protection technical support to projects and operations.
13. Assistance in ensuring the adequacy of design from a code compliance, contractual, and cost benefit standpoint for major construction projects. This shall be accomplished through an established fire protection design review process and a design-based Fire Hazard Analysis, as warranted.
14. Review of facility design drawings for inclusion of adequate fire protection features and systems and for compliance with applicable codes and criteria. This shall be accomplished by establishing requirements that provide an acceptable degree of life safety to facility personnel; by providing a reliable

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water supply and water supply system (source, storage facilities, pumps, valves, and hydrants) of sufficient capacity for the maximum credible fire; by developing and maintaining Fire Hazard Analyses for new facilities; and by providing automatic suppression and detection systems in all areas subject to serious property damage and/or program interruption.

15. Review of all contractual documents for fire protection specifications. This shall be accomplished through an aggressive and documented fire protection design review process and the requirement to have contractual documents reviewed and approved by the Safety and Mission Assurance Office (SMAO).

2.1.4 RESPONSIBILITIES

The LaRC Fire Chief shall have the overall management responsibility for the fire protection program and shall:

1. Plan, direct, and execute a comprehensive fire protection program for LaRC, in accordance with the criteria established in STD 8719.11.
2. Formulate, implement, maintain, and assess the fire protection program.
3. Provide and maintain the necessary staffing and resources for the program.

The LaRC Fire Chief shall be responsible for the day-to-day operation of the fire protection program and shall:

1. Plan, organize, direct and control the fire protection program.
2. Provide and maintain a strong, competent fire protection staff.
3. Periodically assess the fire protection program.

Center Operations Directorate must coordinate with the LaRC Fire Chief for design review and resolution of problems related to fire protection.

All Associate Directors, Organizational Unit Managers, and workers shall be directly responsible for the fire safety of all personnel and property within their respective areas of operation.

2.2 FIRE PROTECTION ISSUES MANAGEMENT

2.2.1 PURPOSE

This section establishes the process and requirements for tracking corrective actions relative to fire protection findings resulting from audits and surveys. This shall include appraisals, inspections, surveys, assessments, and evaluations.

2.2.2 SCOPE

This section shall apply to all fire protection findings resulting from audits and surveys at LaRC.

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2.2.3 REQUIREMENTS

2.2.3.1 Internal Surveys Conducted Under the Direction of the LaRC Fire Chief

The LaRC Fire Chief shall ensure that the required fire protection engineering (FPE) surveys are performed according to Section 9.1:

- Forward copies of the surveys to the responsible Facility Coordinator and/or Facility Safety Head for resolution of deficiencies.
- Discuss with the Facility Coordinator and/or Facility Safety Head, potential corrective actions for identified deficiencies. Additionally, ensure that interim compensatory measures are in place as warranted.

The LaRC Fire Chief shall categorize, consolidate, and track deficiencies according to established protocol and enter the following information into a deficiency tracking system:

1. Violation number.
2. Facility number.
3. Year.
4. Type of violation (life safety, fire system deficiency, other specified code deficiency, NASA fire protection criteria noncompliance, housekeeping deficiency, or noncompliance with a good fire protection practice).
5. Fire protection ranking of violation.
6. Violation description.
7. Recommendation(s)/interim compensatory measures if warranted.

The responsible Facility Coordinator and/or Facility Safety Head shall notify the LaRC Fire Chief when the corrective actions are complete.

The LaRC Fire Chief or an appointed representative shall review and validate the corrective action to ensure that it was satisfactorily completed. The LaRC Fire Chief then shall close the deficiency in the database, as well as notifying the responsible Facility Coordinator and/or Facility Safety Head that the deficiency has been closed.

The LaRC Fire Chief shall maintain documentation relative to all corrected fire protection related findings.

2.2.3.2 Internal Inspections Conducted by the LaRC Fire Department using the Audit Tracking System (ATS)

LaRC Fire Department management shall:

1. Record deficiencies on ATS stipulated under Section 10.7.
2. Contact the Facility Coordinator and/or Facility Safety Head to advise that a fire inspection will be performed.
3. Provide the LaRC Fire Chief with a copy of the inspection report using ATS.

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LaRC Fire Chief shall:

1. Forward the inspection report (ATS) to the SFAB Head for review.
2. Issue requirements for compensatory measures that may be necessary until deficiency resolution (e.g., facility evacuation, fire watch).
3. Validate deficiency correction and close out the deficiency in ATS when notification is received from the Facility Coordinator and/or Facility Safety Head.

SFAB Head shall review ATS inspection report and forwards the report to the respective Facility Coordinator and/or Facility Safety Head.

Facility Coordinator and/or Facility Safety Head shall:

1. Through the ATS system will notify the LaRC Fire Chief when deficiencies are corrected.
2. Ensure that all interim compensatory measures are being performed.

2.2.3.3 External Audits Conducted by Non-LaRC Organizations

The LaRC Fire Chief shall serve as the primary point of contact for external fire protection related audits and shall:

1. Aid in coordination of the audits and question resolution.
2. Assist with resolution of deficiencies but is not responsible for corrective actions unless such actions specifically involve a function under his/her control. This responsibility shall lie with the Facility Coordinator and/or Facility Safety Head.
3. Enter the deficiencies into the fire protection database for tracking purposes.
4. Validate closure of deficiencies when notified by the Facility Coordinator and/or Facility Safety Head.

The Facility Coordinator and/or Facility Safety Head for the area shall achieve resolution of all identified deficiencies and shall:

1. Coordinate corrective actions relative to fire protection findings with the LaRC Fire Chief.
2. Seek funding to resolve deficiencies, as warranted.
3. Notify the LaRC Fire Chief when the corrective action is complete.

2.2.4 RESPONSIBILITIES

LaRC Fire Chief shall:

1. Report fire protection deficiencies observed during audits and validates implementation of corrective actions as delineated in this protocol.
2. Ensure that FPE surveys are performed for major facilities and that the deficiencies are tracked to resolution.

Facility Coordinator and/or Facility Safety Head shall:

1. Perform tasks as delineated in this section.

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2. Aid with deficiency resolution and performance of any other tasks assigned within this section.

LaRC Fire Department shall report fire protection deficiencies observed during facility inspections.

2.3 FIRE PROTECTION DEVIATION AND WAIVERS

2.3.1 PURPOSE

This section identifies the methodology necessary to request a deviation or waiver from a mandated NASA fire protection policy, code, or standard.

2.3.2 SCOPE

This section shall apply to all organizations at LaRC which operate facilities or equipment that may warrant deviations or waivers.

2.3.3 REQUIREMENTS

If compliance with a specified code, standard, or mandated policy cannot be achieved, a deviation or waiver containing the following information must be provided to the LaRC Fire Chief. The deviation or waiver must contain at a minimum:

1. The specification of the standard from which the deviation or waiver is being requested.
2. A detailed explanation of why compliance cannot be achieved.
3. A description of what measures will be implemented and maintained to provide protection equivalent to the requirement.

An analysis of the benefit gained or negative impact avoided by receiving the deviation or waiver versus the worst probable incident that may occur under the deviation or waiver. This shall require the development of a fire hazard analysis in accordance with Section 9.2 to provide technical justification for support of the deviation or waiver.

For temporary deviations or waivers, a statement of when compliance will be achieved and what actions have been and/or will be taken to achieve compliance must be provided to the LaRC Fire Chief. Additionally, interim compensatory measures must be identified to ensure that the highest levels of fire safety are maintained. Temporary deviations or waivers shall be valid for a period of up to 45 days and are permitted to be renewed up to three times.

Requests for deviations / waivers of NASA-specific criteria, codes, standards, and other relevant fire, life safety, and facility requirements shall be made in writing directly to the NASA Fire Chief who serves as the Authority Having Jurisdiction (AHJ) at LaRC. All requests shall contain the following information:

1. Name of person making request for deviation / waiver
2. Company, organization, work group

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3. Address, mail stop, telephone number, email address
4. Facility and room number (or area) where deviation / waiver is sought
5. Subject
6. Origination Date
7. Specific code, standard, or requirement from which deviation or waiver is being requested
8. Reasons why compliance cannot be achieved
9. Justification for approval of request and continued operation
10. Analysis of the benefit gained and negative impact upon operation
11. Systems, area, and personnel affected
12. Existing conditions or compensatory measure to be implemented and maintained to provide commensurate protection
13. If temporary deviation or waiver is requested, when will full compliance be achieved

Attachments such as drawings, sketches, fire hazard analysis to support requested deviation / waiver

2.3.4 RESPONSIBILITIES

All LaRC organizations requesting a deviation or waiver from a mandated fire protection code, standard, and/or policy must submit the request to the LaRC Fire Chief with the information outlined in Section 2.3.3.

The LaRC Fire Chief shall review and approve or reject the submittal from the LaRC Facility Coordinator and/or Facility Safety Head. The LaRC Fire Chief shall annually prepare a list of deviations or waivers that have been approved and are active at LaRC.

2.4 FIRE PROTECTION RULES

2.4.1 PURPOSE

This section outlines the process for issuance of formal fire protection rules by the LaRC Fire Chief pertaining to specific codes, standards, and amendments. Such fire protection rules are promulgated to administer and implement the fire protection program and to provide clarification of language found within applicable regulating documents.

2.4.2 SCOPE

This section shall apply to formal fire protection rules made by the LaRC Fire Chief for applicable fire protection codes, standards, and amendments implemented at the LaRC.

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2.4.3 REQUIREMENTS

2.4.3.1 General

Formal fire protection rules shall provide formal explanations and guidance pertaining to the meaning or intent of any specific provision or provisions of any regulatory document affecting the LaRC fire protection program.

All requests for formal rulings on the intent of NASA-specific criteria, codes, standards, and other relevant fire, life safety, and facility requirements shall be made in writing directly to the NASA Fire Chief who serves as the Authority Having Jurisdiction (AHJ) at LaRC. All requests shall contain the following information:

1. Name of person making request for a formal ruling
2. Company, organization, work group
3. Address, mail stop, telephone number, email address
4. Origination date
5. Cite applicable edition of NASA-specific criteria, code, standard, or requirement
6. Cite specific paragraph or section number where clarification, interpretation, or ruling is being requested
7. Does this matter involve an existing condition or design considerations of proposed project
8. State your business interest in the matter and identify all other parties involved
9. Concerning formal ruling, clearly state question in such a manner that it can be answered with either YES or NO

2.4.3.2 Limitations

A statement, written or oral, that is not processed in accordance with this section shall not be considered the official position of the LaRC Fire Chief or any of the fire protection designees and shall not considered to be, nor relied upon as, a formal rule.

2.4.3.3 Nature of Formal Fire Protection Rules

A request for formal fire protection rules shall be clearly worded so as to solicit a Yes or No answer from the LaRC Fire Chief.

2.4.3.4 Editions to be Ruled

Formal fire protection rules shall be rendered on the text of the requested edition of the applicable document. The formal rule shall also apply to the current edition of the document, if the text is identical, unless deemed inappropriate by the LaRC Fire Chief.

2.4.3.5 Reasons for Not Processing

A request for a formal rule shall not be processed if it involves any of the following:

1. A determination of compliance of a design, installation, or product or equivalency of protection.

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2. A review of plans or specifications, or if it requires judgment or knowledge that can only be acquired as a result of on-site inspection.
3. Text that clearly and decisively provides the requested information.
4. Subjects that were not previously considered by the LaRC Fire Chief or that are not addressed in the document.

2.4.3.6 Method for Requesting Formal Fire Protection Rules

A request for a formal rule shall be directed to the LaRC Fire Chief.

The request shall include a statement which details specific references to a single problem and identifies the portion (e.g., article, section, paragraph) of the document and edition of the document on which a formal rule is requested.

Such a request shall be in writing and shall indicate the business interest of the requester.

A request involving an actual field installation shall state this, and all parties involved shall be named and notified.

2.4.3.7 Processing

Determination of Qualification

The LaRC Fire Chief, after consultation with the appropriate staff, shall determine if the request for a formal rule shall not be processed.

Editing of the Rule Request

A request for a formal rule may be rephrased. The rephrased version and any pertinent background information shall be sent to the requester and all parties named in the request for a formal rule. A deadline for receipt of agreement shall be established.

Approval of Formal Fire Protection Rules

If accepted for consideration, each request shall then be submitted to the LaRC Fire Chief and appropriate staff having expertise in the document or portion covering the subject under consideration. The LaRC Fire Chief will have the Head of SFAB and/or the Executive Safety Board subcommittee that oversees that particular area for which the ruling pertains, to provide comment.

Issuance of Formal Fire Protection Rules

If the required agreement is secured, the requester, the staff, and all named parties shall be notified by the LaRC Fire Chief. The interpretation shall be issued and become effective 20 days after notification unless a complaint is filed with the LaRC Fire Chief within that 20-day period.

Publication

Formal fire protection rules pertaining to text of the current edition of a document shall be published by SFAB. Formal fire protection rules pertaining to text of an outdated document shall not be published by SFAB but shall be sent to the requester and all parties named in the request.

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Applicability

Any formal rule issued shall apply to the edition of the document for which the rule is made and to any other edition of the document where the text is identical to the text of the edition on which the formal rule was rendered unless deemed inappropriate by the LaRC Fire Chief.

2.4.4 RESPONSIBILITIES

All LaRC organizations requesting a formal rule of a mandated fire protection code, standard, and/or policy shall submit the request to the LaRC Fire Chief with the information outlined in Section 2.4.3.

The LaRC Fire Chief shall review and approve or reject all requests for formal rulings brought before him.

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CHAPTER 3

3. ADMINISTRATIVE ASPECTS/FEATURES

3.1 FIRE PROTECTION PROGRAM REPORT

3.1.1 PURPOSE

This section identifies the requirements for preparing a report of fire and other property damage experience and specifies the report format.

3.1.2 SCOPE

This section shall apply to all fire protection related activities at LaRC.

3.1.3 REQUIREMENTS

A report shall be prepared every two years which summarizes the previous two year's experiences and activities at LaRC relative to the control of NASA property damage and loss from fire and other accident causes.

The report shall be prepared in accordance with the format contained in Appendix A.

The report shall be submitted to the SMAO.

3.1.4 RESPONSIBILITIES

LaRC Fire Chief shall prepare the report and submit the report to the SFAB Head.

Fire Protection Engineer shall assist the LaRC Fire Chief, as necessary, by providing information pertaining to the fire protection program.

Center Operations Directorate shall assist the LaRC Fire Chief, as necessary, by providing needed information pertaining to fire protection related maintenance activities.

SFAB Industrial Safety Personnel shall provide the LaRC Fire Chief with information relative to monetary value of losses resulting from fire incidents.

3.2 HALON EXTINGUISHING AGENT

3.2.1 PURPOSE

This section provides the criteria for reducing and eliminating chlorofluorocarbon (CFC)-based Halon fire extinguishing agents at LaRC.

3.2.2 SCOPE

This section shall apply to all Halon extinguishing agents at LaRC.

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3.2.3 REQUIREMENTS

3.2.3.1 General

No new Halon fire suppression agent shall be proposed to mitigate fire and life safety hazards:

1. Alternative protection in the form of automatic sprinkler suppression, water-mist, alternative gaseous agent, carbon dioxide, and preaction type suppression systems coupled with fire detectors shall be considered.
2. Automatic sprinklers shall be the preferred alternative, although facility specific design considerations may warrant the use of other protection.

Halon extinguishing agents that have been budgeted but for which no outside contract exists for procurement shall be canceled.

Where an outside contract exists but procurement may be under way or on an as-needed basis, the contract should be modified to require alternative protection as described in 3.1.1.

Situations beyond NASA control shall require that some or all of the existing Halon systems in inventory be deactivated and portable extinguishers removed.

3.2.3.2 Portable Fire Extinguishers

Halon portable fire extinguishers must not be purchased.

Existing Halon fire extinguishers shall be inspected and maintained pending the next hydrostatic testing interval.

Extinguishers requiring hydrostatic testing shall be removed from service and replaced with alternative portable extinguishers.

Halon agent (1211 or 1301) contained within extinguishers removed from service shall be retained as a reserve in an approved manner to be available for replenishment of Halon systems described in Section 3.2.3.3.

3.2.3.3 Specialty Halon Extinguishing Systems (Aircraft)

Existing Halon systems shall be inspected and maintained.

Existing Halon systems shall be prioritized in order of importance to safety so that if one discharges and no more Halon is available to replenish it, the capability exists to deactivate other system(s) that are of lesser priority.

A contingency plan shall be developed for interim compensatory measures to be implemented if a Halon system is rendered inoperative and cannot be restored.

Planning for projects to replace Halon systems with an alternative means of protection shall be expedited.

3.2.4 RESPONSIBILITIES

SFAB Head shall ensure CFC-based Halon fire extinguishing agents are eliminated or replaced in a timely manner.

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Facility Coordinator and/or Facility Safety Head shall:

1. Assist the LaRC Fire Chief in determining the need for CFC-based Halon fire extinguishing agents within the facilities of equipment.
2. Ensure elimination or replacement of CFC-based Halon fire extinguishing agents as directed by the LaRC Fire Chief.

Fire Extinguisher maintenance personnel shall inspect and maintains Halon portable fire extinguishers as directed in this section.

LaRC Fire Chief shall:

1. Assess the need for CFC-based Halon fire extinguishing agents at LaRC.
2. Establish the priority for the elimination and/or replacement of CFC-based Halon fire extinguishing agents at LaRC.

3.3 FIRE PROTECTION ENGINEERING SURVEY DEFICIENCY DATABASE

3.3.1 PURPOSE

This section establishes the process and requirements for the tracking of corrective actions relative to fire protection deficiencies resulting from fire protection engineering surveys.

3.3.2 SCOPE

This section applies to all fire protection findings resulting from fire protection engineering surveys at LaRC.

3.3.3 REQUIREMENTS

Surveys shall be conducted by a Fire Protection Engineer. The fire protection engineer shall forward copies of the survey report to the LaRC Fire Chief.

The LaRC Fire Chief shall ensure that survey deficiencies and related information are entered on the existing database named *Fire Protection Survey Tracking System*. Information to be entered shall include FPR Number (see Section 3.4), Violation Number, Facility Number, Year, Violation Description, Type of Violation, Recommendation, Status of Violation and Date, and Status of Description:

Type of violation shall be coded as follows:

1. SCD Specified Code Deficiency
2. LSCD Life Safety Code Deficiency
3. FSD Fire System Deficiency
4. ANC Administrative Noncompliance
5. HSK Housekeeping
6. NASAFP STD 8719.11 Noncompliance
7. GFP Good Fire Protection Practice

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An example of the printout from the FPE Survey Deficiency Database is in Appendix B.

The Facility Coordinator/Facility Safety Head shall notify the LaRC Fire Chief when the corrective action is completed.

The LaRC Fire Chief or designee shall validate the closure of fire protection related findings.

The LaRC Fire Chief shall ensure that the appropriate information is entered on the tracking system to close the finding.

The LaRC Fire Chief or designee shall maintain all documentation relative to corrected fire protection related findings.

3.3.4 RESPONSIBILITIES

LaRC Fire Chief shall complete the duties outlined in this section.

Facility Coordinator/Facility Safety Head shall:

1. Coordinate fire protection related corrective actions resulting from FPE surveys.
2. Ensure that interim compensatory measures and/or corrective actions are implemented and completed by the indicated completion date.
3. Notify the LaRC Fire Chief when corrective actions resulting from surveys are completed.

3.4 FIRE PROTECTION ENGINEERING SURVEY DEFICIENCY RANKING SYSTEM

3.4.1 PURPOSE

This section establishes a system for assessing the relative risk associated with each fire protection engineering (FPE) survey deficiency and for determining the priority of abatement activities. In addition, it establishes the requirements for interim compensatory measures based on the deficiency ranking.

3.4.2 SCOPE

This process shall apply to all deficiencies noted during fire protection engineering surveys and to the interim compensatory measures used as alternative protection to meet the intent of code requirements when final resolution of a deficiency is significantly delayed because of funding, scheduling, or other considerations.

3.4.3 REQUIREMENTS

3.4.3.1 Deficiency Ranking System

The FPE survey shall be the basis for assigning the fire protection rating for each deficiency by determining the severity of the injury or damage that could result from the hazard and the probability that an injury or damage could occur.

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Note: Considerable fire protection engineering judgment is necessary to appropriately assess the severity and probability of a specific fire event as well as the impact of related perils.

The classification of the severity of a hazard shall be based on the severity of the injury or damage that could result from the hazard. This classification shall constitute the first step in determining the risk associated with the hazard.

The most serious type of injury or damage that is reasonably predictable as a result of the type of accident of fire shall be used in determining the fire protection rating.

The probability is directly related to the likelihood that a hazard will result in an injury or property damage based on an assessment of applicable safety factors.

The assessor shall identify and evaluate as many relevant factors that may influence the likelihood that an injury or property damage will occur as possible and shall assign them a weight in accordance with the relative contribution of each.

The following safety factors shall be considered when evaluating hazards:

1. Number of personnel or type of facility potentially exposed, both concurrently and sequentially.
2. Frequency and duration of hazard exposure, including the full range of possible frequency/duration, from one-time, short exposures to once-per-week exposures to continuous daily exposure.
3. Personnel/property proximity to the hazard (e.g., from a location at the fringe of the danger zone up to the point of danger).
4. Working conditions that may increase the likelihood of an accident and the existence of appropriate and effective protective equipment.

The assessor shall also consider mitigating factors to the hazardous condition, such as the existence of specific instructions, effective training programs, warning signs and labels, and specific procedures which would provide some protection.

The assessor shall also consider contributing factors specific to the hazardous condition—such as inappropriate or inadequate instructions, inadequate or no training, and widespread hazardous conditions or faulty equipment— with little or no attempt to control them.

The Fire Protection Rating (FPR) assigned to each hazard is an expression of risk which combines its severity and probability. Using the matrix shown in Figure 3.1, the FPR shall be expressed as a single code and shall relate directly to a risk category that can be used as a tool to determine priorities among hazard abatement activities.

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FPR	Major Category Rating Criteria	Subcategory Descriptive Criteria
	Priority Category	**Fire Protection**
V	Nonserious Technical Deficiency	Minor code noncompliance or deviation from a best management practice or recommended guide Permanent deviation or wavier may be on file or need to be sought for these deficiencies
IV	Code Noncompliance (Less Serious)	Technical deficiency, but much less serious in nature than FPR II or III High-dollar value loss or loss of life not likely to occur Fire potential and probability low
III	Code Noncompliance (Moderate)	Deficiency not as serious in nature as FPR II, but warrants some level of priority correction Fire potential moderate
II	Code Noncompliance (Serious)	Major deficiency, major code violations but not imminent in nature Serious life safety deficiencies Major fire protection system problems Lack of required suppression Large loss property damage potential high
I	Imminent	Death or serious injury to personnel very likely to occur Large loss property damage very likely Unacceptable fire loss potential Fire potential high Fire probability high

Figure 3.1, Fire Protection Rating Schedule.

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3.4.3.2 Interim Compensatory Measures

Interim compensatory measures shall be used to abate a hazard when the FPR is determined to be unacceptable if left unattended.

Interim compensatory measures (e.g., fire watches, fire patrols, enhanced hazard control procedures, temporary fire protection features) shall be specified under the following conditions:

1. A fire protection system is impaired, either planned or unplanned.
2. A temporary fire protection and life safety deviation or waiver from NASA directives or other mandatory codes and standards has been requested or granted.
3. Final resolution of a fire protection/life safety deficiency is significantly delayed because of funding, scheduling, or other considerations.
4. The measures specified are based on sound FPE judgment and recommended fire protection practices resulting from fire risk and loss potential assessment of the particular situation. Factors to be considered when assessing the fire risk and loss potential include the process/system involved, the location of the hazard, the impact on the program continuity, and similar items.

3.4.4 RESPONSIBILITIES

LaRC Fire Chief shall:

1. Rank each FPE survey deficiency to determine the overall risk rating.
2. Specify interim compensatory measures to be implemented as a result of a requested or granted fire protection deviation/waiver, or when justified by the hazard.

SFAB Head shall specify interim compensatory measures in the absence of the LaRC Fire Chief.

3.5 FUNDING PRIORITIZATION OF FIRE PROTECTION ISSUES

3.5.1 PURPOSE

The purpose of this section is to provide a credible, standardized, and auditable process to ensure that funding is secured for fire protection deficiencies and projects of high programmatic importance.

3.5.2 SCOPE

This section shall apply to all organizations requesting funding for fire protection modifications, upgrades, and construction related projects.

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3.5.3 REQUIREMENTS

3.5.3.1 General

A ranking system shall be in place so that deficiencies and projects can be evaluated based on the relative risk associated with each item.

The intent shall be to prioritize projects as well as findings resulting from internal and external surveys, appraisals, and audits. This prioritization scheme shall not be intended to include maintenance-type items.

A list of all open fire protection items (such as unfunded projects and findings from internal and external surveys, appraisals, and audits) shall be maintained and updated annually.

3.5.3.2 Capital Equipment

Capital equipment shall include any item of personal property with a unit cost of $5,000 or more and a minimum useful life of 2 years or more.

3.5.3.3 Project Type and Funding Allocation

<u>Major Construction of Facilities (CoF)</u>

CoF projects shall be those construction projects that are submitted for funding as discrete projects valued at $1.5 million or greater.

<u>Minor Construction of Facilities (CoF)</u>

Minor construction projects shall be those construction projects or compilations of projects that are submitted for funding as a package and that shall be specifically reviewed and approved by Congress as a package.

Minor construction projects are minor new construction projects of a general nature, the total estimated cost of which may not exceed $1.5 million for any single project.

<u>Minor Revitalization Construction of Facilities (CoF)</u>

Revitalization projects shall be those construction projects that are submitted for funding separately as rehabilitation, modification, or major repairs to existing facilities valued at less than $1.5 million and that are specifically reviewed and approved by Congress as a package.

<u>Research Operations Support</u>

Research operations support projects shall be minor construction projects of a maintenance, operations, and safety related nature, the total estimated cost of which may not exceed $200,000.

Research operations support funding shall be allocated at the Center level.

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3.5.3.4 Prioritization

General

The prioritization criteria shall consist of two elements of risk: consequence and probability.

The prioritization process shall be universal, encompassing the major category of health and safety and the subcategory of fire protection.

Three other categories shall be considered: (1) environment/waste management, (2) safeguards andsecurity, and (3) programmatic.

Approach

The rating criteria within the major category and subcategory shall be aligned along a scoring scale so that they represent the same severity or priority.

Each funding request shall be prioritized based on the potential risk to assist management in the budgeting process and to ensure that the higher risk items receive funding priority.

Prioritization Levels

Prioritization levels shall be used to identify the importance of each item. The prioritization level shall be established utilizing the Fire Protection Funding Prioritization Scoring Matrix shown in Figure 3.2.

Fire protection funding requests with a score of 50 or greater shall be Priority I and shall warrant immediate compensatory action and/or correction. Priority I issues shall be conveyed to LaRC and NASA Management upon discovery for immediate action.

Fire protection funding requests with a score of 20 to 49 shall be Priority II and must be corrected in a timely manner.

Fire protection funding requests with a score of 19 or less shall be Priority III. These items present little threat to personnel safety or the environment but, if corrected, would improve the effective implementation of the fire protection program.

Consideration must be given to correction of these issues because correction may prove to be cost-effective or of little impact to operations.

3.5.4 RESPONSIBILITIES

Originating Organization (with Outstanding Fire Protection Issues) shall submit copies of their proposed remediation plans and funding sources for outstanding fire protection issues to the SFAB Head for review.

SFAB Head shall forward all fire protection funding requests to the LaRC Fire Chief.

LaRC Fire Chief shall review all fire protection funding requests and establish the priority for each request and maintain the log and status of all fire protection funding requests.

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Score	Major Category Rating Criteria	Subcategory Descriptive Criteria
	Priority Category	**Fire Protection**
10	Nonserious Technical Deficiency	Minor code noncompliance or deviation from a best management practice or recommended guide Permanent deviation/waiver may be on file or need to be sought for these deficiencies
20	Code Noncompliance (Less Serious)	Technical deficiency, but much less serious in nature than 40 or 30 High-dollar value loss or loss of life not likely to occur Fire potential and probability low
30	Code Noncompliance (Moderate)	Deficiency not as serious in nature as 40, but warrants some level of priority correction Fire potential moderate Fire probability low
40	Code Noncompliance (Serious)	Major deficiency, major code violations but not imminent in nature Serious life safety deficiencies Major fire protection system problems Lack of required suppression Large loss property damage potential
50	Imminent	Death or serious injury to personnel very likely to occur Large loss property damage very likely to occur Unacceptable fire loss potential Fire potential high Fire probability high

Figure 3.2, Fire Protection Funding Prioritization Scoring Matrix.

3.6 PROCUREMENT RELATED FIRE PROTECTION ISSUES

3.6.1 PURPOSE

This section establishes requirements and provides guidance for fire protection review of purchase requisitions for capital and Center equipment or materials which present fire protection issues or concerns.

3.6.2 SCOPE

These criteria shall apply to all organizations preparing purchase requisitions for capital equipment and Center equipment costing $5,000 or more, except computer equipment, and all fire protection and life safety related equipment.

3.6.3 REQUIREMENTS

The organization preparing the purchase requisition shall include the SFAB as the first reviewer/approver for fire protection concerns.

SFAB personnel shall forward purchase requisitions for capital equipment and Center equipment costing $5,000 or more (except computer equipment) and all fire protection and life safety related equipment to the LaRC Fire Chief.

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The LaRC Fire Chief shall review the requisition to ensure that all fire protection concerns pertaining to capital and Center equipment or materials are adequately addressed and that all fire protection equipment has been tested or approved for its intended use by a nationally recognized laboratory. In cases where specific components are not available with a listing or approval, they must be evaluated to determine their acceptability for use.

The LaRC Fire Chief shall indicate approval or rejection on the purchase requisition.

Upon approval, the requisition shall be returned to the appropriate personnel in the Office of Procurement.

Upon rejection, the LaRC Fire Chief shall return the requisition to the Office of Procurement.

3.6.4 RESPONSIBILITIES

Originating Organization shall include the SFAB as first reviewer/approver for fire protection concerns when entering requisitions for capital and Center equipment costing $5,000 or more and all fire protection and life safety related equipment.

SFAB Head shall review and forwards all purchase requisitions for capital and Center equipment costing $5,000 or more and all fire protection and life safety related equipment to the LaRC Fire Chief.

LaRC Fire Chief shall review all purchase requisitions for capital and Center equipment costing $5,000 or more and all fire protection and equipment and approve or reject requisitions.

LaRC Office of Procurement shall ensure that purchase requisitions are approved by the LaRC Fire Chief, as necessary, prior to further processing.

3.7 AUTHORITY HAVING JURISDICTION

3.7.1 PURPOSE

This section establishes the authority having jurisdiction (AHJ) for the administration and enforcement of fire protection codes, standards, and recommended guides and practices.

3.7.2 SCOPE

This section shall apply to all fire protection issues, codes, standards, at LaRC.

3.7.3 REQUIREMENTS

3.7.3.1 General

The SFAB Head may delegate an individual to be the AHJ for all fire protection matters.

The individual delegated by the SFAB Head as the AHJ is the LaRC Fire Chief, and he shall assume such powers as necessary for the administration and enforcement of the LaRC fire protection program.

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LaRC Security Management and Safeguards Team and other enforcement agencies shall have authority to render necessary assistance in the enforcement of the fire protection program when requested to do so by the AHJ.

3.7.3.2 Authority of the AHJ

The AHJ or designee shall be authorized to inspect any facility or premises for dangerous or hazardous conditions or materials.

The AHJ shall order any person(s) to remove or remedy such dangerous or hazardous conditions or materials.

Where conditions exist and are deemed hazardous to life and property by the AHJ, he or she shall have the authority to abate such hazardous conditions that are in violation of the fire protection program.

The AHJ shall investigate the cause, origin, and circumstances of any fire, explosion, or other hazardous condition:

1. The AHJ shall take custody of all physical evidence relating to the cause of the fire, explosion, or other hazardous condition.
2. Information that may relate to trade secrets or processes shall not be made part of the public record except as may be directed by a court of law.

The AHJ shall access plans and specifications to ensure compliance with applicable codes and standards.

When any construction or installation work is being performed in violation of the plans and specifications approved by the AHJ, a NASA LaRC Notice of Violation (Contractor) shall be issued to the responsible party to stop work on the portion of the work that is in violation

The notice shall state the nature of the violation, and no work shall be continued on that portion until the violation is corrected.

Whenever any installation subject to inspection prior to use is covered or concealed without having first been inspected (e.g., buried piping), the AHJ shall require that such work be exposed for inspection.

The AHJ shall be notified when the installation is ready for inspection and conducts the inspection within a reasonable time.

The AHJ shall have the authority to approve alternative materials or methods of construction provided (1) the proposed alternative shall be satisfactory and complies with the intent of the provisions of the fire protection program; and (2) the material, method or work offered shall be, for the purpose intended, at least the equivalent of that prescribed in the fire protection program in quality, strength, effectiveness, fire resistance, durability, and safety:

1. Sufficient technical data shall be submitted to substantiate the proposed installation of any material or assembly.

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2. If the AHJ determines that the evidence submitted is satisfactory proof of performance for the proposed installation, he or she shall approve such an alternative subject to the provisions of the fire protection program.
3. The cost of all tests, reports, and investigations required under this provision shall be paid by the applicant.
4. Supporting data, where necessary to assist in the approval of all materials or assemblies not specifically provided for in the fire protection program, shall consist of valid research reports from approved sources.

The AHJ shall order the immediate evacuation of any occupied facility deemed unsafe when such a facility has hazardous conditions that present an imminent danger to facility occupants.

The AHJ shall develop and implement a fire protection program as deemed necessary for the general welfare with respect to the potential fire hazards at LaRC.

The AHJ shall ensure that appropriate or duly authorized fire safety education programs or public fire safety messages are disseminated to LaRC employees and contractors.

3.7.4 RESPONSIBILITIES

SFAB Head shall:

1. Designate the LaRC Fire Chief as the AHJ.
2. Ensure that the duties and authorities of the AHJ are developed.

Authority Having Jurisdiction (LaRC Fire Chief) shall:

1. Perform the duties delineated in this section.
2. Enforce the provisions of the LaRC fire protection program.

LaRC Fire Chief shall act as the AHJ for fire protection and life safety related issues.

3.8 FIRE INVESTIGATION AND REPORTING

3.8.1 PURPOSE

This section identifies the requirements and describes the method of conducting fire investigations and preparing the investigation reports.

3.8.2 SCOPE

These requirements shall apply to all personnel designated to investigate fires, determine cause, and properly report their findings.

3.8.3 REQUIREMENTS

This section is not intended to cover every aspect of a fire investigation. However, certain steps shall be necessary to assure an accurate report of any fire, large or small. The statistics of a fire are vital in every respect. All facts must be exposed. Any information obtained from a knowledgeable persons shall be considered very important, until otherwise determined.

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Fire investigations and reports shall be performed and prepared in accordance with the STD8719.11 and NPR 8715.3.

All field reporting shall be performed in accordance with NFPA 902M, Fire Reporting Field Incident Manual.

The LaRC Fire Chief shall conduct the fire investigations with assistance from the LaRC Fire Department station officer, Security Management and Safeguards Team, Hampton Fire Department investigation unit, or other organizations as requested.

Basic information relative to the facility at which the fire occurred shall be obtained, including the following:

1. Facility Number and Name
2. The specific location of the fire occurrence shall be identified.
3. Facility Function - The type of facility or the activity/function performed by the facility shall be reported. One of the following functions shall be used:
   - Wind tunnel testing facility
   - Computer/Data processing facility
   - Other testing facility.
   - Balance-of-center (e.g., offices, machine shops, site/outside utilities, safeguards/security, and transportation)
4. Facility Coordinator and/or Facility Safety Head - The name, title, and telephone number of the Facility Coordinator and/or Facility Safety Head who has direct line responsibility for operation of the facility shall be reported.
5. Originator - The name, title, and telephone number of the person who obtained the information and documented the facts shall be included.

The response related information shall be identified and documented, including the following:

1. Method used to provide notification of the fire.
2. Beginning and ending recording index.
3. Run number.
4. Individual notifying the LaRC Fire Department.
5. Fire related information provided during initial notification.
6. All responding vehicles/apparatus, including time out and time in.
7. Any vehicle/apparatus not in service at time of response and reason for being out of service.
8. Approach used; position of apparatus.
9. Whether or not equipment functioned properly.
10. Weather conditions and wind direction.

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11. Extent of fire spread or containment.
12. Content or fire load, fuel, ventilation, and facility accessibility.
13. Personal protective equipment properly worn by responders.
14. Equipment damage.
15. Fire fighter, pedestrian, or occupant injuries.
16. Amount of agent used to extinguish the fire.

The point of origin and cause of fire shall be determined and documented.

Photographs taken of the complete area shall be included.

The previous information and any other pertinent information shall be documented in a consistent, organized manner.

3.8.4 RESPONSIBILITIES

LaRC Fire Chief shall investigate all fires and follow these requirements in the performance of his or her duties.

Fire Department Station Officer shall assist in investigation of fires, as needed.

The Security Management and Safeguards Team shall assist LaRC Fire Chief or designee in investigation of fires, as needed.

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CHAPTER 4

4. DESIGN CRITERIA

4.1 FIRE PROTECTION DESIGN CRITERIA

4.1.1 PURPOSE

This section identifies the fire protection design criteria for new facility designs, upgrades, and modifications.

4.1.2 SCOPE

This section shall apply to all designs, upgrades, and modifications to NASA-owned facilities. This criteria shall be applied to NASA-leased facilities to the maximum extent permitted by the local building code or official.

4.1.3 REQUIREMENTS

4.1.3.1 Original Design Codes

The fire protection related codes and standards in effect when facility design commences (code of record) shall remain in effect for the life of the facility unless a significant hazard that endangers the facility occupants or the public is identified. In these cases, the facility shall be upgraded to the current requirements of the applicable code or standard.

Note: If the code of record cannot readily be determined, the Authority Having Jurisdiction shall stipulate the code to be utilized.

4.1.3.2 Current Codes

When upgrades or modifications are made, the current edition of the code shall apply to the upgrade or modification. When substantial upgrades or modifications are made on fire protection systems, the entire system shall be upgraded to the current code or standard.

4.1.3.3 Equipment Testing and Approval

All fire protection designs shall use equipment that has been tested and listed or approved by a nationally recognized testing laboratory for its intended use.

The LaRC Fire Chief shall issue written approval for substitute, equivalent items if no listed or approved item can be procured because the equipment has never been tested for fire protection use.

4.1.3.4 Equipment Compatibility

All equipment components specified in designs shall be compatible with existing equipment and installed as required by the applicable NFPA codes and standards.

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4.1.3.5 Acceptance/Operating Test Procedures

Written acceptance tests or operating procedures shall be prepared and executed for all new system installations and/or modifications to verify that the systems perform as required. Any deficiencies noted during the tests must be documented and tracked until resolved or corrected.

4.1.3.6 Site-Specific Requirements

When site-specific guides or design specifications exist, they shall be included in all fire protection design packages as applicable.

4.1.3.7 Mandatory Design Criteria

Provided in each section of this document are the orders, codes, standards, and other applicable documents that shall be followed for all fire protection designs, modifications, upgrades, and other fire protection related activities.

4.1.4 RESPONSIBILITIES

LaRC Fire Chief (or Designee) shall ensure that design submittals are reviewed in accordance with and meet the design criteria listed herein.

Facility Coordinator and/or Facility Safety Head shall ensure that design submittals meet all applicable design criteria prior to activity initiation.

4.2 PROPERTY LOSS DESIGN CRITERIA

4.2.1 PURPOSE

This section provides requirements for limiting property loss from fire.

4.2.2 SCOPE

These requirements shall apply to all LaRC-managed facilities, operations, programs, and activities. This shall include NASA-managed equipment and components located in leased facilities.

4.2.3 REQUIREMENTS

4.2.3.1 Minimum Requirements for Installing Automatic Fire Suppression Systems

Complete automatic fire suppression systems shall be provided and installed according to the applicable NFPA standards for the following:

All new permanent structures or renovations with total floor area involved is greater than 2,500 square feet.

All projects (regardless of funding sources) where the maximum credible fire loss (MCFL) will result in the loss of use of a vital structure or equipment for a period longer than that specified as acceptable by the program director.

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When the criteria above do not apply, automatic fire suppression and/or detection may still be warranted based on any of the following factors:

1. Programmatic importance
2. Effects on operations
3. Cost vs. benefit
4. Exposure
5. Future conditions

4.2.3.2 Criteria for Installing Redundant Fire Protection Systems

A redundant fire protection system shall be provided when the maximum possible fire loss (MPFL) exceeds $50 million, to limit the loss to this figure, or in situations deemed appropriate by sound fire protection engineering judgment.

In some cases, a fully staffed, trained, and equipped on-site fire department with adequate water supply (including location of hydrants) and automatic means of notification (such as a smoke detection system installed per NFPA 72) shall serve as a redundant system.

4.2.3.3 Redundant System and Fire Barriers/Physical Separation

A redundant fire protection system and a 3-hour rated fire barrier or physical separation shall be provided when the MPFL exceeds $75 million, to limit the loss to this figure.

4.2.3.4 Two-Way Water Flow

Fire protection water supply distribution systems for all new installations shall be looped to provide two-way flow, with sectional valving arranged to provide alternate water flow paths to any point in the system.

Note: The exception, a single feed, shall be allowed, provided the system is reviewed and approved by the LaRC Fire Chief.

4.2.3.5 Water Supply Duration and Main Size Criteria

The water supply for fire protection shall have a minimum supply duration of 2 hours. New primary distribution mains in no case shall be smaller than 12 inches, building/facility loops shall be 8 inches or larger, and fixed suppression feeds in no case shall be smaller than 6 inches.

4.2.3.6 Independent Water Supply Sources

Facilities having an MPFL in excess of $50 million shall have two independent sources of fire protection water.

4.2.3.7 Noncombustible Construction Materials

New structures shall be of noncombustible or fire resistive construction. Materials used in renovations shall also be of noncombustible construction. Allowances for a limited

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amount of combustible trim in accordance with NFPA 101 shall be permitted in the majority of circumstances.

4.2.3.8 Special Fire Protection Criteria for Portable Structures

Portable structures shall comply with Section 8.4, “Fire Protection for Portable Structures.”

4.2.3.9 Criteria for Computer and Data Processing Equipment

Electronic computer systems shall comply with Section 8.10, “Fire Protection for Computer Facilities.”

4.2.3.10 Sitewide Fire Alarm System Connection

When fire protection systems are installed in facilities on the LaRC site, they shall be compatible with and connected to the sitewide fire alarm system.

4.2.3.11 Special Hazards

Special hazards unique to site operations and not addressed by mandatory codes or standards must be protected per STD 8719.11 and/or other criteria as outlined by Factory Mutual (FM) or Industrial Risk Insurers (IRI).

4.2.3.12 Seismic Design Criteria for Fire Protection Systems

The design of fire protection systems to withstand seismic events shall be according to the applicable NFPA standard, except as required by other criteria for safety class equipment.

4.2.4 RESPONSIBILITIES

Project Engineer and/or Facility Coordinator/Facility Safety Head shall ensure that all facilities, operations, programs, and activities are designed and built according to the requirements of this section.

4.3 FACILITY MODIFICATIONS AFFECTING FIRE PROTECTION AND/OR LIFE SAFETY ASPECTS

4.3.1 PURPOSE

This section delineates the criteria for facility modifications which affect fire protection and/or life safety aspects. It also establishes the requirements for the LaRC Fire Chief’s participation in the facility acceptance process.

4.3.2 SCOPE

This section shall apply to the acceptance of modifications to existing facilities or new facilities.

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4.3.3 REQUIREMENTS

4.3.3.1 Facility Modifications Affecting Fire Protection and/or Life Safety Aspects

No modifications in the use or occupancy of any facility or portion thereof which could affect fire protection and/or life safety aspects shall be made without the approval of the LaRC Fire Chief.

Modifications which could affect fire protection and/or life safety aspects shall include (but are not limited to) the following:

1. Changes in the use of a facility
2. Permit increases in the number of occupants within a facility or anytime the occupant load reaches its maximum limit
3. Introduction of high-value and/or hazardous equipment, materials, or processes
4. Changes to corridors, lobbies, exits, or other required means of egress components such as doors and door hardware
5. Changes of any type to fire protection systems
6. Elimination of facility walls and barriers or any portion thereof
7. Rearrangements of structural components affecting the exit requirements
8. Significant changes in existing utilities
9. Addition of new utilities to an existing facility

Ordinary repairs may be made to any facility without requiring notice to the LaRC Fire Chief, provided the repair does not include any item listed above.

Alterations or repairs shall not cause an existing facility to become unsafe or adversely affect the performance of the building.

The unaltered portion of the existing facility shall continue to comply with the fire protection related codes and standards in effect when the facility design commenced (code-of-record), provided the altered portion of the facility or work being completed conforms to Section 4.1 of this document. Situations that present an unusual life safety hazard in the opinion of the LaRC Fire Chief, shall not be allowed to continue regardless of the code in effect at the time of facility construction.

Alterations must be submitted and reviewed in accordance with Section 4.4 of this document prior to beginning work.

Modifications to an existing facility must be inspected and accepted by the LaRC Fire Chief in accordance with Section 4.3.3.2 of this section.

4.3.3.2 Facility Acceptance

Construction Supervisor or Contractor shall provide advance notice of facility acceptance to the Facility Coordinator/Facility Safety Head for existing facility modifications or to the project engineer for new construction.

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LaRC Fire Chief shall:

1. Receive advance notification of the required preliminary facility walkthrough for facilities being released by the construction supervisor or contractor. A minimum advance notice of 3 working days is required to allow for scheduling of personnel.
2. Participate in the preliminary walkthrough of the facility.
3. Ensure that all fire protection systems have been accepted (i.e., successfully acceptance-tested) according to Section 5.6 of this document.
4. Develop a list of fire protection and life safety deficiencies or concerns.
5. Submit the list of deficiencies or concerns generated during the preliminary walkthrough to the responsible Facility Coordinator and/or facility safety head for existing facility modifications or to the project engineer for new construction.
6. Validate the closure of identified fire protection and life safety deficiencies and concerns.
7. Shall notify the Facility Coordinator/Facility Safety Head or the project engineer of proper closure of fire protection and life safety deficiencies and concerns.
8. Shall notify the Facility Coordinator/Facility Safety Head or the project engineer of remaining fire protection and life safety deficiencies and concerns.

Facility Coordinator/Facility Safety Head or Project Engineer shall notify the LaRC Fire Chief when all identified fire protection and life safety deficiencies and concerns have been corrected.

4.3.4 RESPONSIBILITIES

Facility Coordinator/Facility Safety Head or Project Engineer shall notify the LaRC Fire Chief when facility modifications or new construction is scheduled for acceptance walkthrough.

LaRC Fire Chief shall complete the duties outlined in this section.

Construction Supervisor or shall provide advanced notice of acceptance tests.

4.4 FIRE PROTECTION DESIGN/DOCUMENT REVIEW PROCESS

4.4.1 PURPOSE

This section delineates the documents requiring LaRC Fire Chief or designee review.

4.4.2 SCOPE

This section shall apply to the review of work orders/job packages, preliminary planning documents, and design documents for construction projects, including construction submittals for fire protection systems.

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4.4.3 REQUIREMENTS

4.4.3.1 Work Orders/Maintenance Job Packages

LaRC Fire Chief or Designee shall perform fire protection review of work orders provided by the Center Operations Directorate for fire protection and life safety concerns.

The reviewer shall:

1. Sign the work order package if, after reviewing work orders, it is determined that there are no fire protection or life safety concerns or that such concerns are adequately addressed.
2. Note special fire protection/life safety/building safety/system safety requirements or unaddressed concerns in writing as deemed necessary to indicate additional action required before plans are acceptable.
3. Sign the review form after appropriate action has been taken to correct/address the noted concerns.

Work shall not commence until work orders are signed by the LaRC Fire Chief or designee and other required reviewers.

4.4.3.2 Preliminary Planning Documents

Center Operations Directorate shall submit preliminary planning documents and/or drawings for review at the earliest possible time.

LaRC Fire Chief or Designee shall:

1. Perform fire protection reviews of all preliminary planning documents including the following:
   - Data sheets
   - Conceptual design reports
   - Project design standards
   - Conceptual design drawings
2. Prepare and submit written comments on the fire protection review comment record.
3. Consult with document originator to clarify review comments, as necessary.

4.4.3.3 Design Documents

Center Operations Directorate shall submit preliminary planning documents, including sketches, plot plans, drawings, calculations, and other pertinent design data for review.

LaRC Fire Chief or Designee shall:

1. Perform fire protection reviews of all design documents including:
   - Design criteria reports

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- Design/Construction criteria
- Design basis documents (including fire hazard analyses)
- Job plans
- Quality Control checklist
- Design calculations (related to fire protection)
- Preliminary safety analysis reports
- Fire hazard analysis (To the existent required)

2. Prepare and submits written comments.
3. Consult with document originator to clarify review comments, if necessary.

4.4.3.4 Construction Submittals for Fire Protection Systems

Center Operations Directorate shall submit construction submittals for review.

LaRC Fire Chief or Designee shall:

1. Perform fire protection reviews of all construction submittals (shop drawings, catalog data including manufacturer's installation instructions, test plans, and special test reports) for all fire protection systems including the following:
   - Automatic sprinkler systems
   - Special extinguishing systems (e.g., carbon dioxide, dry chemical, water spray)
   - Underground fire mains, valves, etc.
   - Fire hydrants
   - Fire pumps and water storage structures
   - Fire detection and alarm systems
   - Safety interlocks for fuel-fired equipment
2. Stamp and sign construction submittals for fire protection systems which are acceptable. Reviewer may stamp plans as “Acceptable, With Comments.” Submittal originator properly addresses comments.
3. Prepare and submit written comments for those submittals not acceptable.
4. Consult with document originator to clarify review comments, as necessary.

4.4.4 RESPONSIBILITIES

Document Originator (Center Operations Directorate) shall:

1. Submit work order, preliminary planning documents for construction projects, design document for construction projects, and construction submittals for fire protection systems for review by LaRC Fire Chief or designee.

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2. Initiate comment resolution and ensures that prompt action is taken with the design team to resolve comments prior to permitting work to commence.

Center Operations Directorate shall

1. Provide the work orders to the LaRC Fire Chief for review.
2. Ensure that fire protection and life safety concerns are adequately addressed before releasing work orders.

LaRC Fire Chief or Designee shall conduct the reviews as outlined in this section.

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CHAPTER 5

5. FIRE PROTECTION EQUIPMENT AND SYSTEMS (OPERATIONS AND RELIABILITY)

5.1 FIRE PROTECTION SYSTEM IMPAIRMENTS

5.1.1 PURPOSE

This section establishes a means to control fire protection system impairments.

Note: Fire protection system impairments are controlled by limiting impairments to those that are essential, by ensuring that the impairments are restored as quickly as possible, and by ensuring that adequate interim compensatory measures are specified and implemented during impairments.

5.1.2 SCOPE

This standard shall apply to all personnel who may impair a fire protection system at LaRC.

Note: This standard shall not apply to impairments during the normal and usual preventive maintenance inspections and testing of fire protection systems as required by NFPA standards and LaRC standards. However, if a fire protection system must be left impaired following a normal preventive maintenance inspection or test, this impairment standard does apply.

5.1.3 REQUIREMENTS

Requests for fire protection system impairments shall be made to the LaRC Fire Chief by the Facility Coordinator and/or Facility Safety Head, or the maintenance supervisor.

The impairment request shall be evaluated to determine the effect on the overall Center fire protection system and shall include the following:

1. Reason for the impairment.
2. Number of hydrants, sprinkler systems, detection systems, and other equipment affected. Provide the fire department with a diagram or map of all adjacent fire protection which is in service.
4. Estimated duration of impairment.
5. Other sections or systems already out of service.
6. Impact on overall Center operation.

In an emergency, such as an underground main rupture, prompt action shall be taken to isolate the area prior to permit completion.

An emergency condition shall be immediately reported to the Emergency Dispatch Office (EDO) and duty officer. The EDO shall notify the LaRC Fire Chief.

The LaRC Fire Chief shall log the affected fire protection systems as out-of-service.

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Before a fire protection system is shut off, interim protective measures to reduce the fire risk shall be taken.

Work shall begin as soon as interim protective measures are instituted and the system(s) are shut off. If the impairment involves a fixed system (such as automatic sprinkler or standpipe systems), work shall continue around the clock until the system is returned to service.

The Facility Coordinator and/or Facility Safety Head shall assign an employee to patrol (fire watch) the area, as prescribed in Section 7.4 of this document, until protection is restored. If a fire occurs, the fire watch must notify the LaRC Fire Department. If the impairment continues after normal working hours, a request for Security Management and Safeguards Team personnel to perform fire watch duties shall be made.

Any valve affected by the impairment shall be tagged after the valve is closed. The fire systems maintenance personnel shall prepare a red tag in accordance with LPR 1710.10, " Safety Clearance Procedures."

If additional protection is required, temporary feed lines (such as temporary piping, hose lines, or electrical service) shall be installed.

The emergency fire dispatcher shall enter the following information in a manner approved by the NASA Fire Chief:

1. Date of impairment.
2. Time of impairment (military).
3. Control tag number.
4. Equipment tagged out.
5. Reason for impairment.
6. Name and badge number of person placing the control tag.
7. Interim protective measures.

The fire system maintenance personnel shall check repair progress, including tagged equipment, at least once per shift.

When the fire protection system is restored, the fire system maintenance personnel shall inspect the affected system to ensure that equipment is operational.

A 2-inch drain test shall be conducted on sprinkler systems affected by an impairment, and the results shall be recorded on the impairment control tag. Hydrostatic testing shall be witnessed if requested by the fire system maintenance personnel.

After removing the red tag, the fire system maintenance personnel shall enter the following information on the Fire Protection Impairment Log:

1. Date and time the control was terminated.
2. System tested.

The LaRC Fire Chief shall be notified that testing is completed.

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The fire system maintenance personnel shall notify the emergency fire dispatcher that the repairs are completed and all systems are in service.

The EDO shall reset supervisory alarms and log all systems in service.

5.1.4 RESPONSIBILITIES

Fire System Maintenance Personnel shall

1. Comply with requirements delineated in this section when impairing a fire protection system and those applicable requirements contained in NFPA Codes.
2. Ensure that impairments are restored in a timely manner.
3. Monitor the restoration process until the fire protection system is fully operational.
4. Identify to the Facility Coordinator and/or Facility Safety Head actions required to minimize the damage from fire during outages.

LaRC Fire Chief shall perform tasks as delineated in this section.

Emergency Fire Dispatcher shall perform tasks as delineated in this section.

5.2 UTILITY IMPAIRMENTS AFFECTING FIRE PROTECTION SYSTEMS

5.2.1 PURPOSE

This section establishes the requirements for planned and emergency utility outages that affect fire protection.

5.2.2 SCOPE

This standard shall apply to all personnel who may impair a utility system which affects fire protection at LaRC.

Note: This standard shall not apply to impairments during the normal and usual preventive maintenance inspections and testing of utility systems as required by LaRC standards. However, if a fire protection system is impaired as a result of a normal and usual preventive maintenance inspection or test, this impairment standard shall apply.

5.2.3 REQUIREMENTS

The Center Operations Directorate shall notify the Emergency Dispatch Office (EDO) 24 hours in advance of all planned utility outages. Immediate notification shall be made to the LaRC Fire Chief in the event of an emergency outage:

1. The emergency fire dispatcher shall notify the LaRC Fire Chief and fire system maintenance personnel.
2. Utility outages in excess of 24 hours shall require the implementation of Section 5.1 of this document.

The LaRC Fire Chief shall determine if fire protection systems will be affected by the utility outage. If fire protection is affected, the LaRC Fire Chief shall follow the requirements of Section 5.1.

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The LaRC Fire Chief shall ensure that the affected fire protection system is logged out-of-service.

The Facility Coordinator and/or Facility Safety Head shall assign an employee to patrol (fire watch) the area, as prescribed in Sections 5.1 and 7.4 of this document until protection is restored.

If additional protection is required, temporary feed lines (such as temporary piping, hose lines, or electrical service) shall be installed.

The Center Operations Directorate shall notify the emergency fire dispatcher when the utility system is placed back in regular service.

5.2.4 RESPONSIBILITIES

Center Operations Directorate shall:

1. Comply with requirements delineated in this section when impairing a utility system which affects fire protection aspects.
2. Ensure that utility impairments are restored in a timely manner.

LaRC Fire Chief shall:

1. Perform tasks as delineated in this standard.
2. Identify to the Facility Coordinator and/or Facility Safety Head actions required to minimize the damage from fire during outages.

Facility Coordinator and/or Facility Safety Head shall implement the necessary interim compensatory measures as required by the LaRC Fire Chief.

Emergency Fire Dispatcher shall complete the tasks delineated in this section.

5.3 FIRE PROTECTION SYSTEM WINTERIZATION

5.3.1 PURPOSE

This section establishes the requirements for developing a winterization plan to ensure that fire protection systems are protected against cold weather conditions.

5.3.2 SCOPE

This standard shall apply to all water-based fire protection systems at LaRC.

5.3.3 REQUIREMENTS

5.3.3.1 Annual Inspections

The fire system maintenance personnel shall inspect each facility each October to ensure that all areas are winterized to protect the installed fire protection systems.

This annual inspection shall include the following items (as a minimum):

1. Condition/operation and adequacy of heating systems (e.g., forced air, radiant heaters, portable heaters).
2. Condition/operation of thermostats and filters.

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3. Condition/operation/installation of heat tape systems.
4. Draining of sprinkler system drip lines, fire pump hose headers, dry pipe sprinkler system air compressors, and dry system drum drip auxiliary drains.

5.3.3.2 Documenting and Correcting Deficiencies Resulting from Annual Inspections

Any deficiencies identified must be documented. Corrective action to repair or resolve the deficient condition shall be initiated immediately.

5.3.3.3 Inspection Records of Inspections

Winterization inspection records shall be maintained.

5.3.3.4 Preventing Fire Systems from Freezing

All areas where fire systems are installed shall be provided with sufficient heat and/or noncombustible insulation to prevent freezing and/or equipment damage.

5.3.3.5 Permanent Engineered Freeze Protection

Temporary freeze protection measures (such as portable heaters) shall not be used as a permanent means of freeze protection for fire protection systems. Permanent protection (such as forced hot air, fixed radiant heaters, insulation) must be provided.

5.3.3.6 Use of Heat Tape and Portable Heaters for Freeze Protection

Heat tape and portable heaters shall be used to winterize existing fire protection systems only if and when engineered protection measures are not readily available or feasible. If such measures must be used, the following restrictions must be observed.

Portable heaters used for temporary fire protection system freeze protection must comply with Section 7.5 of this document.

If heat tape is to be used as the primary heat source to prevent existing fire suppression system piping from freezing, the following conditions must be met:

1. The heat tape used shall be Underwriters Laboratories Inc. (UL) listed for its intended use (e.g., specifically tested for the use on metal pipe with insulation).
2. The heat tape shall be self-regulating.
3. Noncombustible insulation shall be used over the pipe and heat tape.
4. The fire system pipe temperature shall be monitored by a system that includes a mechanism to transmit a trouble alarm to the communication center if the pipe temperature drops below 45°F.
5. Heat tape shall not be used for new system designs. An exception to this rule is that heat tape in compliance with the other requirements of this standard may be used to prevent fire system risers in unheated trailer crawl spaces from freezing.
6. All heat tape installations shall be approved by the LaRC Fire Chief.

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5.4 NONEMERGENCY USE OF FIRE HYDRANTS

5.4.1 PURPOSE

This section provides the requirements and responsibilities for the nonemergency use of fire hydrants.

5.4.2 SCOPE

This standard shall apply to NASA facilities, operations and activities where water is being drawn from a LaRC fire hydrant.

Note: This standard shall not apply to fire hydrant/water supply testing.

5.4.3 REQUIREMENTS

Requests for the nonemergency use of fire hydrants shall be made to the LaRC Fire Chief prior to use. The request for use must contain the following information:

1. Hydrant(s) location(s) and number(s).
2. Date and duration of use.
3. Responsible contact person.
4, Duty officer notified.

Requests for nonemergency use of fire hydrants shall be approved by the LaRC Fire Chief with the following restrictions:

1. The hydrant user shall install one valve on the 4-inch port on each hydrant being used. This 4-inch port with the valve installed must be reserved for LaRC Fire Department use only.
2. One or both of the 2 1/2 -inch fire hydrant ports must be reserved for nonemergency use only. The hydrant user shall provide an approved 2 1/2-inch gate valve on one or both of the 2 1/2-inch fire hydrant ports, reduced down to 1 1/2 inches.
3. The hydrant user shall provide the estimated duration of impairment and the amount of water to be used
4. Other sections or systems are not already out of service.
5. The requested use does not affect overall Center operation.

5.5 INSPECTION, TESTING, AND MAINTENANCE DOCUMENTATION REVIEW AND ANALYSIS

5.5.1 PURPOSE

This section establishes a system for controlling fire protection inspection, testing, and maintenance documentation to ensure review for determining the expected remaining life for fire protection equipment and, when necessary, for extending that life.

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A life extension program shall provide the technical rationale for allowing aging fire protection equipment, particularly equipment beyond its nominal life expectancy, to continue to operate.

5.5.2 SCOPE

This section shall apply to all fire protection inspection, testing, and maintenance activities at LaRC.

5.5.3 REQUIREMENTS

5.5.3.1 General

Documentation must be generated for all inspection, testing, and maintenance activities. Thorough inspection, testing, and maintenance activities in association with detailed documentation shall reduce costs:

1. Anticipate failures, allowing downtime to be scheduled when it causes the least disruption
2. Assess the consequences of failures, allowing maintenance resources to be targeted in a manner to minimize the probability of occurrence of the worst consequences
3. Prevent failures and the consequences which are unacceptable or more costly than the effort to prevent them
4. Expedite repairs in the most effective way and identify the alternate means of operation to be used when failures occur
5. Provide the tools for self-diagnosis and correction where the program is ineffective

Inspection, testing, and maintenance activities shall provide meaningful evaluation of the adequacy of the equipment for both deployment and implementation.

5.5.3.2 Generation and Management of Documentation

Surveillances and inspections shall be key activities in both maintenance and life extension.

Maintenance inspections shall be designed to determine whether or not the equipment being inspected will operate safely until the next scheduled inspection.

Each inspection, testing, and maintenance activity shall be designed to add confidence to a calculated estimated remaining life.

Inspection, testing, and maintenance documentation shall be reviewed for evidence of equipment aging and wear.

Because every piece of equipment ages differently, records shall be reviewed to determine if the equipment has reached the end of its useful life by one of the following three ways:

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1. Accumulated damage producing conditions in a major component that prevent the equipment from being safely operated
2. Grouped components deteriorating to the point where the effort needed to inspect and replace individual components becomes intolerable, or the components begin to fail in service between inspections
3. A catastrophic failure damaging the equipment beyond repair

The nominal life expectancy of equipment shall be established using accepted industry practices and experience, based on design specification. The design life may or may not equal the nominal life expectancy.

The expected remaining life for each piece of equipment or system shall be estimated based on the review of the inspection, testing, and maintenance documentation. The expected remaining life shall be represented as a range of values or a period of time after which the probability of failure becomes unacceptably high. The remaining life estimate shall be refined based on equipment history, measurements of accumulated damage, and mathematical techniques. Not all equipment can be analyzed for remaining life. For example, motors, generators, and transformers have electrical winding insulation systems that cannot be economically and reliably modeled

Inspection, testing, and maintenance records (including plans, checklists, notes, reports, and other records associated with the establishment, completion and verification of corrective actions for fire protection issues) shall be temporary records maintained by the appropriate section or department. Inspection, testing, and maintenance documentation shall be retained for the life of the system.

5.5.4 RESPONSIBILITIES

Facility Coordinator and/or Facility Safety Head shall:

1. Establish a facility fire protection equipment inspection program which produces useful documentation.
2. Maintain and review the fire protection equipment inspection, testing, and maintenance documentation to determine life expectancy.

LaRC Fire Chief shall:

1. Establish the nominal life expectancy for fire protection equipment.
2. Assist the Facility Coordinator and/or Facility Safety Head in reviewing the inspection, testing, and maintenance documentation.

5.6 INSPECTION, TESTING, AND, MAINTENANCE MATRIX

5.6.1 PURPOSE

This section establishes the inspection, testing, and maintenance frequencies for equipment and systems used at LaRC.

5.6.2 SCOPE

This section shall apply to all fire protection equipment and systems at LaRC.

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5.6.3 REQUIREMENTS

5.6.3.1 General

All water-based fire protection equipment and systems shall be inspected at the frequencies indicated in National Fire Protection Association (NFPA) 25, except for specified deviations approved by the LaRC Fire Chief

When supported by historical documentation, technology, or sound fire protection engineering judgment, the NFPA inspection, testing, and maintenance frequency shall be modified by the LaRC Fire Chief.

5.6.3.2 Fire Barriers and Walls

Floor-ceiling assemblies and bearing and nonbearing wall or partition assemblies used as fire barriers to form fire compartments shall be designed and construction tested to meet the conditions of acceptance in NFPA 251.

Once accepted, the fire barrier shall not require further attention unless it is modified.

5.6.3.3 Fire Doors and Dampers

Fire door and damper assemblies shall be designed and constructed to meet the requirements of NFPA 80.

Fire door and dampers shall be inspected, tested and maintained in accordance with Table 5.1.

Table 5.1, Inspecting, Testing, and Maintaining: Fire Doors and Dampers.

Component	Activity	LaRC Frequency	Component	Activity	LaRC Frequency
Door	Inspection	Annually	Auto closing doors	Test	Annually
Closer	Inspection	Annually	Sliding/Rolling doors	Test	Annually
Latch	Inspection	Annually	Doors	Maintenance	As needed
Hinges	Inspection	Annually	Fire dampers	Inspection	Annually
Coordinator	Inspection	Annually	Fire dampers	Test	Annually
Chains and cables	Inspection	Annually	Fire dampers	Maintenance	Annually

5.6.3.4 Valves and Fire Department Connections

Valves and fire department connections shall be designed and installed to meet the requirements of NFPA 13.

Valves and fire department connections shall be inspected, tested and maintained in accordance with Table 5.2.

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Table 5.2, Inspecting, Testing, and Maintaining: Valves and Fire Department Connections.

Component	Activity	LaRC Frequency	Component	Activity	LaRC Frequency
Control Valve Sealed Locked Tamper switch	 Inspection Inspection Inspection	 Monthly Monthly Monthly	**Preaction/Deluge Valve** Priming water Low air pressure alarms Full flow	 Test Test Test	 Quarterly Quarterly Quarterly
Alarm Valve Exterior Interior Strainers, filters, orifices	 Inspection Inspection Inspection	 Monthly 5 years 5 years	**Control Valve** Position Operation Supervisory	 Test Test Test	 Quarterly Annually Quarterly
Check Valve Interior	 Inspection	 5 years	**Water Flow Alarm**	Test	Quarterly
Preaction/Deluge Valve Enclosure (during cold weather) Exterior Interior Strainers, filters, orifices	 Inspection Inspection Inspection Inspection	 Monthly Monthly Annually Annually	**Dry Pipe Valves/Quick-Opening Devices** Priming water Low air pressure alarm Quick-opening devices Trip test Full flow trip test	 Test Test Test Test Test	 Annually Quarterly Quarterly Annually 3 years
Dry Pipe Valves/Quick-Opening Devices Enclosure Enclosure (during cold weather) Exterior Interior Strainers, filters, orifices	 Inspection Inspection Inspection Inspection	 Monthly Monthly Monthly Annually	**Pressure Regulating and Relief Valves** Sprinkler system Circulation relief Pressure relief valve Hose connection Hose rack	 Test Test Test Test Test	 Annually Annually Annually Annually 5 years
Pressure Regulating and Relief Valves Sprinkler systems Hose connection Hose rack Fire pump: Casing relief valve Pressure relief valve	 Inspection Inspection Inspection Inspection Inspection	 Monthly Annually Annually Annually Annually	**Backflow Prevention Assemblies** Reduced pressure Reduced pressure detector	 Inspection Inspection	 Monthly Monthly
Backflow Prevention Assemblies	Test	Annually	**Control Valve**	Maintenance	Annually
Fire Department Connections	Inspection	Monthly	**Preaction/Deluge Valve**	Maintenance	Annually
Main Drain	Test	Quarterly	**Dry Pipe Valve/Quick-Opening Device**	Maintenance	Annually

5.6.3.5 Deluge/Water Spray Systems

Deluge/water spray systems shall be designed and installed to meet the requirements of NFPA 15 and/or NFPA 16.

Deluge and water spray systems shall be inspected, tested and maintained in accordance with Table 5.3.

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Table 5.3, Inspecting, Testing, and Maintaining: Deluge/Water Spray Fixed Systems.

Component	Activity	LaRC Frequency
Check valves (interior)	Inspection	Monthly
Control valves (sealed)	Inspection	Monthly
Control valves (locked, supervised)	Inspection	Monthly
Deluge valve (exterior)	Inspection	Monthly
Detection systems	Inspection	Monthly
Drainage	Inspection	Quarterly
Fittings	Inspection	Monthly
Fittings (rubber-gasketed)	Inspection	Monthly
Hangers	Inspection	Monthly
Nozzles	Inspection	Monthly
Pipe	Inspection	Monthly
Strainers	Inspection	Annually
Supports	Inspection	Annually
Water supply piping	Inspection	Monthly
Heat (deluge valve house)	Inspection	Daily/weekly
Control valves	Operational test	Quarterly
Deluge valve	Operational test	Quarterly
Detection systems	Operational test	Annually
Flushing	Operational test	Quarterly
Main drain test	Operational test	Quarterly
Manual release	Operational test	Annually
Nozzles	Operational test	Annually
Strainers	Operational test	Annually
Water flow alarm	Operational test	Weekly
Water spray system test	Operational test	Quarterly
Deluge valve	Maintenance	Annually
Detection systems	Maintenance	Annually
Strainers	Maintenance	Annually
Strainers (baskets/screen)	Maintenance	5 years
Water spray system	Maintenance	Annually

5.6.3.6 Carbon Dioxide Suppression Systems

Carbon dioxide suppression systems shall be designed and installed to meet the requirements of NFPA 12. Carbon dioxide suppression systems shall be inspected, tested and maintained in accordance with Table 5.4.

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Table 5.4, Inspecting, Testing, and Maintaining: Carbon Dioxide Suppression Systems.

Component	Activity	LaRC Frequency
Nozzles	Inspection	Annually
Enclosure doors	Inspection	Annually
Protected hazards	Inspection	Annually
Liquid level	Inspection	Annually
Cylinders (leakage)	Inspection	Annually
Flexible hoses and connections	Inspection	Annually
High-pressure cylinders weighed	Test	Annually
High-pressure control valves	Test	Annually
System actuation	Test	Annually
Full system discharge	Test	12 years
System components	Maintenance	As needed
Hose hydrostatic test	Maintenance	5 years
Cylinder hydrostatic test	Maintenance	12 years

5.6.3.7 Portable Fire Extinguishers

Portable fire extinguishers shall be installed to meet the requirements of NFPA 10. Portable fire extinguishers shall be inspected, tested and maintained in accordance with Table 5.5.

Table 5.5, Inspecting, Testing, and Maintaining: Portable Fire Extinguishers.

Extinguisher Type	Visual Inspection	Hydrostatic Test Interval	Maintenance
Stored pressure	Monthly	5 years	Annually
Wetting agent	Monthly	5 years	Annually
Foam/ AFFF	Monthly	5 years	Annually
Dry chemical (SS)	Monthly	5 years	Annually*
Carbon dioxide	Monthly	5 years	Annually
Dry chemical (stored pressure; AS, BB, MS, SS)	Monthly	12 years	Annually*
Dry chemical (cartridge operated, MS)	Monthly	12 years	Annually
Halon 1301	Monthly	12 years	Annually
Halon 1211 (MS)	Monthly	12 years	Annually

AS - Aluminum Shell; BB - Brazed Brass Shell; MS - Mild Steel Shell; SS - Stainless Steel Shell

* Internal examination is not required at annual maintenance for stored pressure dry chemical fire extinguishers.

5.6.3.8 Fire Pumps

Fire pumps shall be designed and installed to meet the requirements of NFPA 20.

Fire pumps shall be inspected, tested and maintained in accordance with Table 5.6.

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Table 5.6, Inspecting, Testing, and Maintaining: Fire Pumps

Component	Activity	LaRC Frequency
Pump house, heating	Inspection	Weekly
Pump house, ventilating louvers	Inspection	Weekly
Fire pump system	Inspection	Weekly
Pump operation, no-flow condition	Test	Weekly
Pump operation, flow condition	Test	Annually
Hydraulic	Maintenance	Annually
Mechanical transmission	Maintenance	Annually
Electrical system	Maintenance	As needed
Controller, various components	Maintenance	As needed
Motor	Maintenance	Annually
Diesel engine system, various components	Maintenance	As needed

5.6.3.9 Fire Water Systems and Fire Hydrants

Fire water systems and fire hydrants shall be designed and installed to meet the requirements of NFPA 24.

Fire water systems and fire hydrants shall be inspected, tested and maintained in accordance with Table 5.7.

Table 5.7, Inspecting, Testing, and Maintaining: Private Fire Service Mains.

Component	Activity	LaRC Frequency
Hydrants (dry barrel and wall)	Inspection	Annually and after each operation
Monitor nozzles	Inspection	Semiannually
Mainline strainers	Inspection	Annually and after each significant flow
Piping (exposed)	Inspection	Annually
Monitor nozzles	Test	Flow annually
Hydrants	Test	Semiannually
Piping (exposed and underground)	Gradient flow test	5 years
Mainline strainers	Maintenance	Annually and after each operation
Hydrants	Maintenance	Annually
Monitor nozzles	Maintenance	Annually

5.6.3.10 Standpipe Systems

Standpipe systems shall be designed and installed to meet the requirements of NFPA 14.

Standpipe systems shall be inspected, tested and maintained in accordance with Table 5.8.

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Table 5.8, Inspecting, Testing, and Maintaining: Standpipe and Hose Systems.

Component	Activity	LaRC Frequency
Control valves	Inspection	Weekly/Monthly
Pressure regulating devices	Inspection	Quarterly
Piping	Inspection	Quarterly
Hose connections	Inspection	Annually
Cabinet	Inspection	Annually
Hose	Inspection	Removing hose
Hose storage device	Inspection	Annually
Alarm device	Test	Quarterly
Hose nozzle	Test	Annually
Hose storage device	Test	Annually
Hose	Test	Removing hose
Pressure control valve	Test	5 years
Pressure reducing valve	Test	5 years
Hydrostatic test	Test	5 years
Flow test	Test	5 years
Hose connections	Maintenance	Annually
Valves (all types)	Maintenance	Annually

5.6.3.11 Facility Emergency Lights

Facility emergency lights shall be designed and installed to meet the requirements of NFPA 101.

Facility emergency lights shall be inspected, tested and maintained in accordance with Table 5.9 and Section 6.3 of this LPR.

Table 5.9, Inspecting, Testing, and Maintaining: Facility Emergency Lights.

Component	Activity	LaRC Frequency
Battery operated unit	Inspection	Biannually
Battery operated unit	30-second test	Biannually
Battery operated unit	1.5-hour test	Not performed

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5.6.3.12 Water Storage Tanks

Water storage tanks are designed and installed to meet the requirements of NFPA 22.

Water storage tanks are inspected, tested and maintained in accordance with Table 5.10.

Table 5.10, Inspecting, Testing, and Maintaining: Water Storage Tanks.

Component	Activity	LaRC Frequency
Condition of water in tank	Inspection	Annually
Water temperature	Inspection	Daily/Weekly*
Heating system	Inspection	Daily/Weekly
Control valves	Inspection	Daily/Weekly
Water level	Inspection	Weekly/Monthly
Tank exterior	Inspection	Quarterly
Support structure	Inspection	Quarterly
Catwalks and ladders	Inspection	Quarterly
Surrounding area	Inspection	Quarterly
Hoops and grille	Inspection	Annually
Painted/coated surfaces	Inspection	Annually
Expansion joints	Inspection	Annually
Interior	Inspection	5 years/3 years
Check valves	Inspection	5 years
Temperature alarms	Test	Monthly
High-temp. limit switches	Test	Monthly
Water level alarms	Test	Semiannually
Level indicators	Test	5 years
Pressure gauges	Test	5 years
Water level	Maintenance	As needed
Drain sediment	Maintenance	Semiannually
Thermostats	Maintenance	As Needed
Cathodic protection	Maintenance	Annually
Drain valves cycled	Maintenance	Annually
Vent screen	Maintenance	Annually
Control valves	Maintenance	Annually
Repainting—steel	Maintenance	As needed
Embankment-supported rubberized fabric (ESRF)	Maintenance	As needed
Check valves	Maintenance	As needed

* Cold weather/heating season only.

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5.6.3.13 Fire Alarm and Detection Systems

Fire alarm and detection systems shall be designed and installed to meet the requirements of NFPA 72.

Fire alarm and detection systems shall be inspected, tested and maintained in accordance with Table 5.11.

Table 5.11, Inspecting, Testing, and Maintaining: Fire Alarm and Detection Systems.

Component	Activity	LaRC Frequency
Alarm Appliances		
Audible devices	Inspection	Annually
Speakers	Inspection	Annually
Visible devices	Inspection	Annually
Batteries	Inspection	Monthly
Charger test (replace battery as needed)	Test	Annually
Discharge test (30 minutes)	Test	Annually
Load voltage test	Test	Annually
Specific gravity	Test	Annually
Control Equipment		
Functions	Test	Annually
Fuses	Inspection/Test	Annually/Annually
Interfaced equipment	Inspection/Test	Annually/Annually
Lamps and LEDs	Inspection/Test	Annually/Annually
Primary (main) power supply	Inspection/Test	Annually/Annually
Transponders	Test	Annually
Control Panel Trouble Signals	Inspection/Test	Annually
Voice Communications Equipment	Inspection/Test	Annually
Fiber-Optic Cable Connections	Inspection/Test	Annually/Annually
Guard's Tour Equipment	Inspection/Test	Annually
Initiating Devices		
Air sampling	Inspection	Annually
Duct detectors	Inspection/Test	Annually
Electromechanical Releasing device	Inspection/Test	Annually
Extinguishing system switches	Inspection/Test	Annually
Fire alarm boxes	Inspection/Test	Annually
Heat detectors	Inspection/Test	Annually
Radiant energy fire Detectors	Inspection/Test	Annually
Smoke detectors	Inspection	Annually
Functional	Test	Annually
Sensitivity (see 7-3.2.1.)	Test	Annually
Supervisory signal devices	Inspection/Test	Annually
Water flow devices	Inspection/Test	Quarterly
Fuel-gas and other detectors	Test	Semiannually
Special Procedures	Inspection/Test	Annually
Transient Suppressers	Inspection	Annually

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5.6.4 RESPONSIBILITIES

The LaRC Fire Chief is responsible for ensuring that inspection, testing, and maintenance operations are conducted as noted in this section.

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CHAPTER 6

6. LIFE SAFETY

6.1 MEANS OF EGRESS

6.1.1 PURPOSE

This section delineates the processes and requirements for maintaining the means of egress in LaRC facilities.

6.1.2 SCOPE

This section shall apply to all normally occupied LaRC facilities, structures, facilities, and operations.

6.1.3 REQUIREMENTS

6.1.3.1 Design and Construction of Means of Egress

Center Operations Directorate shall:

1. Ensure that all new facility designs or modifications under their jurisdiction incorporate the requirements of NFPA 101, Code for the Safety to Life from Fire in Buildings and Structures (a.k.a., Life Safety Code).
2. Ensure that all new facility designs or modifications under its jurisdiction incorporate the requirements of Section 4.1 of this document.
3. Submit all facility designs and modifications to the LaRC Fire Chief for review and approval.

The LaRC Fire Chief shall review and approve all new designs and modifications to ensure that life safety is adequate to meet the specified criteria.

6.1.3.2 Maintaining Life Safety in Facilities

Facility Coordinator and/or Facility Safety Head shall:

1. Ensure that all facility exits and means of egress are maintained clear and unobstructed.
2. Ensure that material is not stored in stairwells or corridors of facilities.
3. Ensure that operations barriers such as roped areas do not affect exit routes.
4. Ensure that life safety features take precedence over security or operations features.
5. Ensure that no furnishings, decorations, or other objects obstruct the means of egress.

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6. Ensure that exit doors are maintained in good operating condition:
   - Doors in the means of egress shall not be locked to prevent unobstructed exiting, unless specific approval is obtained from the LaRC Fire Chief.
   - Doors in the means of egress shall not require more than one action to open, unless specific approval is obtained from the LaRC Fire Chief
   - Fire doors must not be blocked open.
7. Ensure that automatic sprinkler systems, fire detection and alarm systems, exit lighting, fire doors, and other fire protection features required by the Life Safety Code are continuously maintained in operating condition or that interim compensatory measures are implemented.
8. Ensure that interior finishes are maintained noncombustible or flame resistant.
9. Ensure that freestanding partitions and space dividers are manufactured of limited combustible materials and that fabric coverings are flame resistant.

The LaRC Fire Chief shall ensure performance of routine fire protection facility assessments to evaluate life safety components and shall ensure that an acceptable degree of life safety is provided.

The Fire Department station officer shall perform housekeeping inspections of facilities on a routine basis to ensure that means of egress are maintained free of storage and are unobstructed.

6.1.4 RESPONSIBILITIES

Center Operations Directorate shall ensure that each facility is designed with the required life safety features.

Facility Coordinator and/or Facility Safety Head shall:

1. Ensures that an acceptable degree of life safety is provided by following the practices delineated in this section.
2. Contacts the LaRC Fire Chief before establishing a new use for a facility or structure or modifying existing facilities or structures.

LaRC Fire Chief shall evaluate the design and operation of facilities and structures to ensure that the requirements of this section are met.

Fire Department Station Officer shall ensure that an acceptable degree of life safety is provided in facilities by performing periodic facility inspections and maintaining documentation of all inspections.

6.2 FACILITY EVACUATION PLANS

6.2.1 PURPOSE

This section delineates the guidelines for evacuating personnel from LaRC facilities.

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6.2.2 SCOPE

This section shall apply to all normally occupied LaRC facilities, structures, facilities, and operations.

6.2.3 REQUIREMENTS/RESPONSIBILITIES

6.2.3.1 Facility Evacuation Diagrams

A facility evacuation diagram may be developed by a Facility Coordinator and/or Facility Safety Head. If one is developed, it must follow the requirements of this section.

Facility Coordinator and/or Facility Safety Head shall ensure that all evacuation routes are noted on a facility floor plan/diagram. To develop the evacuation diagrams, the following directions shall be used:

1. The facility floor diagram shall be as simple as possible. Note only walls, doors, stairs, or other pertinent structural features that are essential to egress.
2. Use directional arrows to illustrate the evacuation path.
3. Note on the diagram an assembly point for evacuating personnel that is a safe distance away from the facility.
4. Do not note other features, such as fire extinguishers, pull stations, nonrequired egress paths, and safety showers, as they only complicate the diagrams.

The LaRC Fire Chief shall review and approve all facility evacuation diagrams to ensure a safe and orderly evacuation of personnel. A sample facility evacuation plan in shown in Figure 6.1.

6.2.3.2 Personnel Evacuation Directions

All staff shall respond to an evacuation alarm by leaving the affected and/or alarmed area without delay and reporting to the designated assembly point, avoiding any obviously unsafe route while on the way. Special facility/operation hazards may require personnel to shelter in place.

Personnel shall make a visual check along the evacuation route for persons unable to evacuate, guide and assist them if possible without delaying evacuation or jeopardizing one's personal safety, and report such cases to the responding emergency personnel. Personnel shall perform only those necessary crash, panic, or scram shutdowns which can be done without delaying evacuation. Personnel shall stay at the designated assembly point until released by the emergency personnel.

6.2.4 RESPONSIBILITIES

Facility Coordinator and/or Facility Safety Head shall:

1. Ensure that evacuation routes are posted throughout the facility.
2. Ensure that an evacuation assembly point is designated for each facility.

LaRC Fire Chief shall evaluate the facility evacuation diagrams and the designated assembly points.

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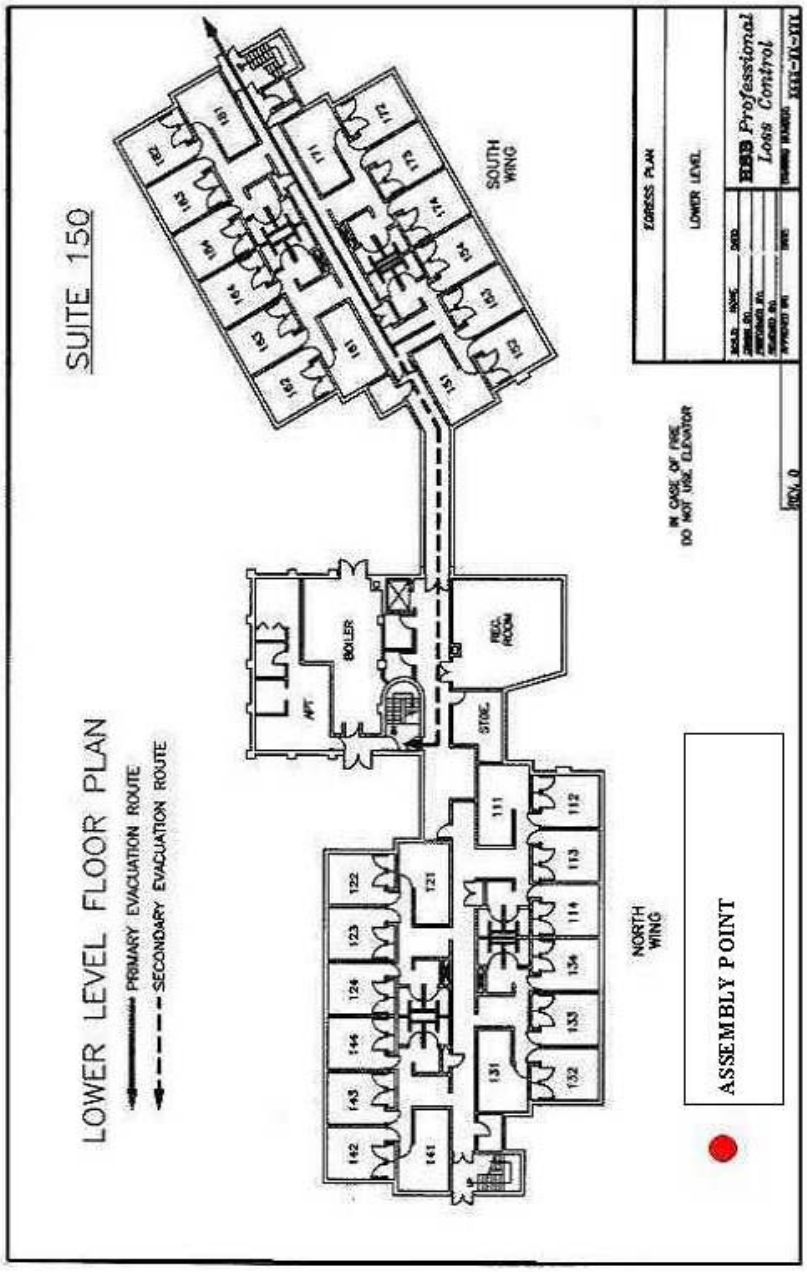
Figure 6.1, Sample Facility Evacuation Plan.



6.3 FACILITY EMERGENCY LIGHTS

6.3.1 PURPOSE

This section provides the requirements and responsibilities pertaining to battery powered emergency lighting systems.

6.3.2 SCOPE

These requirements shall apply to all LaRC-managed facilities, operations, and activities, including facilities leased by NASA (to the extent that leased facility owners must be notified of emergency exit features in need of repair or maintenance).

6.3.3 REQUIREMENTS

6.3.3.1 Required Emergency Light Testing Program

Emergency lights shall be operationally tested semiannually for a minimum of 30 seconds. During this test, the lights shall be inspected to verify the following:

1. Electrical cords shall not be damaged, frayed, or longer than 36 inches
2. Lamps shall not be cracked or damaged
3. Units shall be securely mounted
4. Lamps shall be properly positioned to provide illumination for the required area(s)
5. Lamps shall illuminate within 10 seconds of switching to the backup power supply

All emergency lights shall be operationally tested annually. NFPA standards recommend a 1 1/2-hour operational test.

6.3.3.2 Operational Testing Documentation

All emergency light tests shall be documented and written records maintained at the LaRC Fire Department by assigned maintenance personnel.

Emergency lights that are found deficient shall be repaired within 24 hours, or portable emergency lights shall be provided at the affected area(s) until the permanent lights are restored to service.

6.3.4 RESPONSIBILITIES

The assigned maintenance personnel shall be responsible for testing all the battery powered emergency lighting units within their facility.

6.4 OCCUPANCY PERMIT APPROVAL

6.4.1 PURPOSE

This section outlines the occupancy requirements that must be completed and complied with before LaRC personnel occupy any newly constructed or renovated

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facilities/structures or areas, or before any changes in an existing occupancy classification are made.

6.4.2 SCOPE

This section shall apply to all activities at LaRC and all off-site locations leased by NASA for routine occupancy by LaRC personnel.

6.4.3 REQUIREMENTS

6.4.3.1 General

A Certificate of Beneficial Occupancy shall cover the period of time following construction/modification of an area or facility when the area substantially complies with all fire protection and Life Safety Code requirements but is not in full literal compliance with all Occupational Safety and Health Administration (OSHA), National Fire Protection Association (NFPA), NASA, and LaRC safety requirements. A Certificate of Final Occupancy shall cover the period of time following completion of all aspects of literal compliance with the referenced codes and standards.

A copy of the certificate shall be kept by the facility. The certificate shall be renewed as part of the fire protection engineering survey process.

No LaRC supervisor or employee shall attempt to occupy an area or facility or to operate any processes prior to the issuance of a Certificate of Beneficial Occupancy or a Certificate of Final Occupancy.

Before a Certificate of Beneficial Occupancy shall be issued, the area or facility must be inspected by the LaRC Fire Chief or designee to verify that no imminent danger or serious OSHA violations exist as the facility is presently constructed.

Technical safety deficiencies resulting in the issuance of a Certificate of Beneficial Occupancy rather than a Certificate of Final Occupancy shall be corrected in an expeditious manner, but in no case shall the Certificate of Beneficial Occupancy be valid in excess of 45 days.

Whenever a hazard which would be classified as an imminent danger violation of the OSHA standards is identified, the Facility Coordinator and/or Facility Safety Head immediately must take interim corrective actions (barricade, evacuate, and lock out). Permanent corrective actions shall be completed within 24 hours. Failure to complete corrective actions within 24 hours shall result in revocation of the Beneficial or Final Occupancy status, and the SMAO Director shall be notified of the OSHA noncompliance status.

Whenever a condition which would be classified as a serious violation of the OSHA standards is reported to or observed by the LaRC Fire Chief, the Facility Coordinator and/or Facility Safety Head shall immediately barricade the hazardous condition. Permanent corrective actions shall be taken within 10 working days. Noncompletion of corrective actions within 10 working days shall result in the revocation of the Certificate of Beneficial or Final Occupancy.

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6.4.3.2 Items/Features Required Prior to Issuance of a Certificate of Beneficial Occupancy

Portable fire extinguishers shall be located as required by NFPA 10 (Portable Fire Extinguishers) and identified by conspicuous signs visible from all angles. The LaRC Fire Chief shall concur with the location and identification methods for the extinguishers.

A request for the completion of a Life Safety Code Review shall be submitted to the LaRC Fire Chief at least 2 weeks before the desired effective date of a Certificate of Beneficial Occupancy. This review shall include the following:

1. Emergency lighting, if required.
2. Employee emergency evacuation routes.
3. Method to summon emergency response team.
4. Means to notify employees of local facility evacuation.

Emergency lighting shall be required if the area or facility is to be occupied at night or if there are interior areas where windows do not provide minimum lighting (1 foot-candle at floor level) in the means of egress.

Employee emergency evacuation routes shall be identified by the Facility Coordinator and/or Facility Safety Head and approved by the LaRC Fire Chief. Diagrams of the emergency evacuation routes are displayed on the wall adjacent to each required exit. These routes shall take into consideration interface with any ongoing construction activities.

A fully functional employee evacuation alarm system must be operational prior to the issuance of a Certificate of Beneficial Occupancy.

No combustibles shall be stored in the means of egress. This shall require removal of all packing materials for fixtures and furniture before personnel are assigned to work in the area or facility.

Floor plans showing all dimensions of the permanent offices and temporary work spaces shall be approved by the LaRC Fire Chief prior to the issuance of a Certificate of Beneficial Occupancy.

No flammable/combustible liquid processing or any other high-hazard operations shall be performed, even if an area is designed to process such liquids or is classified as high hazard, while an area or building/ structure is being occupied under a Certificate of Beneficial Occupancy.

A Certificate of Final Occupancy shall be required prior to any processing of flammable or combustible liquids. An interim flammable/combustible liquids handling plan shall be developed if such liquids are to be present as part of the construction necessary to achieve the Certificate of Final Occupancy.

Permanent/Temporary identification of all hazards required by OSHA and NFPA shall include temporary hazards related to unfinished construction which shall be provided by signs, painting/color coding of hazards, and barricading. Hazard identification signs that

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will still exist once the Certificate of Final Occupancy is granted shall be installed before the issuance of a Certificate of Beneficial Occupancy.

Preplanned impairments of automatic sprinkler and/or fire alarm systems during the period of Certificate of Beneficial Occupancy are authorized, in writing, by the LaRC Fire Chief. All impairments of the fire protection system(s) shall be conducted in accordance with Section 5.1 of this document.

Electrical installation and modifications which are part of new construction shall be verified to confirm their compliance with NFPA 70 (National Electrical Code).

6.4.3.3 Items/Features Required Prior to Issuance of Certificate of Final Occupancy

Emergency evacuation alarms used on-site shall be connected to the sitewide supervised system and shall be audible in all public parts of the area requesting Final Occupancy. Off-site locations shall have a plan approved by the LaRC Fire Chief.

Central station fire alarm monitoring of all fire alarm boxes at on-site locations must be verified by the LaRC Fire Department inspector as part of the sitewide fire alarm. Systems at off-site locations shall be connected to a central station alarm monitoring location and shall be tested to ensure functional operation. This shall be accomplished in conjunction with the local authority having jurisdiction over the leased space location.

A flammable/combustible liquids storage plan must be prepared by the Facility Coordinator and/or Facility Safety Head. This plan shall meet the requirements of NFPA 30 (Flammable and Combustible Liquids Code) and shall be approved by the LaRC Fire Chief or designee.

Permanently established and identified aisles shall be provided in nonoffice areas and shall be clearly apparent in office areas. The aisles must be free of any obstructions, including storage of transient materials.

Exit signs shall be in place. Emergency lighting shall be required if the area or building/ structure is to be occupied at night or if it contains interior areas where windows do not provide minimum lighting (1 foot-candle at floor) in the means of egress.

Fire preplans shall be developed in accordance with Section 10.10 of this document prior to issuance of the Certificate of Final Occupancy.

Unobstructed 36-inch access to utility rooms/electrical disconnects shall comply with NFPA 70 (National Electrical Code). All areas in front of electrical disconnects and circuit breaker boxes shall be identified by markings on the floor or by appropriate signs notifying the occupants to keep the area clear at all times.

Permanent signs and postings shall be required by OSHA, NFPA, NASA, and LaRC performance requirements conform to the requirements of 29 CFR 1910.145 for the marking of hazards. Temporary (handwritten or typewritten signs) or other nonstandard signs shall not be acceptable under a Certificate of Final Occupancy.

6.4.3.4 Requirements for On-Site Construction and Modifications

All facilities constructed or modified on-site shall be designed to meet an improved risk level of fire protection.

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All off-site leased facilities shall fully comply with the local building and fire codes. Additionally, all off-site leased space shall be protected by an automatic sprinkler system equipped with a fire alarm monitoring system that shall automatically notify the local fire department, and the portion of the facility occupied by LaRC personnel shall fully comply with NFPA 101 (Life Safety Code).

6.4.3.5 Issuance of Certificate of Beneficial Occupancy

The Facility Coordinator/Facility Safety Head/project engineer shall submit a written request for the issuance of a Certificate of Beneficial Occupancy by the LaRC Fire Chief. The LaRC Fire Chief shall verify that all required items of this section are present and that no imminent danger or serious hazards exist in the area. Any item that is in technical noncompliance with OSHA, NFPA, NASA, or LaRC safety performance requirements is noted on the Certificate of Beneficial Occupancy. Where appropriate, the noncompliances shall be identified by tags, barricades, or other interim corrective measures.

The LaRC Fire Chief shall identify to the Facility Coordinator/Facility Safety Head/project engineer, all actions necessary prior to the issuance of Certificate of Final Occupancy.

Note: The Certificate of Beneficial Occupancy shall not be issued until all interim corrective measures are physically in place and functional.

6.4.3.6 Issuance of Certificate of Final Occupancy

To obtain a Certificate of Final Occupancy, the Facility Coordinator/Facility Safety Head/project manager shall notify the LaRC Fire Chief that all technical deficiencies identified by the inspection (that was part of the issuance of the Certificate of Beneficial Occupancy) have been corrected.

The LaRC Fire Chief shall assign professional staff members from affected disciplines to reinspect the area to verify that all identified deficiencies are corrected and that no new deficiencies have arisen in the area applying for Certification of Final Occupancy.

6.4.4 RESPONSIBILITIES

Center Operations Directorate shall:

1. Request the assistance of the LaRC Fire Chief in determining if proposed on-site or off-site space is suitable for proposed occupancy.
2. Submit drawings, sketches, etc., to the SFAB for approval prior to structural modifications by LaRC or subcontractor personnel.
3. Ensure that all new construction at LaRC is designed and constructed to the improved risk level of fire protection and that no known violations of OSHA, NFPA, NASA, or LaRC safety requirements are included as part of the final construction turnover packages.
4. Request the LaRC Fire Chief to issue a Certificate of Beneficial Occupancy and/or a Certificate of Final Occupancy.

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Facility Coordinator and/or Facility Safety Head shall:

1. Request the assistance of the LaRC Fire Chief in determining if proposed changes in on-site use will affect the occupancy of an area or facility.
2. Initiate work orders, construction projects and purchase requisitions necessary to bring the area or facility into full compliance with all applicable standards.
3. Ensure that all proposed modifications meet an improved risk level of fire protection.
4. Submit design plans for temporary work space for approval.
5. Request the LaRC Fire Chief to issue a Certificate of Beneficial Occupancy and to issue a Certificate of Final Occupancy for all nonproject on-site facility modifications.

LaRC Fire Chief shall:

1. Review all proposed structural modifications to existing areas or facilities/structures and construction proposal drawings/packages to verify that an on-site proposed usage qualifies as an improved risk level of fire protection.
2. Review drawings of off-site office areas and facilities/structures to ensure that they meet all local fire codes and that whatever portion is used by LaRC personnel fully complies with NFPA 101 (Life Safety Code).
3. Review all drawings for the installation of temporary workspace to ensure that the installation does not invalidate the Certificate of Final Occupancy.
4. Issue Certificates of Beneficial and Final Occupancy using LF 112, "Certificate of Occupancy."

Fire Department Station Officer shall:

1. Perform specified fire inspections of all LaRC on-site and off-site locations to verify ongoing compliance with OSHA, NFPA, NASA, and LaRC safety requirements.
2. Inform and identify to the LaRC Fire Chief any condition that appears to be an imminent danger of fire protection concern.
3. Verify that no apparent changes in occupancy have occurred since the issuance of the Certificate of Final Occupancy.

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CHAPTER 7

7. FIRE PROTECTION

7.1 SMOKING REGULATIONS

7.1.1 PURPOSE

This section reinforces the LaRC smoking policy and regulations.

7.1.2 SCOPE

This section shall apply to all facilities and areas that lie within the boundaries of LaRC.

7.1.3 REQUIREMENTS

Smoking shall be permitted only in designated smoking areas.

Adequate receptacles shall be provided in designated smoking areas.

Locations of fire extinguishers shall be noted at designated smoking areas.

Lighters, matches, or other flame-producing devices must be used as intended. Carrying/using “strike anywhere” matches is prohibited at LaRC. Safety matches shall be permitted.

7.1.4 RESPONSIBILITIES

Office of Human Resources shall:

1. Be responsible for smoking policy at LaRC.
2. Coordinate requests for designated smoking areas with SFAB.

LaRC Fire Chief or Designee shall:

1. Determine if requested smoking areas are within a fire hazard area.
2. Ensure that all fire protection requirements of smoking areas are maintained.

7.2 FIRE LANES

7.2.1 PURPOSE

This section establishes general operating practices to ensure facility accessibility for fire fighting forces.

7.2.2 SCOPE

This section shall apply to all personnel and all facilities at LaRC.

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7.2.3 REQUIREMENTS

7.2.3.1 General

Provisions for facility fire lane accessibility in new facilities or existing facility modifications or additions shall be considered in the design.

Facility entry/access points and response routes (fire lanes) shall be identified in the LaRC Fire Department prefire plan as required in Section 10.9 of this document. The Facility Coordinator and/or Facility Safety Head shall notify the LaRC Fire Chief prior to facility configuration alteration to review and approve the potential fire lane impairments and to allow the LaRC Fire Department to update its prefire plan.

Access points and ingress/egress routes shall be maintained free of equipment, furniture, stored materials, and other items which impede interior access.

The arrangement of stored materials shall be such that all portions of the materials can be reached by fire fighting hose streams.

7.2.3.2 Fire Lanes

Fire lanes shall be provided to within 150 feet of all portions of a structure or outside storage area. Where fire lanes are longer than 150 feet and terminate at a dead end, approved provisions for turning around fire department apparatus must be provided. Figure 7.1 provides an illustration of the approved turnarounds.

Fire lanes shall not be less than 20 feet of unobstructed width.

Fire lanes shall be designed with an appropriate 25-foot inside turning radius and a 50-foot outside turning radius at turns to accommodate fire department apparatus.

Access roads shall be furnished by application of an all-weather driving surface of hot mix asphaltic concrete or concrete pavement over a flexible base capable of supporting loads imposed by LaRC Fire Department apparatus (not less than 80,000-pound live vehicle load). Access roads shall also have a minimum of 13 feet 6 inches of vertical clearance.

Fire lanes shall be marked with freestanding signs or marked curbs, sidewalks, or other traffic surfaces with the words “FIRE LANE – NO PARKING” painted in black letters on a yellow background.

7.2.4 RESPONSIBILITIES

Fire Department Station Officer shall conduct facility walkthrough inspections, as part of the prefire planning, to identify facility access points.

Facility Coordinator and/or Facility Safety Head shall:

1. Ensure that access points and ingress/egress routes are not obstructed.
2. Ensure that proper configuration of stored items is maintained.
3. Notify LaRC Fire Chief of any facility configuration changes.

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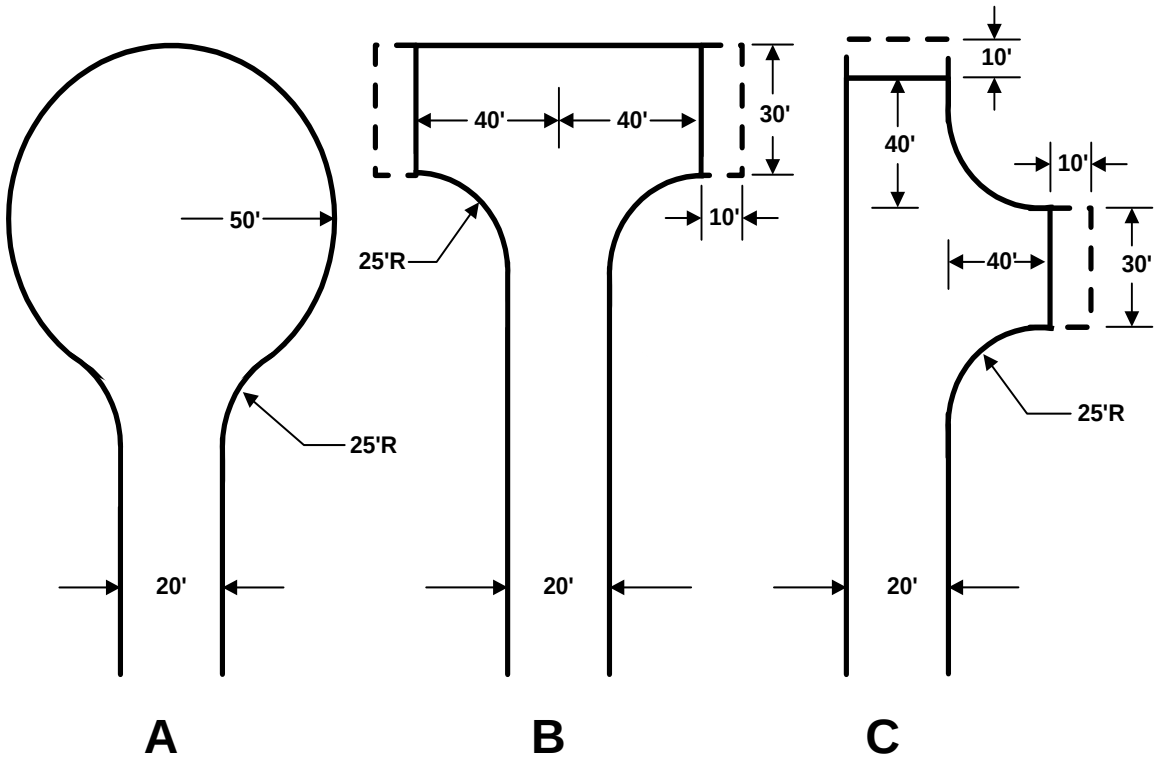

Figure 7.1, Approved Fire Lane Turnarounds.

The LaRC Fire Chief shall approve a cul-de-sac with a minimum 50-foot unobstructed radius and 30-foot by 80-foot “T” section of “Hammerhead” turn around, provided that an additional 10 feet of right of way around the 30-foot by 80-foot dimension can be provided with no obstructions over 1 foot high.

7.3 HOT WORK/OPEN FLAME AND WELDING PERMIT SYSTEM

7.3.1 PURPOSE

This section establishes fire protection requirements for work or activities which require the use of flame-, heat-, smoke-, or spark-producing tools. These include, but are not limited to, acetylene and propane torches, grinders, electric arc welders, and activities such as grinding or brazing outside of designated shop facilities. The requirements for designated hot work shops are stipulated in Section 7.3.3.4 of this document.

7.3.2 SCOPE

This section shall apply to all organizations at LaRC, as well as to all contractors that operate at the facility. Deviations or waivers from the standard for specialized operations must be submitted to the LaRC Fire Chief in writing for review and consideration in accordance with Section 2.3. Only the LaRC Fire Chief shall grant deviation or waiver approval.

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7.3.3 REQUIREMENTS

7.3.3.1 General Precautions

Hot work activities shall not be performed on the following:

1. Combustible walls or ceilings or those containing combustible insulation.
2. Tanks or pipes that have held flammable liquids (unless they have been thoroughly purged and tested for residual vapors).
3. Pipes or other metal in contact with combustible materials if ignition of material is possible due to conduction.
4. Metal partitions, walls, ceilings, or roofs having a combustible covering.
5. Walls or partitions of combustible sandwich-type panel construction.

The Hot Work Permit shall be in effect for no longer than 24 hours except as permitted in Section 7.3.3.4. If conditions related to the permit change during this time, the permit shall be void and a new permit issued. The permit must be posted in the area where the work is performed.

Industrial Hygiene personnel shall review the process for special ventilation or respiratory requirements when hot work is being performed on metals such as stainless steel, lead, nickel, chromium, or metals with special coatings.

Nearby personnel shall be protected from heat, sparks, and/or slag. This may be accomplished through the use of fire resistive screens or shields.

7.3.3.2 Hot Work Requirements

A NASA Langley Form 71, "Hot Work Permit (Non-fixed)," must be completed and approved prior to the start of work.

A flammable vapors test must be conducted when flammable liquids, vapors, or gases may be present. If test results exceed 25% of the lower explosive limit (LEL) for liquids and 0% LEL for gases, additional precautions shall be required.

Automatic sprinkler protection must be in service where provided. (Hot work activities shall be specifically prohibited in areas that have automatic sprinkler protection which is out of service. Additionally, welding or torch cutting on automatic sprinkler systems after installation is prohibited.)

Portable fire extinguishers must be available for fire watch use. Facility fire extinguishers shall not be used to satisfy this requirement.

Flammable liquids within 35 feet of the hot work area must be removed.

Oily deposits within 35 feet of the hot work area must be cleaned/ removed.

Combustible materials within 35 feet of the hot work area must be removed.

Combustible materials which cannot be removed must be covered or shielded with flameproof covers, fire resistant guards, or fire resistant curtains.

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Cracks in walls, floors, ducts, or other concealed spaces within 35 feet of the hot work area must be covered to prevent the passage of sparks or slag to adjacent areas.

Combustible materials must be removed from the other side of walls where hot work is performed near walls, partitions, ceilings or roofs of combustible construction.

Special precautions, as recommended by the LaRC Fire Chief, must be taken to avoid unwanted activation of automatic detection or suppression systems due to the use of hot work equipment. This shall include impairment of the smoke detectors in the work area through the correct fire protection impairment protocol as outlined in Section 5.1.

7.3.3.3 Fire Watch Requirements for Hot Work Activities

A fire watch must be provided for all hot work operations performed outside of a dedicated “fixed” hot work shop location.

The fire watch shall ensure that a portable fire extinguisher of adequate size and type is available for the hot work operation. The extinguisher shall be in addition to the portable extinguishers located throughout the facility.

The fire watch shall locate the nearest emergency pull station and telephone to report an emergency.

The fire watch shall continuously monitor the work area for hazards and must immediately notify the other worker(s) of the hazards.

The fire watch shall not have any other collateral duties.

The fire watch shall monitor the work area for any smoldering fires or hot spots for at least 30 minutes following the hot work operation.

7.3.3.4 Shop Welding and Cutting Areas

Shops that perform hot work activities must be located in noncombustible or fire resistant structures unless otherwise approved by the LaRC Fire Chief.

The area or shop must be located in the sprinklered portion of the facility. Hot work activities shall not be permitted while sprinkler protection is out of service, unless approved by the LaRC Fire Chief. The LaRC Fire Chief shall notify the Facility Coordinator and/or Facility Safety Head of any impairments to the automatic sprinkler system within the shop area.

The area or shop boundary must be constructed to prevent sparks and/or slag migration outside the approved area, or the immediate space surrounding the defined hot work area must be kept clear of all combustibles or at least 35 feet in any direction in which sparks may travel. This 35-foot buffer shall not be considered part of the hot work area or shop.

Screens must be provided to protect other workers from ultraviolet radiation hazards.

Unconnected gas cylinders stored in the areas or shops must be limited to a 1-day supply.

Fixed shop areas that perform hot work operations shall be issued a Hot Work Permit (a single permit can cover multiple operations) by the LaRC Fire Chief after review of the

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proposed area or shop for conformance to this standard. Shop permits shall be written for a period not to exceed 1 year, with a 6-month evaluation.

The NASA Langley Form 70, "Hot Work Permit (Fixed)," must be completed and posted within the shop or work area.

The shop or area supervisor must request a new shop or area inspection whenever the configuration and/or occupancy of the fixed hot work area is changed.

A fire watch shall be required under specific circumstances in approved fixed hot work shops or areas at the discretion of the shop/area supervisor or the LaRC Fire Chief.

7.3.4 RESPONSIBILITIES

Facility Coordinator and/or Facility Safety Head shall:

1. Serve as the interface for special hazard situations and provides oversight and guidance to facility personnel performing hot work activities.
2. Ensure that all fixed hot work shop areas have permits posted as outlined in the standard.

LaRC Fire Chief or Designee shall:

1. Ensure that Hot Work Permits are issued in accordance with this standard.
2. Review special hazard situations and recommends practices and compensatory measures to prevent fires or explosions related to hot work activities.
3. Inspect fixed weld shop areas upon request from the shop supervisor or Facility Coordinator/Facility Safety Head and issues fixed weld shop permits.
4. Reinspect the shops annually at the request of the shop supervisor or Facility Coordinator/Facility Safety Head.

Fire Watch shall ensure that the requirements of this section are followed.

Personnel Performing Hot Work shall

1. Ensure that all aspects of the Hot Work Permit are in place and that the parameters of the permit are not breached.
2. Conduct hot work in accordance with the permit requirements.
3. Shop Welding Area Supervisor shall request a new Hot Work Permit prior to the expiration of the existing permit.

7.4 FACILITY FIRE WATCH REQUIREMENTS

7.4.1 PURPOSE

This section establishes the requirements for performing facility fire watch duties at LaRC.

7.4.2 SCOPE

This section shall apply to all personnel performing facility fire watch duties.

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7.4.3 REQUIREMENTS

Facility fire watch personnel must understand the specific nature of the fire system impairment and the specific area(s) affected.

Facility fire watch personnel shall patrol all areas affected by a fire system impairment.

Facility fire watch personnel shall be instructed in the frequency of the facility fire watch tours by the LaRC Fire Chief. The frequency of tours typically shall be as follows:

1. Continuous, when required by facility process standards or process controls.
2. Hourly, when automatic suppression systems are out of service.
3. Once every 2 hours if only automatic alarm capability is out of service.
4. As dictated by the LaRC Fire Chief.

Facility fire watch personnel shall be given instruction before standing facility fire watch.

Each facility fire watch personnel shall be instructed on the following:

1. Areas to be watched.
2. Frequency of tours required.
3. Specifics of the fire protection impairment.
4. Appropriate emergency procedures and actions.
5. Methods for sounding the alarms.
6. Procedure for manually activating fire suppression systems.
7. Use of fire extinguishers (hands-on training required).
8. Methods for recording conduct of tours.
9. Other pertinent information in the log.

A log or other documentation system shall be established and used to provide an auditable record of compliance with the requirements of this standard. The log or other documentation shall include (but is not limited to) the following:

1. Facility, building, and area under facility fire watch.
2. Nature of fire protection impairment.
3. Date of first fire protection impairment.
4. Dates and frequencies of facility fire watch.
5. Signatures of personnel serving as facility fire watch.
6. Date of fire protection restoration.

Facility fire watches for welding, cutting, grinding, or open flame activity are performed in accordance with Section 7.3 of this document.

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7.5 HEAT-PRODUCING APPLIANCES

7.5.1 PURPOSE

This section establishes the requirements for the use of portable heat-producing appliances.

7.5.2 SCOPE

This section shall apply to the use of portable heating appliances at LaRC.

7.5.3 REQUIREMENTS

7.5.3.1 General Requirements

Heat-producing devices shall not be used on or near combustible surfaces unless provided with adequate insulation. See manufacturer's recommendations for required separation distances.

Only those heat-producing devices that have been approved for the service intended by a nationally recognized testing/certification laboratory shall be used. They must be disconnected from their power source or de-energized by an approved switch when tilted or tipped over.

When open-flame equipment is used, a special written permit shall be required for each use.

Coffee makers and similar appliances shall be installed so that they are in plain view and shall be separated and insulated from combustibles. They must be de-energized when not in use.

Combustible liquids used for refueling shall be stored in safety cans.

Heaters using gasoline (or other Class I Flammable and Class II Combustible liquids) shall be prohibited in any location (see National Fire Protection Association [NFPA] 30 for definitions).

Hourly fire watches shall be provided for burner-type heaters which are in use during other than normal working hours, except where the heaters used are house-type furnaces or space heaters that are provided with fully automatic controls. In such cases, hot flues, unless appropriately insulated, must be 10 feet or more from combustibles.

The use of burner-type heaters shall not be permitted in areas where painting or other activities may create possible explosive atmospheres. Heat furnished to such areas must be indirect (steam or forced ducted air).

7.5.3.2 Melting Kettles or Pots

An approved type of fire extinguisher must be available at all locations where heating or melting kettles are used or hot substances are applied. The extinguisher shall be in addition to the portable extinguishers located throughout the facility.

All heating or melting kettles or pots must be mechanically stable. Appropriate barriers must be provided so the kettles/pots are isolated from pedestrian and vehicular traffic.

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Kettles/pots shall not be used in combustible facilities, nor shall they to pose a fire risk to nearby structures. They shall be covered and equipped with temperature indicating devices appropriate for the materials being heated. Thinning with flammable solvents is not permitted.

Protective equipment and clothing must be provided and must be used by all persons handling hot substances.

7.5.3.3 Space Heaters

When heating an occupied area, heaters shall be of the indirect-fired type with combustion exhaust gases discharged to the outside atmosphere. However, if direct-fired units are used or if combustion gases do not discharge outside, a monitoring program for toxic gases shall be established which is acceptable to the responsible safety organization.

Portable heaters requiring liquid or gaseous fuel shall not be located within facilities. They shall be located outside with the heated air ducted to the point-of-use.

Heaters of the pot type shall be prohibited, as are open fires or fires in open end drums. Heater combustion controls are UL listed or American Gas Association (AGA) approved. If AGA approval is accepted in lieu of UL listing for combustion controls, the full complement of personnel safety devices required for UL listing shall be provided.

Permanent fixed boilers, fixed heaters, or heaters without watchmen or heater tenders shall be equipped with the full complement of combustion controls.

7.5.3.4 Heater Fuel Supply and Storage

Oil or liquefied petroleum gas (LPG) fuel supply tanks for heaters must be installed or contained outside of facilities or enclosures. Fuel lines shall be protected against mechanical damage.

Supply or storage tanks shall be buried. If installing the tanks above ground is necessary, they must be labeled with their contents, “No Smoking” labels shall be placed on them, and barricades placed around them. Such tanks shall meet the requirements of NFPA 30 or NFPA 31.

LPG supply tanks of less than a 125-gallon aggregate cylinder content shall be installed in racks immediately outside an enclosure. Larger supply tanks are installed in accordance with NFPA 58.

The fuel supply tank is permitted to be an integral part of the heating unit if the minimum distance separating it from any combustible material is 10 feet. Such units shall be shut down and cooled before being refueled or moved.

7.5.3.5 Temporary Portable Electric Heaters

Temporary portable heaters shall not be approved except for freeze protection or when facility heat is lost.

Before requesting a portable heater, all options available to improve comfort and to ensure maximum efficiency and conservation of energy through existing fixed systems

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shall be examined. Facility managers shall investigate ways to improve the central heating distribution. If, as a final solution, a portable heater is necessary in an area, two major safety concerns must be considered:

1. Portable heaters are an additional ignition source and must be well separated from all combustible materials.
2. Portable heaters produce an additional electrical load which may cause an overload in the existing electrical circuits and cause conduit breakers to trip. This interrupts power to the circuit, which may be serving a computer, lights, or other electrical appliance.

With respect to these safety concerns and applicable safety and fire protection requirements, the following instructions have been established for the selection and use of temporary portable electric heaters:

1. Approval for use shall be obtained from the SFAB Head and cognizant Facility Coordinator/Facility Safety Head after review and concurrence of the proposed use by the LaRC Fire Chief and the facility electrician.
2. The heater shall be approved by a nationally recognized testing/certification laboratory such as UL. Only oil-filled portable electric heaters will be approved. In addition, the heater must not exceed 1800 watts.
3. Due to the additional electrical load, the proposed heater usage shall be reviewed by the facility electrician or other electrical specialist to verify that the circuit is not overloaded. Some facilities have specific electrical load restrictions which must be adhered to.
4. The location of the unit shall be considered. It shall not be placed against combustible materials or where a tripping hazard may be created because of the unit or its electrical cord.
5. Administrative controls shall be implemented to ensure the unit is unplugged or turned off when space being heated is unoccupied.

7.5.4 RESPONSIBILITIES

Facility Coordinator and/or Facility Safety Head shall ensure that practices delineated in this procedure are followed and shall contact the LaRC Fire Chief prior to the use of portable heating equipment.

Fire Department Inspector shall:

1. Inspect the work area, prior to the use of portable heating appliances, to ensure that the work area is properly prepared to prevent fires.
2. Determine if additional protective measures are necessary during the use of portable heating appliances.
3. Consult with the LaRC Fire Chief to determine the adequacy of heat-producing appliances, as necessary.

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7.6 FIRE PROTECTION DURING CONSTRUCTION

7.6.1 PURPOSE

This section prescribes minimum fire protection safeguards for construction and demolition activities, including alteration and demolition.

7.6.2 SCOPE

This section shall apply to all construction and demolition activities at LaRC. This shall include operations performed by NASA and contract personnel.

7.6.3 REQUIREMENTS

7.6.3.1 Preconstruction Conference

Before construction and demolition activities shall be initiated, a preconstruction conference shall be held.

Items to be discussed in the preconstruction meeting shall include:

1. Emergency and business telephone numbers for the LaRC Fire Department.
2. Requirements for construction contractor-provided fire extinguishers.
3. Use of specified fire hydrants in accordance with Section 5.4 of this document.
4. Smoking policy (cessation of smoking 30 minutes prior to end of shift).
5. Pre-entry inspection of construction vehicles.
6. Transport and storage of flammable liquids:
   - Capacity of 5 gallons or less shall be transported only in approved safety containers
   - No bulk storage of flammable liquids shall be permitted without LaRC Fire Chief approval
7. Requirements for accumulation of combustibles, form lumber, forms, waste, and debris.
8. Temporary heating equipment.
9. Maintenance of required exit components.
10. Maintenance of existing fire protection systems and fire resistive assemblies.
11. Any other items pertaining to fire protection/prevention.

7.6.3.2 Fire Safety Plan

A fire safety plan shall be included in all construction or demolition projects

The construction safety inspector, LaRC Fire Chief, and fire department station officer have the authority to enforce the plan even though the facility, during construction, is under the jurisdiction of the construction contractor. Upon request by the LaRC Fire

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Chief, the construction contractor shall conduct a construction area tour for emergency response personnel.

The plan shall include full compliance with requirements set forth in NFPA 241 as well as the following:

1. Good housekeeping practices in accordance with Section 7.9 of this document.
2. Installation of new fire protection systems as construction progresses.
3. Preservation of existing fire protection systems during demolition.
4. A prefire plan developed with assistance from the LaRC Fire Department station officer in accordance with Section 10.9 of this document.
5. Rapid notification of fires in accordance with Section 7.10 of this document.
6. Consideration of special hazards resulting from previous operations:
   - Any cutting, welding, or other types of hot work at construction sites comply with Section 7.3 of this document.
   - The storage of flammable compressed gases at construction sites complies with Section 8.3 of this document.

7.6.4 RESPONSIBILITIES

LaRC Fire Chief or Designee shall:

1. Answer questions relative to fire protection/prevention asked by construction contractor.
2. Enforce the construction fire safety plan with assistance from the construction safety inspector.

Construction Safety Inspector shall:

1. Enforce the construction fire safety plan with assistance from the LaRC Fire Department and LaRC Fire Chief.
2. Attend preconstruction meeting.
3. Discuss fire protection and prevention policies with construction contractor.
4. Answer questions relative to fire protection/prevention asked by construction contractor.

7.7 STANDARD FIRE SYMBOLS FOR LaRC

7.7.1 PURPOSE

This section establishes the requirements for the posting of symbols to identify the most severe hazard(s) associated with materials stored in a facility or storage site in order to alert responding fire fighters of the expected hazards and to identify outside fire protection equipment.

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7.7.2 SCOPE

This section shall apply to all facilities at LaRC.

7.7.3 REQUIREMENTS

7.7.3.1 General

All existing facilities or storage sites containing explosive materials, flammable liquids or gases, or other hazardous substances shall be posted with National Fire Protection Association (NFPA) 704 symbols to identify the hazard classification of the material within the facility or site. Additionally, all facilities shall be posted with appropriate outside markings for fire protection equipment in accordance with Section 7.7.3.3 of this section.

7.7.3.2 NFPA 704 Posting

All facilities shall be posted with the NFPA 704 diamond. This symbol provides visual information on four categories of hazard: health, flammability, reactivity (stability), and special hazards such as oxidizers or water reactivity.

The NFPA 704 diamond is divided into four intrinsic diamonds, each representing the four hazard categories. The left-hand diamond represents the health hazard of the material within the facility. The top diamond represents the flammability hazard of the material within the facility. The right-hand diamond represents the reactivity hazard of the material within the facility. The bottom diamond is used to provide special information relative to the material in the facility.

Each of the four diamonds of the main symbol shall be color coded. The background color of the diamond representing the health hazard is blue. The background color of the diamond representing the flammability hazard is red. The background color of the diamond representing the reactivity hazard is yellow. The background color for the diamond providing special information is white.

Each hazard category shall be assigned a hazard classification based on the properties of the material. Table 7.1 lists the five classifications of hazards and the general meaning to fire fighters. The hazard classification for each hazard category is placed within the diamond representing the respective hazard category.

The assigned hazard classification shall reflect the most severe hazard expected in the area, whether it be from material itself or breakdown products of the material.

The color of each number representing the hazard classification shall be black.

The size and location of the diamond shall comply with recommendations contained in NFPA 704.

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Table 7.1, Degrees of Hazards

DEGREE OF HAZARD	HAZARD INVOLVED
4	Fire is too dangerous to approach with standard fire fighting equipment and procedures. Withdraw and obtain expert advice.
3	Fire can be fought using methods intended for extremely hazardous situations, such as remote-control monitors or personal protective equipment that prevents bodily contact.
2	Fire can be fought with standard procedures, but hazards are present that can be handled safely only with certain special equipment or procedures.
1	Nuisance hazards are present that require some care, but standard fire fighting procedures can be used.
0	No special hazards are present.

7.7.3.3 Marking of Outside Fire Protection Equipment

All outside fire protection equipment shall be posted with the applicable markings to aid in identification and operation during emergency response.

Signs shall be permanently marked and constructed of weather resistant metal or rigid plastic materials. Signs shall be nominally 12 inches high and 18 inches wide. Signs shall have a red background and white letters and border. Letters shall be at least 2 inches and of retroreflective material. The border shall be at least 1 inch in width and of retroreflective material.

Signs shall contain the following information in three distinct lines (See Figure 7.2):

Line 1: The service design (e.g., AUTOSPKR, OPEN SPKR, STANDPIPE, or AUTOSPKR and STANDPIPE)

Line 2: The portions of the facility served (e.g., entire facility, 1st floor computer room)

Line 3: System information (e.g., inlet pressure to deliver the greatest system demand [125 psi], manual valve locations)

Each line of information shall be separated from the next adjacent line or border by at least 1 inch of space.

The sign shall be permanently attached or mounted within 2 feet of the applicable outside fire protection equipment. When multiple pieces of equipment are present, signs shall be mounted in a manner to eliminate confusion.

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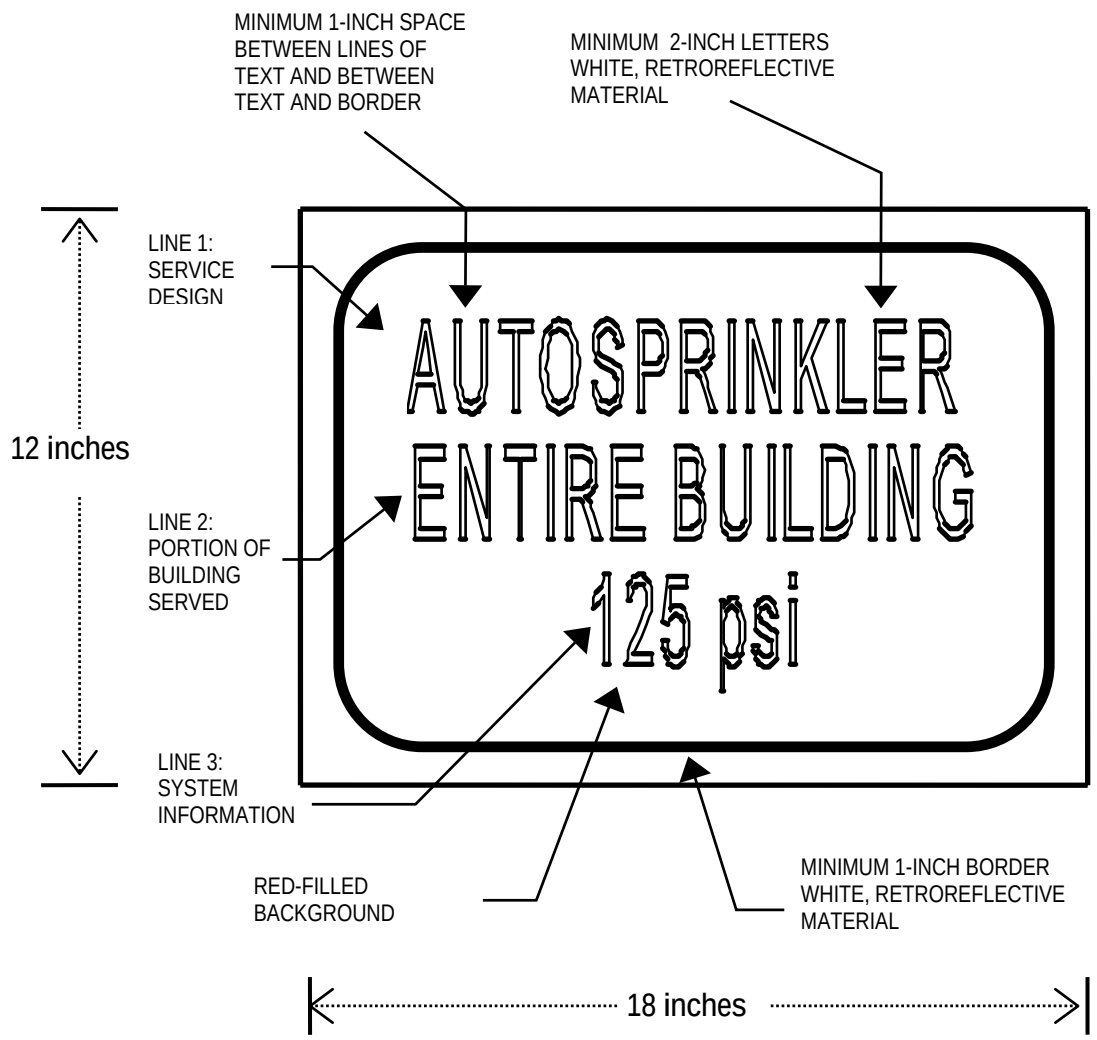

Figure 7.2, Outside Fire Protection Equipment Signage.

7.7.4 RESPONSIBILITIES

Facility Coordinator and/or Facility Safety Head shall:

1. Ensure that the flammable liquids or gases and other hazardous materials are identified and assigned a proper hazard classification for all facilities.
2. Display symbol on the facility or site to reflect the most serious hazard classification pertaining to the facility or site.

LaRC Fire Chief shall:

1. Assist Facility Coordinator and/or Facility Safety Head in identifying hazardous materials and determining hazard classification for each material.
2. Ensure response to emergencies involving facilities or sites containing hazardous materials.

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7.8 CONTROL OF COMBUSTIBLES

7.8.1 PURPOSE

This section establishes administrative controls for combustibles (transient fire loads [TFL's]) at LaRC and to ensure that provisions are adequate for fire prevention, control, and suppression.

7.8.2 SCOPE

These controls and protection philosophies shall apply to safety related systems, high-value structures, and sensitive components. They shall be extended to other areas to the extent possible.

7.8.3 REQUIREMENTS

7.8.3.1 General

The control of TFL's is essential to the defend-in-place fire protection philosophy for safety related systems, structures, and components and to prevent economic loss due to exposure fires to auxiliary facilities and equipment necessary for LaRC operation.

7.8.3.2 Normal Combustibles

The location of TFL's in safety related areas shall be restricted to minimize potential fire hazard exposures to safety related cables, equipment, and fire rated barriers. TFL's shall not be positioned within 6 feet of a fire door, measured perpendicularly, or within less than 0.8 times the door width, measured from the edge of the nearest door opening.

The LaRC Fire Chief shall ensure that the total transient and permanent fire loading in any safety related area does not exceed the capabilities of the installed fire protection systems and equipment as outlined in the fire hazard analysis (FHA), except in approved controlled conditions where adequate supplemental protection and supervision are provided. In safety related areas where there is a heavy concentration of safety related cables or equipment protected by fixed fire protection systems for those specific hazards, no credit shall be taken for those systems to provide extinguishment capability for the TFL's. TFL's, when allowed in these areas, shall be strictly controlled and require adequate protection measures, such as supplemental fire protection and/or fire watches.

The LaRC Fire Department station officer shall perform and document LaRC inspections to determine the adequacy of the TFL controls. Deficiencies shall be identified and documented, and corrective action shall be promptly pursued. The appropriate Facility Coordinator and/or Facility Safety Head shall be advised when it is determined that TFL precautions do not meet section requirements.

Combustible materials and flammable and combustible liquids shall be limited in quantity to the minimum amounts necessary to perform operations for one shift. All materials shall be removed from safety related areas at the completion of the work and taken to a suitable location for disposal/storage.

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Equipment located in safety related areas that requires periodic replenishment with combustible material (e.g., lubricating oil, charcoal filters) shall be controlled as follows:

1. Only the replenishment amount that will be used during the work shift shall be brought into the area.
2. Used combustible materials such as dirty oil and spent filters shall be removed from the safety related area when work is completed and taken to a suitable location for storage or disposal.

Waste, debris, scrap, rags, oil spills, or other combustibles resulting from the work activity shall be removed from safety related areas following the completion of the activity, or at the end of each work shift, whichever is sooner.

Paper, dirty dressout gear, and other trash which has been bagged for removal shall not be left to accumulate in safety related areas. This material shall be removed or placed in an approved storage location at the end of each shift. Storage locations inside safety related areas shall be approved by the LaRC Fire Chief in accordance with the controls of this section.

The use of welding/burning equipment shall be in accordance with Section 7.3 of this document.

Equipment or supplies shipped in untreated combustible packaging or containers shall be unpacked in safety related areas <u>only</u> if:

1. A continuous fire watch has been established in accordance with Section 7.4 of this LPR.
2. A valid reason exists for equipment and supplies not being unpacked in an area separate from the safety related area (e.g., sensitive equipment, material handling, or fragility).
3. All combustible packing materials and containers shall be removed immediately following unpacking.
4. Loose combustible packing materials, such as wood or paper excelsior or plastic sheeting, shall have been placed in metal containers with tight fitting, self-closing metal covers until removal from the area.

Gasoline, liquefied petroleum gas (LPG), or diesel operated vehicles that enter any safety related area shall have met the requirements of this section.

Insulation on high-temperature casings or pipes that shall become soaked or suspected of being soaked with hydraulic fluids is replaced as soon as possible. Generally, hydraulic fluids have an autoignition temperature of 1150°F, but when soaked into insulation, this fluid will ignite at temperatures as low as 600°F. Because of this phenomenon, cleanup of all spills and elimination of all leaks that may soak insulation in high-temperature casings or pipes shall be undertaken immediately.

Rags shall be removed from safety related areas at the completion of the work and taken to a suitable location for disposal. Care shall be taken to prevent accumulation of rags in the safety related area while work is in progress. Soiled rags in safety related areas shall be temporarily stored in covered metal containers.

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Work activities shall be evaluated by the LaRC Fire Chief or designee to determine if additional controls are required to minimize the additional fire load.

Ion exchange resins shall not be stored in areas that contain or expose safety related equipment.

7.8.3.3 Flammable/Combustible Liquids or Gasses

Flammable or combustible liquids shall not be stored in safety related areas of LaRC. Incidental use shall be controlled by the requirements of Section 8.2 of this document.

Compressed gas cylinders containing flammable gases shall meet the requirements of Section 8.3 of this document.

7.8.3.4 Building Materials

Fire retardant, pressure treated lumber and any other related combustible materials that are to be used in any area of LaRC for temporary structures shall be in accordance with Section 8.12 of this document. The use of nonpressure treated wood materials and other combustible building materials shall be prohibited unless specifically evaluated and approved by the LaRC Fire Chief.

7.8.4 RESPONSIBILITIES

LaRC Fire Chief or Designee shall:

1. Interpret the guidelines in this section and specifies the controls and protective measures required by the TFL's introduced.
2. Process the TFL in accordance with this document section.

Supervisor Directly Responsible for Work shall:

1. Review proposed work activities to identify those involving TFL's.
2. Ensure that this review and authorization process has been completed and any needed safeguards are in place before the introduction of the TFL.
3. Provide the equipment and arrange for the fire watch coverage (through the LaRC Fire Chief) when controls are specified requiring supplemental fire protection or fire watch coverage.
4. Inspect the TFL each workday to ensure that it is properly controlled.
5. Before weekends, holidays, or other nonwork periods, the supervisor shall ensure that the material is properly stored.

7.9 HOUSEKEEPING PRACTICES TO MINIMIZE FIRE LOSS

7.9.1 PURPOSE

This section establishes good housekeeping practices to minimize the risk of life and property losses from fire.

7.9.2 SCOPE

This section shall apply to all LaRC personnel, subcontractors, and visitors.

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7.9.3 REQUIREMENTS

7.9.3.1 General

Housekeeping comprises the basic aspects of facility care and maintenance, cleanliness and order, and control of operating supplies and wastes.

The housekeeping program shall include, but is not limited to the following:

1. Control of operating supplies and wastes.
2. Use and storage of flammable and combustible materials.
3. Control of daily working supplies of flammable and combustible materials in the workplace.
4. Daily removal of waste and packaging materials.
5. Daily inspection of assigned areas to detect and correct problems.

Storage and use of hazardous chemicals shall be in accordance with Section 8.16 of this document.

Each facility shall be inspected to ensure general housekeeping practices are met. These practices shall include the following.

7.9.3.2 Storage and Removal of Rubbish (Trash)

Approved trash receptacles/containers shall be provided for rubbish.

Trash containers shall have either self-closing lids or are of the self-extinguishing type (flame arrestor).

Trash carts shall have the doors closed when not in use. The carts shall be emptied into dumpsters before overflowing or before the end of the work shift.

Trash carts shall be staged in the areas approved and designated for these receptacles.

Combustible wastes shall not be allowed to accumulate in the work bays, in cells, or outside of waste receptacles.

Specific guidelines on the handling, storage, and disposal of Environmental Protection Agency (EPA) and Resource Conservation and Recovery Act (RCRA) regulated waste must be followed.

7.9.3.3 Maintaining Areas Around Fire Protection Equipment Free of Stored Materials or Equipment

Exits and exit accesses shall be clear and unobstructed.

Fire doors shall be kept clear of obstructions to ensure operation.

Access to portable fire extinguishers, sprinkler system control valves, and manual actuation devices shall be clear and unobstructed.

Sprinkler heads shall not be obstructed by equipment or stored materials. A minimum vertical clearance of 18 inches shall be maintained between sprinkler heads and equipment or storage.

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Fire hydrants shall be accessible at all times. The area around hydrants shall be kept free of weeds and other obstructions.

Fire alarm control panels shall be clear and unobstructed at all times.

7.9.3.4 Prevention of Excessive Combustible Loading

Combustible materials shall be controlled in accordance with Section 7.8 of this document.

Dust and oil mops shall be stored to ensure adequate ventilation in order to prevent spontaneous ignition.

Areas between facilities shall be maintained so they are clear of combustible materials, such as stored lumber, rubbish, or weeds.

7.9.3.5 Maintaining Electrical Equipment in Good Condition

Electrical wall plates and junction and outlet box covers shall be in place and tight.

Breaker box covers shall be in place, and there is no exposed wiring in the breaker box.

Equipment shall be grounded.

Equipment shall be permanently wired where practical.

Extension cords shall be listed by a recognized testing laboratory.

Extension cords shall be in good condition, not abraded or worn.

Motors and equipment shall be clean and free of excess lubricants and dust.

Lights shall have protective covers in place.

7.9.3.6 Maintaining Smoking Areas in Acceptable Order

An acceptable number of receptacles shall be provided.

Ash trays shall not be dumped into waste paper or trash receptacles:

Ash trays shall be emptied into a separate metal container daily.

The metal container shall not be used to dispose of smoking materials into waste paper or trash receptacles.

7.9.4 RESPONSIBILITIES

Facility Coordinator and/or Facility Safety Head shall:

1. Enforce an effective housekeeping program within areas of his or her responsibility.
2. Ensure that unsafe conditions are corrected immediately.

Fire Inspector shall:

1. Observe housekeeping conditions of facilities during routine inspections (weekly, monthly or quarterly, based on facility contents, fire potential, and impact on LaRC mission).

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2. Report unsafe conditions to the Facility Coordinator and/or Facility Safety Head.

LaRC Fire Chief shall:

1. Observe housekeeping conditions of facilities during routine inspections (weekly, monthly or quarterly, based on facility contents, fire potential, and impact on LaRC mission).
2. Report unsafe conditions to the Facility Coordinator and/or Facility Safety Head.
3. Close facility or area if unsafe conditions cannot be immediately corrected.
4. Conduct facility assessments.

7.10 FIRE NOTIFICATION/FACILITY EVACUATION

7.10.1 PURPOSE

This section establishes the requirements for notifying the LaRC Fire Department of fires and provides personnel with the minimum information necessary to evacuate a facility in fire situations at LaRC.

7.10.2 SCOPE

This section shall apply to all LaRC employees, subcontractors, and visitors.

7.10.3 REQUIREMENTS

Any person observing a fire or explosion shall promptly evacuate the affected area or facility as quickly as possible, and if possible, activating a manual fire alarm pull station on the way outside should the fire alarm not already be sounding.

During evacuations, all work in the affected area cease, except those activities directly relating to the evacuation effort. All personnel, except those assigned to operations where evacuation present a more serious hazard than sheltering in place, shall immediately leave the area. The person(s) to remain shall be determined by the Facility Coordinator and/or Facility Safety Head.

All personnel shall proceed to the safest and most convenient mustering station assigned for that facility and shall stand by for further instructions.

Once at your mustering point and safe, someone in your group should promply call 911 to relay the following type of information:

1. Exact location of fire or explosion.
2. Type of fire or explosion (e.g., material involved).
3. Whether explosives or highly flammable substances are present and, if so, the identity of the substances.
4. Progress of fire and how long it has been burning.
5. Name of individual reporting fire or explosion.
6. Any other pertinent information requested by the dispatcher.
    - Phone number

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- Personnel requiring assistance

In the event of a fire or explosion in a structure protected by an automatic fire protection system (automatic sprinkler or deluge system, or automatic detection system), the facility alarm shall activate, and the location is automatically transmitted to the LaRC EDO upon activation of the system. If the structure is occupied or an individual observes a fire or explosion in the structure, all personnel must evacuate the facility in accordance with this section.

Any supervisor present shall make a roster of all personnel at that mustering station. The supervisor who executes the mustering station roster shall forward it to the responding fire departments.

All fire alarms and fire drills shall coordinate with the Facility Coordinator and/or Facility Safety Head. A person shall be designated to monitor the area(s) when time does not permit for classified material to be placed in secure repositories (this applies only to fire drills).

Fire drills shall be held at least annually in all facilities. Fire drills shall be conducted on a random basis by the LaRC Fire Department station officer. A drill report shall be completed by the LaRC Fire Department station officer for each drill conducted. The following information is required to complete the drill report:

1. Date of drill.
2. Facility number.
3. Time of alarm.
4. Type of alarm.
5. Number and type of emergency vehicles that responded.
6. Arrival time of LaRC Fire Department vehicles.
7. Time facility check was completed.
8. Time "All Clear" was given.
9. Any other pertinent information relative to the drill.

The buddy system shall be used to assist physically challenged personnel in evacuating the facility/area during evacuations, both actual and drill. A person of adequate strength shall be assigned to each physically challenged employee to assist in evacuation. Responding emergency forces shall be notified if physically challenged personnel require assistance with evacuation.

7.10.4 RESPONSIBILITIES

LaRC Employees, Subcontractors, and Visitors shall:

1. Notify the LaRC emergency fire dispatcher of any observed fire or explosion by dialing 911 from any LaRC onsite telephone.

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2. Know evacuation routes and mustering stations for facilities where normally assigned.
3. Contact Facility Coordinator or Facility Safety Head for evacuation routes and mustering stations when working in areas different than normally assigned location.

LaRC Fire Chief shall:

1. Ensure that a continually staffed EDO is provided to receive incoming telephone, radio, or coded messages relative to fire or explosion reports.
2. Ensure quick responses to all fires or explosions at LaRC.
3. Ensure familiarity with facility layouts by conducting preplans.

Fire Department Station Officer shall:

1. Schedule and conduct fire drills.
2. Complete drill report after fire drill has been conducted.
3. Assess and approve, through coordination with LaRC Fire Chief, all mustering station/assembly point locations.

Facility Coordinator and/or Facility Safety Head shall:

1. Know the evacuation routes and all mustering stations for his or her work areas.
2. Inform employees of the following:
   - Location of emergency exits.
   - Evacuation routes and procedures.
   - Evacuation alarm signals.
   - Locations of mustering stations.
3. Ensure that all personnel have evacuated the affected area.
4. Direct LaRC Fire Department personnel to the location of the fire and convey the nature of the fire (from outside of the facility).

Area Supervisors shall ensure each machine operator shuts off any machine which is being operated, unless shutting off the machine creates a greater danger than running it unattended.

Equipment and Transportation Operators shall:

1. Cease operations in affected areas and close doors to areas and freight cars or trucks.
2. Restrict any unauthorized traffic into the area.
3. Ensure that trucks, loaded and empty, proceed to safe location outside of area.

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7.11 EMPLOYEE FIRE PROTECTION TRAINING

7.11.1 PURPOSE

This section establishes the required information, relative to the LaRC fire protection program, to be included in General Employee Training.

7.11.2 SCOPE

This section shall apply to all new hire employees required to receive General Employee Training at LaRC.

7.11.3 REQUIREMENTS

Each employee shall receive reinforcement of the following topics: (New employee video)

1. LaRC evacuation procedures.
2. LaRC smoking policies.
3. Notification and reporting of fires at LaRC.
4. Emergency telephone numbers for reporting fires and medical emergencies at LaRC.

Each employee shall receive fire extinguisher education including the discussion of the following topics: (Only if training is requested)

1. Four types of fire extinguishers available at LaRC.
2. Four classes of fires.
3. Proper procedures if employee discovers a fire at LaRC.
4. How to use a portable fire extinguisher.

7.11.4 RESPONSIBILITIES

LaRC Fire Chief shall:

1. Develop training material relative to fire protection for General Employee Training.
2. Review and revise training material as necessary.
3. Ensure that training sessions relative to fire protection are conducted during scheduled employee training course.
4. Obtain necessary audiovisual aids and printed material to be used by the trainer.

7.12 FIRE PROTECTION IN FACILITY OPERATING PROCEDURES

7.12.1 PURPOSE

This section ensures that fire protection standards and the accompanying guides are incorporated into LaRC facility operating procedures.

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7.12.2 SCOPE

This section shall apply to all facility operating procedures which are developed for use at LaRC.

7.12.3 REQUIREMENTS

The fire protection standards are compulsory. In some instances, the fire protection standard will refer to another code or standard. In those instances where a fire protection standard refers to another code or standard, this reference shall be deemed compulsory.

New or revised operating procedures must include the applicable requirements of these fire protection standards.

New and revised operating procedures which affect fire protection program issues must be reviewed by the LaRC Fire Chief.

7.12.4 RESPONSIBILITIES

SMAO Manager ensures that new operating procedures incorporate fire protection criteria.

Operating Procedure Author shall review the fire protection standards and incorporates the applicable requirements in new operations procedures and contact the LaRC Fire Chief if new procedures affect the fire protection program.

LaRC Fire Chief shall assist procedure developer, as requested, in determining if new procedure will affect the fire protection program and review and approve procedures affecting fire protection aspects.

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CHAPTER 8

8. FIRE HAZARD PROTECTION

8.1 ELECTRICAL INSTALLATION IN HAZARDOUS LOCATIONS

8.1.1 PURPOSE

This section establishes the requirements controlling the installation and use of explosion proof electrical systems and equipment at LaRC.

8.1.2 SCOPE

This section shall apply to the design, operation requirements, and responsibilities for explosion proof electrical installations.

8.1.3 REQUIREMENTS

NFPA 70, Articles 500 through 504 cover the requirements for electrical equipment and wiring for all voltages in locations where fire or explosion hazards may exist due to flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers or flyings.

Locations shall be classified depending on the properties of the flammable vapors, liquids or gases, or the combustible dusts or fibers that may be present and on the likelihood that a flammable or combustible concentration or quantity is present. Each room, section, or area shall be considered individually in determining its classification.

Explosion proof electrical equipment of the proper classification shall be provided in locations where flammable vapors, liquids, gases, or combustible dusts or fibers may be present in concentrations sufficient to produce explosive or ignitable mixtures.

All explosion proof electrical equipment used shall be UL listed or FM approved for use in the appropriate hazardous atmosphere.

No alterations or modifications shall be made to listed or approved equipment for hazardous locations. If modifications are made, the equipment shall be void for use in a classified hazardous location.

8.1.4 RESPONSIBILITIES

Facility Coordinator and/or Facility Safety Head shall:

1. Ensure that practices delineated in this section are followed.
2. Contact the LaRC Fire Chief prior to installation of new electrical systems and equipment or modification of existing electrical systems and equipment.

LaRC Fire Chief shall evaluate locations requested for the installation of electrical systems and equipment and modifications to existing electrical systems and equipment.

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8.2 FLAMMABLE AND COMBUSTIBLE LIQUIDS

8.2.1 PURPOSE

This section establishes the requirements for the safe use, storage, and handling of flammable and combustible liquids at LaRC.

8.2.2 SCOPE

This section shall apply to the use, storage, and handling of flammable and combustible liquids at LaRC.

8.2.3 REQUIREMENTS

8.2.3.1 General

Users of flammable/combustible liquids shall be familiar with the hazard classification for the purpose of complying with this section and NFPA 30.

All flammable and combustible liquid handling equipment and storage areas shall be labeled in accordance with Section 7.7 of this document.

8.2.3.2 Storage

Flammable or combustible liquids shall be stored in designated locations which have been approved by the LaRC Fire Chief or designee. All flammable storage cabinet locations shall be approved by the LaRC Fire Chief.

Flammable/combustible liquids storage shall provide for segregation and/or separation from incompatible materials.

The storage of flammable and combustible liquid shall not obstruct corridors, aisles, or exit doors; and flammable/combustible liquids are not stored in exit enclosures (e.g., stairwells).

Flammable liquids shall be stored in UL listed or FM approved flammable liquids storage cabinets and safety cans. Exception: Oil-based paints, varnish, shellac, and similar substances may be stored in their approved shipping containers in designated storage locations and may be used from these containers:

1. When flammable liquid storage cabinets shall be used, not more than 120 gallons of Class I, II, and IIIA liquids are stored in the cabinet. Of this total, not more than 60 gallons shall contain Class I and II liquids.
2. When flammable liquid storage cabinets are used, not more than three cabinets shall be stored in a single fire area. In industrial facilities, additional cabinets (limited to groups of three) may be stored in the same fire area, provided the groups of cabinets are separated by 100 feet. When flammable liquid storage cabinets are used, the vent openings shall be sealed with fitted metal bungs. When the cabinets are required to be vented, they shall be vented to the outside.

When storage quantities exceed amounts outlined above, the liquids shall be stored in rooms or facilities complying with NFPA 30 and 29 CFR 1910.106.

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Flammable liquids shall be in closed containers at all times when not in actual use. Containers and drums which have contained flammable liquids shall have covers, caps, or bungs replaced immediately after emptying. Bungs shall be replaced with pressure and vacuum relief vents once the sealed drum is opened. Safety cans shall have self-closing caps and flame arrestor screens. A dip tank or other similar open vessel used to hold flammable liquids shall be provided with a hinged metal cover arranged with fusible links to close automatically in case of a fire. Portable containers for storage of flammable liquids shall not exceed 5 gallons.

In operating facilities, not more than a 1-day supply of flammable/ combustible liquid shall be stored in a single fire area outside of an approved flammable liquid storage cabinet.

8.2.3.3 Transferring, and Dispensing Flammable and Combustible Liquids

Air pressure shall not be used on a drum, portable tank, or small container for transferring flammable and combustible liquids. Hand-operated rotary pumps or metal faucets shall be used.

Liquids shall be transferred to or from safety cans by means of a hand pump drawing through the top, or by gravity through an approved self-closing valve.

When dispensing or transferring flammable/combustible liquids, containers shall be bonded together and grounded to eliminate buildup of static electricity. When transferring liquids between conductive containers, the containers shall be bonded with a wire. The bonding wire or one of the containers shall be grounded.

During transfer of bulk quantities of flammable/combustible liquids, the transport tractor shall not be uncoupled from the tanker without approval of the LaRC Fire Chief.

When dispensing from drums, the drums shall be equipped with UL listed or FM approved dispensing devices.

When transferring Class I liquids in laboratories from containers of less than 5-gallon capacity, the transfer shall be made by either; inside a laboratory hood or in an area provided with ventilation to prevent the accumulation of a flammable vapor/air mixture exceeding 10 percent of the lower flammable limit.

When transferring Class I liquids in laboratories from containers of 5-gallon capacity or more, the transfer shall be made either from a separate area outside the facility or in a separate, inside storage room that complies with the requirements of NFPA 30 and 29 CFR 1910.106.

Mechanical ventilation shall be provided, which meets the following criteria, when transferring Class I liquids in nonlaboratory areas:

1. The ventilation flow rate shall be 1 cubic foot per minute per square foot of floor area, but in no case less than 150 cubic feet per minute.
2. The intake and exhaust points shall be within 12 inches of the floor and are positioned at opposite sides or ends of the room.
3. A flow monitor or equivalent mechanism shall be provided so an audible alarm will sound if the ventilation system fails.

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8.2.3.4 Using or Transporting Flammable or Combustible Liquids

A UL listed or FM approved safety can shall be required when flammable or combustible liquids are used or transported in LaRC. The use of 1-gallon glass or plastic containers for storage of flammable liquids shall be authorized by the LaRC Fire Chief or designee if the liquid either would be rendered unfit for its intended use by contact with metal or would excessively corrode a metal container and cause leakage. A small approved plastic container shall be used to limit the quantity of flammable liquids taken into an area. Class IA and IB liquids shall be stored in glass containers of not more than 1 gallon, if required for liquid purity or to avoid excessive corrosion of metal containers.

Each area where flammable or combustible liquids shall be stored or dispensed is marked with DANGER signs stating “NO SMOKING OR OPEN FLAMES.”

Combustible waste and residue shall be stored in closed, metal containers for daily disposal.

8.2.4 RESPONSIBILITIES

Facility Coordinator and/or Facility Safety Head shall:

1. Ensure that practices delineated in this section are followed.
2. Contact the LaRC Fire Chief prior to establishing new flammable and combustible liquids storage areas or modifying existing flammable and combustible liquids storage areas.

LaRC Fire Chief shall evaluate locations requested to be used as a flammable and combustible liquid storage areas and modifications to flammable and combustible liquids storage areas.

8.3 SAFE STORAGE AND USE OF FLAMMABLE GASES

8.3.1 PURPOSE

This section establishes the requirements for the use, storage, and handling of compressed gases at LaRC.

8.3.2 SCOPE

This section shall apply to the storage, transportation, identification, and use of compressed gases at LaRC.

8.3.3 REQUIREMENTS

8.3.3.1 Storage

Compressed gas cylinders in transit or storage shall be provided with protective valve caps and are secured in an upright position.

All storage areas shall be clearly identified. The storage of compressed gas cylinders within facilities shall be limited to the quantity required for daily operations unless additional quantities are permitted by the applicable National Fire Protection Association

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(NFPA) standard. The storage of compressed gas cylinders outside of facilities shall be in accordance with the applicable NFPA standard.

Flammable and oxidizing compressed gas cylinders shall be separated by 20 feet or a 5-foot high, 30-minute fire rated wall. Where gases of different types are stored at the same location, cylinders shall be grouped by types of gas.

Empty and full gas cylinders shall be segregated, and empty cylinders tagged “EMPTY.”

“NO SMOKING” signs shall be posted around the storage rooms.

8.3.3.2 Operation

Compressed gas cylinders shall not be exposed to temperatures above 125°F and are protected from direct sun and weather elements.

Compressed gas cylinders shall be identified according to their contents, free of defects, and within their hydrostatic test dates. All gas cylinders shall be hydrostatically tested and marked to meet Department of Transportation (DOT) requirements.

Gases shall not be mixed or transferred from one compressed gas cylinder to another. Cylinders are refilled only by trained personnel.

Cylinders shall not be lifted by magnetic devices or by their protective caps. They shall be secured to a cradle or platform and must never be dragged, dropped, or struck.

Compressed gas cylinders shall not come in contact with electrical circuits, open flames, or arcs.

Compressed gas cylinders shall not be used for any purpose other than compressed gas containment.

Gas from compressed gas cylinders shall not be used without approved reducing regulators.

Connecting devices shall be free of oil, grease, and dirt and have threads corresponding to the cylinder valving.

Valves shall be closed when cylinders are transported, moved at sites, and connected for use.

All devices used on compressed gas cylinders shall comply with the American National Standards Institute (ANSI) and Compressed Gas Association Standards C-4 and V-1.

All compressed gas manifolds shall be designed in accordance with the applicable NFPA standards.

8.3.4 RESPONSIBILITIES

Facility Coordinator and/or Facility Safety Head shall:

1. Ensure that practices delineated in this section are followed.
2. Contact the LaRC Fire Chief prior to establishing new compressed gas storage areas or modifying existing compressed gas storage areas.

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LaRC Fire Chief shall evaluate locations requested to be used as compressed gas storage areas and modifications to compressed gas storage areas.

8.4 FIRE PROTECTION FOR PORTABLE STRUCTURES

8.4.1 PURPOSE

This section establishes the requirements for the installation and use of portable structures at LaRC.

8.4.2 SCOPE

This section shall apply to all purchased, leased, or locally constructed portable structures at LaRC. (The requirements in this section apply to new portable structures, or existing portable structures where the use has been changed. This does not apply to existing portable structures already in place and where the use remains unchanged).

8.4.3 REQUIREMENTS

8.4.3.1 Construction

A graded fire hazard analysis (FHA), meeting the requirements of Section 9.2 of this document, shall be performed for all portable structures where any one of the following conditions exist:

1. Creates a life safety hazard.
2. Contains a daycare or classroom.
3. Endangers the public or environment.
4. Replacement value (structure and contents) exceeds $1 million.
5. Is vital to a NASA program.

All trailers and mobile home units shall meet the appropriate construction, mechanical system, and electrical system installation requirements of ANSI A119.1 and 24 CFR 280. Trailer/mobile home complexes that exceed 3000 square feet (278.71 square meters) shall meet all requirements for permanent structures listed in this document and local codes. Requirements for smaller complexes shall be determined by the authority having jurisdiction (AHJ).

All portable structures shall meet the minimum requirements as specified in the BOCA National Building Code. All portable structures used to support construction/ demolition operations shall be in accordance with NFPA 241 and 29 CFR 1926. The use of portable structures for housing electronic computer and data processing systems shall meet the requirements of Section 8.10 of this document.

Trailers and mobile home units arranged for occupancy shall comply with the interior finish, concealed space and exit requirements of NFPA 101.

Trailers and mobile home units shall be located in accordance with NFPA 80A but in no case less than 25 feet (7.62 meters) from permanent facilities and 25 feet (7.62 meters) apart.

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A complete fire detection and evacuation alarm system shall be provided.

Complete automatic sprinkler protection designed in accordance with the applicable NFPA standards shall be provided for portable structures as follows:

1. In all new structures over 5000 square feet.
2. In all structures having a maximum possible fire loss (MPFL) in excess of $1 million.
3. In all structures where the MPFL will affect a vital program for a period longer that that specified as acceptable by the LaRC Director.
4. In all structures where the quantities of hazardous materials used or stored exceed the limits delineated in the local fire code.
5. In all structures used for sleeping quarters, including daycare centers. (For such structures, “quick response” sprinklers should be utilized.) An exception is that limited supply suppression systems may be used where a reliable water supply is not available or where the application of water would increase the overall hazard in the event of a fire.

8.4.3.2 Anchors and Supports

Each portable structure shall have support and anchoring systems that will resist overturning and lateral movement of the unit. Support and anchoring equipment shall be in accordance with the manufacturer’s specifications.

Deviations from approved stabilization plans shall be designed by a registered structural engineer. Such designs shall carry the seal and signature of the registered engineer.

8.4.3.3 Identification

Portable structures shall be identified by a unique, alphanumeric marking on each side of the unit (e.g., B-1299 T-7).

The identification marking shall consist of a painted, 11-inch x 17-inch orange square, bordered by a 1-inch black border; and the identification marking in black characters, 1/2 inch or wider and at least 4 inches high within the orange square.

All other numerical identification shall be removed from the structure.

8.4.3.4 Skirting

Each portable structure shall have the area under the floor enclosed to prevent the accumulation of windblown debris and to prevent the space from being used for storage. Semi trailers used exclusively for storage shall also require skirting.

The skirting shall be of noncombustible material and without openings. The only exceptions shall be service access doors and screened louvers installed for ventilation.

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8.4.3.5 Pedestrian and Handicapped Access

All walkways shall be constructed of weather resistant materials except for those walkways used for temporary construction trailers. These may be constructed of weather resistant lumber with a permanent nonskid surface.

There shall be means of egress from a portable structure discharges into a roadway or traffic flow area.

Stairs with platforms and handrails shall be provided for each exterior door.

Ramps or wheelchair lifts shall be provided for portable structures that are to be used by the physically handicapped.

Note: Facilities provided for the physically handicapped shall be in accordance with the Americans with Disabilities Act (ADA).

Stairs, platforms, ramps, and handrails shall be arranged to resist movement.

Stairs, ramps, and platforms shall be constructed of steel, concrete, fiberglass, or other weather resistant materials. All stairs shall comply with 29 CFR 1910 and NFPA 101.

Stairs, ramps, platforms, and walkways shall have a permanent nonskid walking surface.

8.4.3.6 Electrical

All electrical conductors and equipment shall be in accordance with the latest edition of NFPA 70, National Electric Code (NEC). NEC Article 305 (Temporary Wiring) shall not apply to any wiring for trailers. NEC Article 215 shall apply to all feeder circuits installed on-site. Article 305-4(b) shall not apply.

All electrical conductors shall be copper.

All electrical circuits shall have a separate grounding wire. The use of trailer frame or other metal parts is not a permitted method of grounding. All conductive parts of the portable structure, including frame and siding skirting shall be bonded (grounded) to the main circuit breaker box.

Any wiring presently being installed or installed after the portable structure has been delivered shall be in steel conduit and surface mounted. Conduit shall not be used as the grounding path (separate grounding wire is required).

All installed breakers shall be permanently identified for their use.

Main service disconnects shall be located on the outside of the portable structure and clearly identified.

8.4.3.7 Heating and Cooling Systems

Installed heating and cooling equipment shall be listed or labeled and shall be installed in accordance with its listed design and appropriate standards.

Air duct and plenum materials shall be UL Class I or better.

Only electric or steam units shall be installed.

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8.4.3.8 Exits

All normally occupied portable structures shall have a minimum of two exits remote from each other.

Note: Other egress arrangements shall be permitted as specified by NFPA 101, Life Safety Code.

The minimum width of any main egress corridor serving multiple exit passageways shall be 44 inches.

The minimum width of any aisle serving to gain access to a corridor or exit passageway shall be 36 inches in the clear.

Note: The LaRC Fire Chief shall be permitted to approve aisles serving a single occupant that are 28 inches in clear width.

Passageways, aisles and corridors, serving as access to a required exit shall not be used for any purpose that could interfere with their intended use, including storage of boxes, file cabinets, desks, or trash containers.

No door opening in the means of egress shall be less than 32 inches in clear width.

Doors shall be arranged to be readily opened from the egress side whenever the structure is occupied.

Exits shall be marked by an approved sign readily visible from any direction of exit access.

Note: An exception shall be the main exterior doors that are obviously and clearly identified as exits.

Every required exit sign shall be suitably illuminated by a reliable light source.

8.4.3.9 Emergency lighting

All portable structures having an occupancy of 50 persons or more or a total footage of 10,000 square feet shall be provided with emergency lighting.

8.4.3.10 Vehicle Access

Vehicle access shall be provided in accordance with Section 7.2 of this document.

8.4.3.11 Location of Portable Structures Inside Other Structures

Unprotected portable structures shall not be permitted inside permanent facilities where the combined potential loss exceeds $500,000.

Portable structures that have complete sprinkler systems shall be permitted inside permanent structures but are limited to 1000 square feet in floor area per unit. Automatic sprinklers shall be positioned over and under the unit when materials that will burn or support combustion are present.

A minimum of 10 feet of clear space, free of combustibles, shall be maintained around each unit.

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The location of portable structures shall not hinder safe movement of personnel in the permanent facility nor violate the requirements of NFPA 101, Life Safety Code.

8.4.3.12 Operation

Flammable and/or combustible liquids shall be kept to an absolute minimum and shall be stored in and dispensed from UL listed or FM approved safety cans. Flammable or combustible liquid-soaked clothes, rags, or waste shall be stored in UL listed or FM approved safety containers.

Combustible materials which are used in the portable structure must NOT be allowed to accumulate. All combustible waste must be removed from the portable structure after each work shift.

The required minimum clear width of exits, aisles, and passageways to a public way shall be maintained at all times as specified in NFPA 101 and 29 CFR 1926.

Cutting, welding, open flame, or grinding shall not be performed in portable structures without an approved permit in accordance with Section 7.3 of this document.

Access for use of heavy fire fighting equipment shall be provided to the portable structure at the start of the project and is maintained until completion.

8.4.4 RESPONSIBILITIES

Facility Coordinator and/or Facility Safety Head shall:

1. Ensure that practices delineated in this section are followed.
2. Contact the LaRC Fire Chief prior to constructing or placing new portable structures.

LaRC Fire Chief shall evaluate locations requested to be used for a portable structure.

8.5 FIRE PROTECTION FOR STORAGE FACILITIES AND AREAS

8.5.1 PURPOSE

This section establishes the requirements for controlling the construction and use of storage facilities at LaRC.

8.5.2 SCOPE

This section shall apply to all general storage facilities at LaRC. (This section does not apply to current storage facilities unless the use has changed or the hazard in increased from its original approved usage).

8.5.3 REQUIREMENTS

8.5.3.1 Construction

Storage facilities shall be constructed in accordance with the applicable sections of the BOCA National Building Code and NFPA 101.

Storage facilities storing vital and important equipment or supplies shall be located in noncombustible facilities protected with automatic sprinklers. Sprinkler systems

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installed in facilities used for solid pile, bin box, shelf, or palletized storage which is less than 12 feet in height shall be in accordance with NFPA 13. Sprinkler systems installed in facilities used for solid pile, bin box, shelf, or palletized storage which is greater than 12 feet in height shall be in accordance with NFPA 231, NFPA 231C, and the applicable sections of NFPA 13.

8.5.3.2 Operation

Appropriate fire extinguishers shall be provided for storage facilities.

Good housekeeping, orderliness, and maintenance of equipment shall be provided for storage facilities.

Storage facilities shall be posted as “No Smoking” areas.

Storage facilities shall not be used as working spaces, except as approved by the LaRC Fire Chief.

Combustible materials which are used in the storage facility operations (e.g., files, films, paper products) shall be removed from the storage facilities immediately after use or stored in approved metal containers with lids. All combustible waste shall be removed from the records storage facility after each work shift.

The required minimum clear width of exits, aisles, and passageways to a public way shall be maintained at all times as specified in NFPA 101.

Cutting, welding, open flame, or grinding shall not be performed in storage facilities without an approved permit in accordance with Section 7.3 of this document.

8.5.3.3 Yard/Outdoor Storage

Yard/Outdoor storage shall only be permitted in designated locations. The LaRC Fire Chief shall be notified prior to the establishment of new yard/outdoor storage locations in order to evaluate the site for determination of adequate protection and potential impact on the emergency evacuation of adjacent facilities / fire department access. The following requirements generally apply only to situations involving combustible storage. Where requirements apply to both combustible and noncombustible storage, a requirement will be immediately followed by an asterisk (*).

Materials shall be stored in piles as low in height and small in area as practical for material stored. The pile size shall be based on the following:

1. Stability of pile
2. Effective reach of fire fighting hose streams
3. Combustibility of material
4. Ease of pile breakdown under fire or salvage conditions

Clear aisles shall be maintained between the following*:

1. Individual piles.
2. Piles and buildings.
3. Piles and boundary of yard/outdoor storage site.

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All aisle widths shall be twice the pile height.

Yard/Outdoor storage locations shall be kept clear of rubbish (e.g., broken pallets, scrap paper, packing materials), vegetation, and any other unnecessary combustible materials*.

Cutting, welding, or other operations involving the use of flame-, heat-, or spark-producing tools shall not be performed within 50 feet of any yard/outdoor storage area.

Portable heating devices shall not be used or located within yard/outdoor storage areas.

Smoking shall not be permitted in yard/outdoor storage areas.

Tarpaulins or other covers used to protect the stored materials from the weather shall be of fire retardant material.

Means of expediently notifying the LaRC Fire Department in case of fire shall be provided at all yard/outdoor storage locations.

Portable fire extinguishers shall be provided at conspicuous, accessible locations throughout all yard/outdoor storage.

Access to fire hydrants must not be obstructed*.

Yard storage areas shall be inspected to ensure that storage practices comply with the requirements of this section*.

8.5.4 RESPONSIBILITIES

Facility Coordinator and/or Facility Safety Head shall:

1. Ensure that practices delineated in this section are followed.
2. Contact the LaRC Fire Chief prior to establishing new storage facilities*.

LaRC Fire Chief shall evaluate locations requested to be used as a storage facility*.

8.6 FIRE PROTECTION FOR COMBUSTIBLE SOLIDS, METALS, AND DUSTS

8.6.1 PURPOSE

This section establishes the requirements for the use, storage, and handling of combustible solids, metals, and dusts at LaRC.

8.6.2 SCOPE

This section shall apply to the design, operation requirements, and personnel responsibilities in locations where combustible solids, metals, and dusts are stored, processed, or handled.

8.6.3 REQUIREMENTS

8.6.3.1 Design

Facilities handling or storing combustible solids, metals, and dusts shall be in accordance with the local building code and applicable National Fire Protection Association (NFPA) standards.

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Whenever inert gas environment systems are used, a reserve supply of gas shall be available for emergency use.

8.6.3.2 Operation

The appropriate extinguishing agents shall be used where pyrophoric materials and combustible solids, metals, and dusts are processed, stored, or handled. Most pyrophoric materials react violently with water, foam agents, halogenated agents, and carbon dioxide gas. Some combustible metals cannot be extinguished with water and require special extinguishing powders (for Class D fires) or special inerting gases.

Processes involving pyrophoric materials shall be performed in an enclosed, oxygen free, oxygen deficient, or inerting atmosphere that is moisture-controlled (dry).

Ordinary combustible materials, such as paper, wood, cartons, and packing material, shall not be stored or allowed to accumulate near processes where pyrophoric materials and combustible solids, metals, and dusts are handled.

Smoking and uncontrolled use of open flames shall be prohibited where combustible solids, metals, and dusts are processed, stored or handled. Areas shall be clearly posted with “NO SMOKING” signs.

Nonsparking tools shall be used when handling combustible metal dusts.

8.6.3.3 Pyrophoric Materials

Plans for a designated pyrophoric materials storage area shall be forwarded to the LaRC Fire Chief for approval.

Class D portable fire extinguishers shall be provided and located so that the travel distance to an extinguisher does not exceed 75 feet.

Other combustible materials shall not be stored in the designated pyrophoric materials storage area. This designated storage area shall be separated from storage of Class A combustible materials by at least 30 feet or fire walls with a 2-hour rating shall be provided. Any opening in this wall shall be protected by listed, 1 -hour, automatically closing fire doors. The designated storage area shall be separated from combustible liquids storage by at least 50 feet or fire walls with a 4-hour rating shall be provided. Any opening in this wall shall be protected by listed, 3-hour, automatically closing fire doors on both sides of the opening. Appropriate secondary confinement must be provided to prevent any spilled liquids from entering the designated storage area. Noncombustible materials in noncombustible containers on metal pallets are permitted to be stored in the separation space.

Smoking and uncontrolled use of open flames shall be prohibited in the pyrophoric materials storage area.

8.6.4 RESPONSIBILITIES

Facility Coordinator and/or Facility Safety Head shall:

1. Ensure that practices delineated in this section are followed.

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2. Contact the LaRC Fire Chief prior to establishing new pyrophoric materials and combustible solids, metals, and dusts operations areas or modifying existing pyrophoric materials and combustible solids, metals, and dusts operations areas.

LaRC Fire Chief shall evaluate locations requested to be used as combustible solids, metals, and dusts operations areas and modifications to existing pyrophoric materials and combustible solids, metals, and dusts operations areas.

8.7 FIRE PROTECTION FOR CLEAN ROOMS

8.7.1 PURPOSE

This section establishes the requirements for the construction and use of clean room facilities at LaRC.

8.7.2 SCOPE

This section shall apply to all new clean room facilities, and those existing clean rooms that undergo significant renovation at LaRC.

8.7.3 REQUIREMENTS

8.7.3.1 Construction

NASA clean rooms shall be constructed and protected in accordance with the appropriate provisions of National Fire Protection Association (NFPA) 318 and FM Data Sheet 1-56.

Automatic fire suppression shall be provided throughout facilities containing clean rooms and clean zones. Sprinklers shall be installed throughout all clean rooms regardless of classification. Sprinkler temperature rating within the clean room shall be 130°F. Special consideration shall be given for installation of local application, gaseous suppression systems to protect special hazards.

Clean rooms shall be separated from adjacent occupancies by 1-hour fire resistant construction. Operations within facilities shall be arranged in separate zones according to their clean room classification and in a manner compatible with operating efficiency. The cutoff construction shall have a fire resistance commensurate with both the clean room and exposing area hazards and values. Clean rooms shall be located to minimize external exposure from fires and other hazards. Floors over clean rooms shall be made watertight. Fire retardant plastic panels prone to producing large quantities of smoke shall not be used in the construction of clean rooms. Noncombustible panels shall be used instead. Benches and hoods shall be of noncombustible construction or protected with automatic sprinklers.

High-efficiency particulate air (HEPA) filtration systems shall be in accordance with Section 8.15 of this document. Clean room ventilating ducts and equipment shall constructed of noncombustible materials.

A complete fire detection and evacuation alarm system shall be provided in facilities containing clean rooms and clean zones.

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8.7.3.2 Operation

Fire extinguishers shall be provided for clean room facilities in accordance with NFPA 10.

Good housekeeping, orderliness, and maintenance of equipment shall be provided for clean room facilities.

Clean room facilities shall be posted as “No Smoking” areas.

Combustible materials which are used in the clean room facility operations shall be removed from the clean room facilities immediately after use or shall be stored in approved metal containers with lids.

The required minimum clear width of exits, aisles, and passageways to a public way shall be maintained at all times as specified in NFPA 101.

8.7.4 RESPONSIBILITIES

Facility Coordinator and/or Facility Safety Head shall ensure that practices delineated in this section are followed.

LaRC Fire Chief shall evaluate clean rooms in accordance with this section.

Center Operations Directorate shall ensure that all new clean room facilities or modifications to existing facilities meet the requirements of this section.

8.8 FIRE PROTECTION FOR AIRCRAFT HANGARS

8.8.1 PURPOSE

This section establishes the requirements for the construction and use of aircraft hangar facilities at LaRC.

8.8.2 SCOPE

This section shall apply to all aircraft hangar facilities at LaRC.

8.8.3 REQUIREMENTS

8.8.3.1 General

NASA aircraft hangars shall be constructed and protected in accordance with the provisions of National Fire Protection Association (NFPA) 409 and FM Data Sheets 7-93 and 7-93N.

8.8.3.2 Protection Systems

New hangars shall be protected by one of the following methods:

1. Overhead, foam-water deluge systems, utilizing aqueous film forming foam (AFFF), and designed in accordance with NFPA 409.
2. Overhead foam-water wet pipe sprinkler systems and AFFF monitor nozzles.

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8.8.3.3 Construction

New aircraft hangars shall be of protected noncombustible construction with all principal supporting members protected by gypsum panels sufficient to achieve at least a 1-hour fire resistance rating.

In existing hangars, main structural elements need not be rendered fire resistant if the hangar is provided with a floor drainage system and is protected by a complete, automatic fire suppression system.

Aircraft ramps used for fueling operations shall be designed in accordance with NFPA 415.

8.8.3.4 Draft Curtains

Draft curtains shall be provided in accordance with the guidelines contained in NFPA 204M. The distance between curtains boards shall not exceed 100 feet.

8.8.3.5 Operation

Appropriate fire extinguishers shall be provided for aircraft hangar facilities.

Good housekeeping, orderliness, and maintenance of equipment shall be provided for aircraft hangar facilities.

Aircraft hangar facilities shall be posted as “No Smoking” areas.

Combustible materials which shall be used in the aircraft hangar facility operations shall be removed from the aircraft hangar facilities immediately after use or shall be stored in approved metal containers with lids.

The required minimum clear width of exits, aisles, and passageways to a public way shall be maintained at all times as specified in NFPA 101.

Aircraft fuel servicing operations shall be in accordance with NFPA 407.

Aircraft maintenance operations shall be in accordance with NFPA 410.

Cutting, welding, open flame, or grinding must not be performed in aircraft hangar facilities without an approved permit in accordance with Section 7.3 of this document.

8.8.4 RESPONSIBILITIES

Facility Coordinator and/or Facility Safety Head shall ensure that practices delineated in this section are followed.

LaRC Fire Chief shall evaluate aircraft hangars in accordance with this section.

Center Operations Directorate Director shall ensure that all new aircraft hangar facilities or modifications to existing facilities meet the requirements of this section.

8.9 FIRE PROTECTION FOR FLIGHT SIMULATORS

8.9.1 PURPOSE

This section establishes the requirements for the construction and use of flight simulator facilities at LaRC.

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8.9.2 SCOPE

This section shall apply to all new flight simulator facilities and existing flight simulator facilities undergoing significant renovation. Existing flight simulators not undergoing significant renovation shall comply with these requirements to the extent practicable.

8.9.3 REQUIREMENTS

8.9.3.1 Construction and Protection

NASA flight simulators shall be constructed and protected in accordance with the appropriate provisions of FM Data Sheet 7-3.

Facilities and rooms containing flight simulators as well as the training module shall be constructed of noncombustible materials.

The hydraulic fluid pump and reservoir shall be separated from other portions of the simulator facility by 1-hour fire resistant construction.

The training module for new simulators shall be protected by an approved automatic total-flooding fire extinguishing system to protect the cockpit, beneath the floor, behind the instrument panels, and inside the electronic switchgear and electronic data processing cabinets:

Actuation of the extinguishing system shall be done by ionization-type smoke detectors.

Electronic data processing equipment shall be in accordance with Section 8.10 of this document.

The hydraulic pump and storage facility shall be protected by automatic sprinklers over the hydraulic fluid pump room and storage facility.

The simulator system room and facility shall be protected with automatic sprinklers throughout all areas where there is combustible occupancy or construction or where hydraulic fluids are used.

Visual aid equipment shall require automatic sprinkler protection if the visual display is of combustible construction.

HEPA filtration systems shall be in accordance with Section 8.15 of this document.

A complete fire detection and evacuation alarm system shall be provided in facilities containing flight simulators. The signaling system shall be fully supervised and arranged to sound an alarm at a constantly attended location.

8.9.3.2 Operation

Appropriate fire extinguishers shall be provided for flight simulator facilities in accordance with NFPA 10.

Good housekeeping, orderliness, and maintenance of equipment shall be provided for flight simulator facilities.

Flight simulator facilities shall be posted as “No Smoking” areas.

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Combustible materials which are used in the flight simulator facility operations shall be removed from the flight simulator facilities immediately after use.

The required minimum clear width of exits, aisles, and passageways to a public way shall be maintained at all times as specified in NFPA 101.

8.9.4 RESPONSIBILITIES

Facility Coordinator and/or Facility Safety Head shall ensure that practices delineated in this section are followed.

LaRC Fire Chief shall evaluate flight simulators in accordance with this section.

Center Operations Directorate shall ensure that all new flight simulator facilities or modifications to existing facilities meet the requirements of this section.

8.10 FIRE PROTECTION FOR COMPUTER FACILITIES

8.10.1 PURPOSE

This section establishes the requirements for the installation and use of computer facilities at LaRC.

8.10.2 SCOPE

This section shall apply to computer facilities which meet one or more of the following conditions:

1. Designated as vital to the NASA mission.
2. Required for security.
3. Valued at $1 million or more.
4. Required for operations which could be performed by substitute methods but where the substitute methods would result in unacceptable delays or would involve significant additional expenditures of personnel, facilities, and equipment.

8.10.3 REQUIREMENTS

8.10.3.1 Construction

All new computer facilities shall meet the minimum constructions requirements and shall be provided with the appropriate fire protection features specified in National Fire Protection Association (NFPA) 75 and STD 8719.11, Section 703, except as modified herein.

8.10.3.2 Operation

Waste shall not be allowed to accumulate..

Computer facilities with raised floors shall be provided with floor lifters which are mounted near the room exit door. The area under the raised floor shall be inspected annually to assure that no combustibles have accumulated.

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Employees who normally work in computer facilities must be familiar with the fire protection systems in their work area.

The required minimum clear width of exits, aisles, and passageways to a public way must be maintained at all times specified in NFPA 101.

8.10.4 RESPONSIBILITIES

Facility Coordinator and/or Facility Safety Head shall ensure that practices delineated in this section are followed and must contact the LaRC Fire Chief prior to establishing new computer facilities or modifying existing computer facilities.

LaRC Fire Chief shall evaluate locations requested to be used as computer facilities and modifications to existing computer facilities.

8.11 FIRE PROTECTION FOR ANECHOIC CHAMBERS

8.11.1 PURPOSE

This section establishes the requirements for the construction and use of anechoic chamber facilities at LaRC.

8.11.2 SCOPE

This section shall apply to all new anechoic chamber facilities, and those undergoing significant renovation at LaRC. Existing anechoic chamber facilities shall comply with the requirements listed below to the extent practicable.

8.11.3 REQUIREMENTS

8.11.3.1 General

No single protection approach is appropriate for all anechoic chambers. Because of the range of chamber sizes, purposes, contents, sensitivities and locations, a specific protection goal has been established and the following requirements developed to meet the criteria of STD 8719.11.

Anechoic chambers shall be constructed and protected in accordance with the appropriate provisions of STD 8719.11 and FM Data Sheets 1-53, 1-53S.1, and 1-53S.2, except as amended herein.

8.11.3.2 Construction

Control rooms shall be separated from the chamber by partitions having a fire resistance rating of 1 hour.

Note: Higher fire resistance ratings may be required based on the fire hazards associated with the chamber.

Vision panels shall be no more than 9 square feet and are wired glass in steel frames.

Air conditioning systems or other chamber ducting shall be independent of main facility systems.

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All new anechoic chamber foam materials shall meet the fire retardant criteria specified by FM.

Existing chambers with non-Naval Research Laboratory (NRL) foam shall be converted to NRL foam wherever possible.

Areas such as control rooms, concealed ceiling spaces, subfloor areas, and below pedestals shall be protected if combustibles are present. Protection shall be consistent with the protection of the chamber.

Electrical equipment in the chamber shall be arranged as follows:

1. Power supplies shall be in conduit, and outlets shall have watertight-type covers installed so that the spring-loaded cover is on the top when the outlet is in use.
2. Control cables shall have abrasion resistant, nonflammable insulation and screw-on or bayonet twist lock connectors.

Standpipe connections shall be provided just outside the doors of the chamber so that all points within the chamber shall be within reach of the hose stream.

If anechoic chambers are located in stories above other water damageable occupancies, their floors shall be watertight and built with curbs to protect against any penetration at the walls.

Floor drainage shall be incorporated into the design of new chambers as follows:

1. The drain outlets shall be arranged to drain to safe locations where other property will not be exposed to water damage.
2. The drainage system shall be designed with sufficient capacity to safely dispose of the sprinkler and hose stream water discharge during a fire.

Anechoic chambers shall be protected by a complete automatic sprinkler system.

Exception: Existing chambers shall be protected by a carbon dioxide or other suitable and approved gaseous fire extinguishing system.

The use of RF shielding gaskets in sprinkler systems shall be limited to those types that pose no obstruction to the waterway. If any portion of the gasket must protrude into the pipe interior, the resulting friction loss should be established and taken into account in the hydraulic calculations.

The sprinkler system shall be designed in accordance with Table 8.1 and is controlled by a separate indicating-type control valve.

HEPA filtration systems shall be in accordance with Section 8.15 of this document.

A complete smoke detection system shall be provided in facilities containing anechoic chambers.

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Table 8.1, Sprinklers for Anechoic Chambers

	SMOOTH SURFACES		GEOMETRIC SHAPES (Pyramids)		
Protection	Up to 10 in. thick (250 mm)	Over 10 in. thick (250 mm)	Up to 6 in. thick (150 mm)	6 to 12 in. thick (300 mm)	Over 12 in. thick (300 mm)
Automatic Sprinklers: 100-ft^2 coverage, 10-ft max. spacing, 212ºF, standard sprinkler heads, 1/2-in. extra hazard piping, 0.30-gpm/ft^2 (12-l/min/m^2) average density (Note 2)	X		X		
Automatic Sprinklers: 50-ft^2 coverage, 8-ft max. spacing, 212ºF, standard sprinkler heads, 1/2-in. extra hazard piping, 0.60-gpm/ft^2 (25-l/min/m^2) average density (Note 2)		X		X (Note 3)	
Automatic Sprinklers: 40-ft^2 coverage, 7-ft max. spacing, 212ºF, standard sprinkler heads, 1/2-in. extra hazard piping, 0.60-gpm/ft^2 (25-l/min/m^2) average density (Note 2)					X (Note 3)
Side Wall Automatic Sprinklers (not over 7-ft spacing)	X (Note 4)	X (Note 4)	X (Notes 3,5)		
Side Wall Automatic Sprinklers (not over 5-ft spacing)				X (Notes 3, 5)	X (Notes 3, 5)

NOTES

1. Adapted from Factory Mutual Loss Prevention Data Sheets.
2. For chambers under 2000 ft^2 (186 m^2) of floor area, the average density is for all heads. For chambers over 2000 ft^2, average density is for 3/4 of the sprinklers.
3. Sprinklers are located 1/3 the length of the pyramid from its base.
4. Required for walls over 15 ft (5 m) high and installed at approximately 15-ft vertical intervals.
5. Intermediate row required for walls over 15 ft high.

8.11.3.3 General Safeguards

No open flame equipment shall be allowed. All equipment shall have covers in place.

All equipment with fans shall have shields and screens installed to ensure free flow of inlet and outlet air. No exposed electrical terminals of any kind shall be permitted on any equipment.

Commonly used metal halide lamps shall be acceptable, but all incandescent lights shall be vented to prevent heat buildup.

The power density of any equipment operated in the chamber shall not exceed 1 watt per square inch incident upon the liner material. Where higher power densities are needed, the foam shall be laboratory tested for resistance to smoldering, and appropriate operating conditions shall be established.

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Prior to use of any electrical equipment in the chamber (including flexible wiring or exposed power supply terminals), the difference between the chamber ground and equipment chassis shall not exceed 0.5 volt.

Wiring in the chamber shall be repaired only by qualified personnel.

Fire extinguishers type and capacity shall be provided near the chamber door.

No equipment shall be left operating in the chamber while the control room is unattended. At the close of business each day, all exterior doors to the chamber shall be closed, and the main power to the chamber shall be secured.

Flammable or combustible liquids shall not be permitted inside the chamber unless approved by the LaRC Fire Chief. Alcohol used for cleaning electrical contacts shall be replaced by Freon 113.

Welding equipment, smoking, or open flames shall not be allowed in the chamber. A sign placed near each entrance shall outline restrictions affecting fire safety.

High-intensity flood lamps shall be used only with the approval of the LaRC Fire Chief.

Fire protection equipment shall be inspected and maintained as recommended in Section 5.6 of this document. Particular attention shall be given to the following:

1. The system activating devices shall be checked to see that they are functional.
2. The protection equipment shall be arranged so that it can be adequately tested every 6 months by simulating emergency mode conditions.
3. All equipment requiring servicing and testing shall be readily accessible and provided with a practical means for adequate cleaning.
4. Where protection systems use telescoping assemblies, they shall be moved through their full travel distance annually.

All employees having access to the chamber shall receive basic instruction in the general operation of the protection system, including the adverse consequences of using manual pulls or abort switches.

Chamber operators shall establish a salvage plan as part of their overall property conservation preparedness.

The required minimum clear width of exits, aisles, and passageways to a public way shall be maintained at all times as specified in National Fire Protection Association (NFPA) 101.

8.11.4 RESPONSIBILITIES

Facility Coordinator and/or Facility Safety Head shall ensure that practices delineated in this section are followed.

LaRC Fire Chief shall evaluate anechoic chambers in accordance with this section.

Center Operations Directorate shall ensure that all new anechoic chamber facilities or modifications to existing facilities meet the requirements of this section.

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8.12 FIRE PROTECTION FOR TEMPORARY ENCLOSURES AND MEMBRANE STRUCTURES

8.12.1 PURPOSE

This section establishes the requirements for the installation and use of temporary enclosures and membrane structures at LaRC.

8.12.2 SCOPE

This section shall apply to all temporary and rigid frame membrane enclosures at LaRC and includes requirements and personnel responsibilities for fire protection. The scope of this section also shall require compliance with the applicable sections of National Fire Protection Association (NFPA) 241.

8.12.3 REQUIREMENTS

Temporary enclosures erected within or around a facility shall not be structurally supported by piping arrangements designed for automatic sprinkler systems and other fire protection equipment.

Temporary enclosures shall be provided with adequate temporary fire protection systems and/or portable fire extinguishers, as approved by the LaRC Fire Chief. Fire protection systems installed in temporary enclosures shall comply with the applicable NFPA standards. Temporary enclosures shall require LaRC Fire Department inspections in accordance with Section 10.7 of this document.

Only noncombustible supports and panels, flame resistant tarpaulins, or approved materials of equivalent fire retardant characteristics shall be used for construction of temporary enclosures. Wood materials purchased for use in safety related areas at LaRC shall be designated as fire retardant, pressure-treated lumber suitable for exterior use. All wood materials shall comply with the requirements for flame spread of 25 or less, with no evidence of significant progressive combustion when tested for a 30-minute period under the standard test method for fire hazard classification of building materials (ASTM E 84) and with no increase in the listed classification when subjected to the UL standard rain test (ASTM D 2898). Each piece of wood shall permanently bear the mark of an accredited testing agency every 2 feet. Alternate markings shall be acceptable, if approved by the LaRC Fire Chief. The purchase of lumber not meeting the requirements specified above must be approved by the LaRC Fire Chief. The end use, location to be used, and justification for not using fire retardant, pressure-treated lumber shall be presented to the LaRC Fire Chief for review and approval before purchase of the lumber. Exemptions shall be granted by exception rather than by rule.

All plastic films and fabrics for general use shall be of the flame retardant type meeting or exceeding the flame resistant requirements of NFPA 701.

The material specified for the shell of a membrane structure shall pass the NFPA 701 large-scale test. The material specified for the shell of a membrane structure shall meet the requirements of the ASTM E 84-89a (maximum flame spread 25/maximum smoke development 450). The material specified for the shell of a membrane structure shall be submitted to a third-party, independent testing laboratory for evaluation, and the test

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results shall be submitted to the LaRC Fire Chief for review and authority. The material specified for the shell of a membrane structure shall be tested and evaluated, in accordance with Chapter 14 of NFPA 701, which outlines accelerated dry cleaning, laundering, and water leaching test protocols to determine the adequacy of fire retardant and ultraviolet protection to hold up over a period of time when exposed to weather.

Temporary is defined as any equipment or structure whose use will not exceed 6 months. Temporary equipment or structures shall not exceed 1 year. (Temporary units may be permitted one 6-month extension). Temporary equipment or structures in use or remaining at the Center for over one year shall be considered permanent and must meet all applicable requirements of said equipment or structure.

All enclosing material shall be fastened securely so it cannot be blown against heaters or other sources of ignition. Note: Temporary enclosures, trailers, sheds, security barricades, and other facilities, when located within a structure or within 30 feet of a structure, shall be of noncombustible construction.

Temporary enclosures and areas within 10 feet of the perimeter of the enclosures shall be posted as "No Smoking" areas.

All construction/operation electrical wiring and equipment for light, heat, or power supplies shall be in accordance with the applicable sections of NFPA 70.

Flammable and/or combustible liquids shall be kept to an absolute minimum and shall be stored in and dispensed from UL listed or FM approved safety cans. Flammable or combustible liquid-soaked clothes, rags, or waste shall be stored in UL listed or FM approved safety containers.

Combustible materials which are used in the enclosure operations (e.g., rags, paper products) must be removed from the enclosure immediately after use or are stored in approved metal containers with lids in place. All combustible waste must be removed from the enclosure after each work shift.

The required minimum clear width of exits, aisles, and passageways to a public way shall be maintained at all times as specified in NFPA 101 and 29 CFR 1926.

Cutting, welding, open flame, or grinding must not be performed in enclosures without an approved permit in accordance with Section 7.3 of this document.

Access for use of heavy fire fighting equipment shall be provided to the temporary enclosure or job site at the start of the project and maintained until completion.

8.12.4 RESPONSIBILITIES

Facility Coordinator and/or Facility Safety Head or LaRC Engineering shall ensure that practices delineated in this section are followed and contact the LaRC Fire Chief prior to establishing new temporary enclosures.

LaRC Fire Chief shall evaluate locations requested to be used as a temporary enclosure.

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8.13 FIRE PROTECTION FOR VITAL RECORDS STORAGE

8.13.1 PURPOSE

This section establishes the requirements for the construction and use of new record storage facilities and those undergoing significant renovation, including record vaults, file rooms, archives, and records centers at LaRC. This section does not consider requirements that may be part of a security program needed to prohibit forcible entry.

8.13.2 SCOPE

This section shall apply to the collection of records in record storage facilities at LaRC.

8.13.3 REQUIREMENTS

8.13.3.1 Construction

Record storage facilities shall be constructed in accordance with the applicable sections of National Fire Protection Association (NFPA) 232. Record storage vaults and file rooms exceeding 50,000 cubic feet and all archives and records centers shall be in accordance with NFPA 232AM.

Record storage facilities which store vital and important records shall be located in noncombustible facilities protected with automatic sprinklers. Areas that provide storage of vital and important records shall be equipped with smoke detection systems.

8.13.3.2 Operation

Vital and important records (as defined by NFPA 232) shall be protected against fire.

Records that can be reproduced shall be duplicated and stored away from the originals so they will not be subject to the same fire incident.

Appropriate fire extinguishers shall be provided for record storage facilities.

Good housekeeping, orderliness, and maintenance of equipment shall be provided for record storage facilities.

Record storage facilities shall be posted as “No Smoking” areas.

Record storage facilities shall not be used as working spaces.

Unauthorized persons are not permitted in record storage facilities.

Combustible materials which are used in the record storage facility operations (e.g., files, films, paper products) shall be removed from the record storage facility immediately after use or transported and stored in approved metal containers with lids. All combustible waste shall be removed from the record storage facility after each work shift.

The required minimum clear width of exits, aisles, and passageways to a public way shall be maintained at all times as specified in NFPA 101.

Cutting, welding, open flame, or grinding must not be performed in record storage facilities without an approved permit in accordance with Section 7.3 of this document.

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8.14 FIRE PROTECTION FOR OVENS, FURNACES, AND ENVIRONMENTAL CHAMBERS

8.14.1 PURPOSE

This section establishes the fire protection requirements for the installation and use of ovens, furnaces, and environmental chambers at LaRC.

8.14.2 SCOPE

This section shall apply to the design, operation requirements, and personnel responsibilities for ovens, furnaces, and environmental chambers creating fire protection issues at LaRC.

8.14.3 REQUIREMENTS

8.14.3.1 Design

Before new equipment is installed or existing equipment is modified, complete plans, sequence of operations, and specifications shall be submitted to the LaRC Fire Chief for approval. Plans shall be drawn and show all essential details as to location, construction, ventilation, piping, and electrical safety equipment. A list of all combustion control and safety equipment, including manufacturer and type/model number, shall be included. Wiring diagrams and sequence of operations for all safety control shall be provided. All wiring in and around ovens, furnaces, and environmental chambers shall be in accordance with National Fire Protection Association (NFPA) 70.

Ovens, furnaces, and environmental chambers shall be located with consideration given to the possibility of fire resulting from overheating, quench tanks, ignition of hydraulic oil, overheating of material in the equipment, or the escape of fuel and to the possibility of facility damage and personal injury resulting from an explosion. Ovens, furnaces, and environmental chambers shall be located and erected so that the facility structural members will not be adversely affected by the maximum anticipated temperatures.

Ovens, furnaces, and environmental chambers that may contain flammable liquids, vapors, or gases shall be equipped with an unobstructed relief vent for freely relieving internal explosions.

Emergency shutoff valves shall be provided to permit turning off fuel in an emergency and are located so that fires and explosions in the ovens, furnaces, and environmental chambers will not prevent access to these valves.

Fuel-fired ovens, furnaces, and environmental chambers shall be provided with all safety devices in accordance with established safe practices.

Ovens, furnaces, and environmental chambers containing or processing sufficient combustible materials to sustain a fire shall be equipped with automatic sprinklers, as required by the LaRC Fire Chief. When oven, furnace, or environmental chamber temperatures are over 465°F or when a flash fire condition may exist, an open sprinkler system, supplied by an approved deluge valve equipped with a hand-pull for manual operation and controlled by heat-actuated devices, shall be recommended within the equipment.

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8.14.3.2 Operation

Operational and maintenance procedures shall be developed for each oven, furnace, and environmental chamber and include:

1. Entry requirements.
2. Maintenance checklist.
3. Cleaning requirements.
4. Combustible loading and usage limits.

Regular personnel shall receive scheduled training and testing to maintain a high level of proficiency and effectiveness. Operator training shall include:

1. Combustion of fuel-air mixtures.
2. Explosion hazards.
3. Sources of ignition including auto ignition.
4. Functions of control and safety devices.
5. Handling of special atmospheres.
6. Handling and processing of hazardous materials.

Portable fire extinguishers shall be provided for the appropriate hazards.

Accumulation of combustible materials such as cartons, papers, and packaging materials shall be prohibited in and around ovens, furnaces, and environmental chambers.

The required minimum clear width of exits, aisles, and passageways to a public way must be maintained at all times as specified in NFPA 101.

8.14.4 RESPONSIBILITIES

Facility Coordinator and/or Facility Safety Head shall ensure that practices delineated in this section are followed and contact the LaRC Fire Chief prior to installation of new ovens, furnaces, and environmental chambers or modification of existing ovens, furnaces, and environmental chambers.

LaRC Fire Chief shall evaluate locations requested for the installation of ovens, furnaces, and environmental chambers and modifications to existing ovens, furnaces, and environmental chambers.

Center Operations Directorate shall ensure that the design requirements delineated in this section are followed.

Operators/Employees shall follow the operational requirements delineated in this section.

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8.15 FIRE PROTECTION FOR HEPA FILTER SYSTEMS

8.15.1 PURPOSE

This section establishes the requirements for the installation and use of high-efficiency particulate air (HEPA) filters and equipment at LaRC.

8.15.2 SCOPE

This section shall apply to the installation and use of new permanent HEPA filters and equipment at LaRC as well as change outs made to permanent systems. These requirements do not apply to portable HEPA filtration systems used on a temporary basis.

8.15.3 REQUIREMENTS

8.15.3.1 Atmosphere Filtration

Air and inert gas shall enter each ventilated area through at least one fire resistant HEPA filter and shall be discharged through at least one fire resistant prefilter and one fire resistant HEPA filter to exhaust ductwork leading to a final filter system.

8.15.3.2 Ventilation System Fire Protection

The ventilation system shall be designed to withstand any credible fire or explosion and shall continue to act as a confinement barrier. Fire protection features of ventilation systems shall include fire resistant materials of construction, fire resistant filters, heat and smoke detectors, alarms, heat removal devices, fire suppression equipment, and fire doors and dampers or other proven devices to restrict the spread of fires.

Design of the system shall include an analysis to determine if the ventilation system is capable of operating under design basis fire conditions as specified in the design criteria. HEPA filtration systems serving as a final means of effluent cleaning shall have at least two stages of fire resistant filters in series in a filter plenum. If it can be determined that the filters can be subjected to sufficient heat to cause failure, the final filters shall be protected by heat removal or sprinkler systems that automatically activate at a preset temperature. If a heat removal system is deemed necessary, an inlet baffle and a spark arrestor and demister shall precede the first stage of filters. If a cooling spray is used for heat removal, it shall be followed by a combination spark arrester/demister screen to remove entrained droplets. A roughing filter shall be mounted behind these components to remove the bulk of the draft-carried debris.

The cooling spray system shall operate automatically upon abnormal temperature increase indicated by detectors in the exhaust ducts feeding the cool chamber inlet. A manually operated valve actuating the spray system also shall be provided as a backup.

8.15.3.3 Instrumentation

Ventilation systems shall be provided with instrumentation to read out and alarm in one or more central control areas. These areas shall be designed to permit occupancy and the ability to operate ventilation systems safely during normal and abnormal conditions. The instrumentation system shall provide the following:

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1. Readout from appropriate surveillance instrumentation for all essential functions of the ventilation systems.
2. Visual and/or audible alarms for significant abnormal conditions, such as filter plugging or breakthrough, low airflow or reversal, fire protection system activation, high stack and effluent activity.
3. For normal or abnormal conditions, where combustible solvents, gases, and vapors could possibly be present in a ventilation system, continuous monitoring systems suitable for monitoring such substances shall be included in the design, with readout normally in the control room. The ventilation system shall be designed with flow rates or other features to preclude the possibility of an explosion, as evaluated in the safety analysis document.
4. All HEPA filters shall be equipped with differential pressure instrumentation.

8.15.4 RESPONSIBILITIES

Facility Coordinator and/or Facility Safety Head shall ensure that practices delineated in this section are followed and contact the LaRC Fire Chief prior to installation of new filter and plenum equipment or modification of existing filter and plenum equipment.

LaRC Fire Chief shall evaluate locations requested for the installation of new filter and plenum equipment or modifications of existing filter and plenum equipment.

8.16 FIRE PROTECTION FOR HAZARDOUS MATERIALS STORAGE

8.16.1 PURPOSE

This section establishes the requirements for the storage, handling, and use of hazardous materials at LaRC. Hazardous materials are defined by Section F-2303 of the BOCA National Fire Prevention code and can include flammable and combustible liquids, gases, corrosives, oxidizers, water reactive chemicals, and radioactive materials.

8.16.2 SCOPE

This section shall apply to the handling and storage of hazardous materials at LaRC.

8.16.3 REQUIREMENTS

8.16.3.1 Design

Hazardous material storage shall be separated by minimum distances from other facilities and personnel areas in accordance with the appropriate standard. Incompatible hazardous materials stored outside of facilities shall be separated from one another by minimum distances as specified in the appropriate standard. Hazardous materials that may cause environmental damage in the event of fire shall be located in separate hazardous material containment buildings or tanks.

Hazardous material storage areas and buildings shall be provided with containment for liquid runoff control.

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Hazardous material storage buildings and aboveground tanks shall be provided with appropriate fire protection.

Separate hazardous material containment buildings shall be provided with fire sprinkler systems or other approved fire protection control and extinguishing systems.

8.16.3.2 Operation

Incompatible hazardous materials in the same facility shall be separated by suitable fire rated construction. A material that is incompatible with another is a material that can cause hazardous reactions or can promote or initiate combustion with the material. Examples of materials that require separation from one another are flammable/combustible liquids, corrosive materials, oxidizers, and water reactives.

Hazardous materials shall be stored in appropriate containers.

Accumulation of combustible materials such as cartons, papers, and packaging materials shall be prohibited in and around hazardous material storage.

Weeds, rubbish, or similar combustibles shall not be permitted within 15 feet of hazardous material storage areas.

Portable fire extinguishers in hazardous storage buildings shall be provided for the hazard.

Personnel involved in hazardous material operations shall receive instructions in handling the materials in a safe manner.

Smoking shall not be permitted in or near hazardous materials storage areas.

Hazardous materials storage facilities shall not be used as dispensing facilities.

8.16.4 RESPONSIBILITIES

Facility Coordinator and/or Facility Safety Head shall ensure that practices delineated in this section are followed shall contact the LaRC Fire Chief prior to establishing new hazardous materials storage facilities.

LaRC Fire Chief shall evaluate locations requested to be used as hazardous materials storage facilities.

Center Operations Directorate shall ensure that the design requirements delineated in this section are followed.

Operators/employees shall follow the operational requirements delineated in this section.

8.17 FIRE PROTECTION FOR LABORATORY FACILITIES

8.17.1 PURPOSE

This section establishes the requirements for the installation and use of laboratory facilities at LaRC.

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8.17.2 SCOPE

This section shall apply to all laboratories at LaRC.

8.17.3 REQUIREMENTS

8.17.3.1 Construction

All laboratories shall meet the minimum constructions requirements specified in the local building code and National Fire Protection Association (NFPA) 45.

All laboratories shall be provided with the appropriate fire protection features in accordance with NFPA 45.

Pressure relief systems shall discharge to a safe location.

All permanent piping shall be identified as to its contents at the supply and discharge points.

Operating controls for apparatus shall be accessible under normal and emergency conditions.

Entrances to laboratory units or areas shall be identified with signs to warn emergency personnel of unusual or severe hazards that are not related to the fire hazard of contents.

8.17.3.2 Operation

The quantity of hazardous chemicals stored in the open in a laboratory work area shall be limited to the amount required for each specific task being performed.

Incompatible materials shall be segregated to prevent accidental contact with one another.

Containers of materials that may become hazardous over time shall be dated and inspected every 6 months to evaluate their condition. Materials that are safe shall be redated, and those that can be made safe by treating them shall be treated and redated. All other materials shall be safely discarded.

Documented monthly housekeeping inspections shall be performed for each laboratory, and corrective action shall be initiated immediately to resolve identified deficiencies.

The required minimum clear width of exits, aisles, and passageways to a public way shall be maintained at all times as specified in NFPA 101.

8.17.4 RESPONSIBILITIES

Facility Coordinator and/or Facility Safety Head shall ensure that practices delineated in this section are followed and contact the LaRC Fire Chief prior to establishing new laboratories or modifying existing laboratories.

LaRC Fire Chief shall evaluate locations requested to be used as laboratories and modifications to existing laboratories.

Center Operations Directorate shall ensure that the design requirements delineated in this section are followed.

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8.18 FIRE PROTECTION FOR VACANT FACILITIES

8.18.1 PURPOSE

This section establishes the requirements for protecting vacant facilities at LaRC from fire and other related perils.

8.18.2 SCOPE

This section shall apply to all vacant and abandoned facilities at LaRC.

8.18.3 REQUIREMENTS

Vacant facilities are a high-risk target property that require specialized fire protection solutions:

If left totally unsupervised, vacant facilities often are used for inappropriate activities, such as storage, leading to either accidental or intentional ignition.

If the exterior of the facility and the adjacent grounds are allowed to deteriorate, the probability of fire is increased.

Vacant facility shall be managed and protected in accordance with the appropriate provisions of FM Data Sheet 9-17.

Upon vacating or abandoning a facility or property, the occupant shall remove combustible and hazardous materials to the extent specified by the NASA Fire Chief in order to achieve an acceptable level of safety.

Vacant facilities and properties shall be maintained to be free of accumulations of combustible and hazardous materials.

Vacant facilities shall be maintained to be securely locked or barricaded to prevent entry by unauthorized persons.

Required sprinkler and standpipe systems and all component parts shall be maintained in an operable condition at all times. Exception: Where the type of construction, fire separation and security of the structure does not create a fire hazard as approved by the LaRC Fire Chief.

If maintaining sufficient facility heat to avoid freezing is impractical, the automatic sprinkler system shall be arranged for cold weather operation in accordance with FM Data Sheet 2-8N. It shall not be drained and removed from service. If the interruption of heat is likely to be long-term or permanent, wet pipe systems shall be fully converted to dry pipe systems.

Fire alarm systems shall be maintained in operable conditions at all times.

Vacant facilities shall be posted as “No Smoking” areas.

The required minimum clear width of exits, aisles, and passageways to a public way shall not be used for storage and shall be maintained at all times as specified in National Fire Protection Association (NFPA) 101.

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8.18.4 RESPONSIBILITIES

Facility Coordinator and/or Facility Safety Head for Facility or Property Vacated shall ensure that practices delineated in this section are followed.

LaRC Fire Chief shall evaluate vacant facilities in accordance with this section.

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CHAPTER 9

9. ASSESSMENT AND ANALYSIS

9.1 FIRE PROTECTION ENGINEERING SURVEY PROGRAM

9.1.1 PURPOSE

This section identifies the requirements for the fire protection engineering (FPE) survey program.

9.1.2 SCOPE

The requirements of this section shall apply to the performance of FPE surveys at LaRC.

9.1.3 REQUIREMENTS

FPE surveys shall be performed on LaRC facilities with the following priority, and based upon the Fire Protection Engineering (FPE) resources available. FPE surveys shall be conducted for facilities (plus equipment) valued at $50 million or more, or where a significant safety hazard or vital programs are involved. FPE surveys shall be conducted for facilities (plus equipment) valued at $10 million to $50 million. FPE surveys shall be conducted for facilities (plus equipment) valued at $500,000 to $10 million. Facilities valued at less than $500,000 shall not require FPE surveys unless significant programmatic impacts, hazardous materials, or some other type of specialized hazard is involved. The FPE survey reports for each facility shall be retained in accordance with Section 3.8 of this LPR.

The facility FPE surveys shall address, as a minimum, the following items as they relate to fire protection:

1. General description of construction.
2. Fire protection.
3. Fire protection water supplies.
4. Occupancy.
5. Life safety.
6. Special hazards.
7. Exposures.
8. Property loss potential.
9. Programmatic loss potential.
10. Liquid runoff control.
11. Fire department.
12. Approved deviations and waivers for facility.
13. Administrative compliance and housekeeping.
14. Violations and recommendations.

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An FPE survey schedule shall be prepared annually based on the criteria stated above.

The FPE surveys shall consist of a standardized report covering the topics identified in above. The complete written report shall be issued every other time according to the required assessment frequency, unless significant changes have occurred to the facility. If significant changes have occurred, then the total report must be issued.

The engineer performing the survey shall conduct an opening meeting with the Facility Coordinator and/or Facility Safety Head to discuss the purpose of the review.

The finalized report shall be forwarded to the LaRC Fire Chief for distribution. The LaRC Fire Chief shall ensure all findings are entered on the Fire Protection Engineering Deficiency Database with a 45-day completion date. This date shall be changed when the 30-day response is received from the Facility Coordinator and/or facility safety head. This process shall be to aid the Facility Coordinator and/or Facility Safety Head at the opening meeting.

9.1.4 RESPONSIBILITIES

Facility Coordinator and/or Facility Safety Head shall ensure timely resolution of all findings as a result of a FPE survey.

LaRC Fire Chief shall ensure that FPE surveys are conducted according to the annual schedule and perform tasks as delineated in this section.

9.2 FIRE HAZARD ANALYSIS PROGRAM

9.2.1 PURPOSE

This section provides the requirements for a fire hazard analysis (FHA).

9.2.2 SCOPE

The requirements of this section shall apply to the performance of an FHA at LaRC.

9.2.3 REQUIREMENTS

9.2.3.1 Facilities Requiring an FHA

New facilities, existing high-value facilities, or facilities with significant fire protection issues or concerns generated in the fire protection engineering surveys may have an FHA prepared, as determined by the LaRC Fire Chief.

9.2.3.2 Facility Safety Analysis Report

Each facility required to have a safety analysis report shall include or reference an FHA as part of that report. The FHA shall be documented (including all assumptions).

9.2.3.3 Competent Individual

All FHA's shall be performed under the direction of, or are approved by, a fire protection engineer.

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9.2.3.4 Minimum Contents

FHA's, as a minimum, shall address the following items:

1. Description of construction.
2. Safety class systems.
3. Fire protection features.
4. Description of fire hazards.
5. Life safety considerations.
6. Critical process equipment.
7. High-value property.
8. Damage potential: maximum credible fire loss (MCFL) and maximum possible fire loss (MPFL).
9. Fire department/brigade response.
10. Recovery potential.
11. Potential for a toxic, biological, and/or radiological incident due to a fire.
12. Emergency planning.
13. Security and safeguards considerations related to fire protection.
14. Natural hazards (earthquake, flood, wind) impact on fire safety.
15. Exposure fire potentials.

9.2.3.5 Single Failure Criteria for FHA's

Each FHA shall assume that one installed, automatic fire protection system will malfunction.

If redundant automatic fire protection systems are provided in the area, only the system whose failure would cause the most vulnerable condition shall be assumed to fail.

Passive fire protection features (such as blank fire rated walls or continuous fire rated cable wraps) shall be assumed to remain viable.

9.2.3.6 Selecting the Analysis Boundary

The focus of the FHA shall be the individual fire areas that comprise the facility. The boundaries of exterior fire areas (yard areas) shall be as determined by the program secretarial officer or delegated authority. Where a facility is not subdivided by fire rated construction, the fire area shall be defined by the exterior walls and roof of the facility.

9.2.3.7 Effect of Fire on Vulnerable Safety Class Systems

An essential element of an acceptable FHA shall be an inventory of all safety class systems within the fire area that are susceptible to fire damage. This shall include those primary and supporting mechanical and electrical systems that must function effectively during and after a fire event to assure safety (including safe shutdown, where

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applicable). Such safety class systems shall include, but are not limited to, process monitoring instrumentation, instrument air, facility hydraulic system, and emergency lighting system.

For example, loss of the facility ventilation system in a fire (due to damage to power cables) may result in an ambient air temperature increase which may cause the failure of sensitive electrical safety class components such as relays.

9.2.3.8 Credible Failure Modes for Safety Class Systems

All credible fire related failure modes of safety class systems shall be considered.

For example, it is insufficient to assume that fire will merely cause the loss of function of safety class equipment when power cables to that equipment are within the fire area. It is also necessary to consider the potential for spurious signals which may cause the maloperation of such equipment. Similarly, fire induced electrical faults may trip upstream electrical disconnect devices in such a way as to render inoperable other safety class systems that may not even be located within the fire area. In addition, the effects of combustion products, manual fire fighting efforts, and the activation of automatic fire suppression systems must be assessed.

9.2.3.9 Ventilation System Operation and Failures

Fire propagation and the potential for fire induced material dispersal through the facility air distribution system must be considered for the normal operating mode of the air distribution system as well as alternate modes that may result from the fire, such as shutdown.

9.2.3.10 Computer Models

An acceptable tool that shall be used to aid in the development of an FHA is a fire model (such as FPETOOL, FAST, or HARVARD) as applied by fire protection engineers and approved by the authority having jurisdiction (AHJ).

9.2.3.11 Simplifying Assumptions

Where appropriate, as a simplification to the analysis, an assumption is permitted that all potentially vulnerable systems will be damaged within the fire area. Acceptable exceptions to this assumption shall be water filled steel pipes, tanks, and similar components of superior structural integrity with welded fittings and adequate pressure relief.

9.2.3.12 Combustible Material

The quantity and associated hazards of flammable and combustible materials that can be expected to be found within the fire area shall be factored into the analysis. Consideration should also be given to the presence of transient combustibles associated with storage and maintenance activities. Averaging combustible loading over the floor or fire area as a means to characterize the fire severity shall <u>not</u> be considered an acceptable technique.

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9.2.3.13 Special Considerations for High-Bay Facilities and Areas

FHA's for high-bay locations shall consider the effects of smoke/hot gas stratification that may occur at some intermediate point below the roof or ceiling. The effect of smoke movement through doors and dampers held open by fusible links shall be addressed.

9.2.4 RESPONSIBILITIES

The LaRC Fire Chief shall be responsible for ensuring that FHA's are conducted in accordance with this section.

9.3 FIRE PROTECTION PROGRAM REVIEW/SELF-ASSESSMENT

9.3.1 PURPOSE

This section identifies the requirements for the review and self-assessment of the fire protection program.

9.3.2 SCOPE

The requirements of this section shall apply to the performance of the LaRC fire protection program review and self-assessment.

9.3.3 REQUIREMENTS

LaRC shall conduct periodic reviews of the fire protection program elements and performs a self-assessment of the fire protection program effectiveness to ensure compliance with the NASA fire protection goals and requirements. The frequency shall be every five years.

The fire protection self-assessments must address, as a minimum, the following items:

1. Comprehensive nature of the fire protection program.
2. Procedures for engineering design and review.
3. Procedures for maintenance, testing, and inspection of fire protection equipment/systems, including water supplies.
4. Fire protection engineering staff (number, qualifications, training).
5. Fire suppression organization (personnel and training).
6. Fire suppression mutual aid agreements.
7. Management support.
8. Documented deviations and waivers.
9. Inspection, testing, and maintenance reports.
10. Adequacy of facility appraisal reports.
11. Administrative controls.
12. Temporary protection and interim compensatory measures.
13. Status of previous appraisal findings.
14. New appraisal findings.

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The fire protection program self-assessment reports shall be retained in accordance with Section 3.8 of this document.

9.3.4 RESPONSIBILITIES

The LaRC Fire Chief shall be responsible for ensuring that fire protection program self-assessments are conducted every five years.

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CHAPTER 10

10. FIRE DEPARTMENT OPERATIONS AND EMERGENCY RESPONSE

10.1 FIRE DEPARTMENT EMERGENCY EQUIPMENT

10.1.1 PURPOSE

This section provides specific requirements for LaRC Fire Department emergency equipment, to ensure that it will meet the needs required by LaRC.

10.1.2 SCOPE

This section shall apply to LaRC Fire Department emergency equipment used for fire fighting, specialized rescue, hazardous materials, emergency medical, and other types of emergency response.

10.1.3 REQUIREMENTS

10.1.3.1 Procurement of Fire Department Emergency Equipment

LaRC Fire Chief shall:

1. Ensure the development of the internal operations procedures to ensure that emergency response equipment meets the minimum specifications of the applicable referenced National Fire Protection Association (NFPA) standards.
2. Prepare the necessary procurement documentation according to the LaRC criteria pertaining to the procurement of equipment.

Office of Procurement shall:

1. Ensure that the ordered emergency equipment meets the specifications as developed by the LaRC Fire Department.
2. Prepare the necessary procurement documentation according to the LaRC criteria pertaining to the procurement of equipment.

10.1.3.2 Use of Fire Department Emergency Equipment

Fire Department Station Officer shall:

1. Develop the internal operating procedures to ensure that emergency equipment is used for its intended purpose.
2. Maintain emergency equipment according to the manufacturer's recommendations and the applicable referenced NFPA standards.
3. Ensure that emergency equipment which does not meet the minimum specifications or is unsafe for use is removed from service and replaced with compliant equipment.

10.1.3.3 Responsibilities

LaRC Fire Chief shall:

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1. Ensure the development of the internal operating procedures in accordance with this section.
2. Recommend and specify LaRC Fire Department emergency equipment to be purchased.
3. Prepare the appropriate procurement paperwork to purchase the LaRC Fire Department emergency equipment.

LaRC Fire Department Station Officer, in conjunction with the LaRC Fire Chief shall develop the internal operating procedures in accordance with this section and ensure the proper use, maintenance, and care of LaRC Fire Department emergency equipment.

LaRC Fire Department Personnel shall report unsafe emergency equipment to the LaRC Fire Department station officer.

10.2 FIRE DEPARTMENT PERSONNEL PROTECTIVE EQUIPMENT

10.2.1 PURPOSE

This section provides specific requirements for the purchase and care of personal protective equipment used for emergency operations.

10.2.2 SCOPE

This section shall apply to personal protective equipment used for fire fighting, rescue, hazardous materials, emergency medical, and other LaRC Fire Department emergency responses.

10.2.3 REQUIREMENTS

10.2.3.1 Procurement of Personal Protective Equipment

LaRC Fire Chief shall:

1. Ensure the development of the internal operations procedures to ensure that personal protective equipment meets the minimum specifications of the applicable referenced National Fire Protection Association (NFPA) standards.
2. Prepare the necessary procurement documentation according to the LaRC criteria pertaining to the procurement of equipment.

Office of Procurement shall

1. Ensure that the ordered personal protective equipment meets the specifications as developed by the LaRC Fire Chief.
2. Prepare the necessary procurement documentation according to the LaRC criteria pertaining to the procurement of equipment.

10.2.3.2 Use of Personal Protective Equipment

LaRC Fire Chief shall ensure the development of internal operating procedures to make sure that personal protective equipment is utilized for its intended purpose.

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LaRC Fire Department Station Officer shall:

1. Ensure that personal protective equipment is maintained according to the manufacturer's recommendations and the applicable referenced NFPA standards.
2. Ensure that the personal protective equipment which does not meet the minimum specifications is removed from service and replaced with compliant equipment.

10.2.4 RESPONSIBILITIES

LaRC Fire Chief shall:

1. Ensure the development of the internal operating procedures in accordance with this section.
2. Recommend and specify personal protective equipment to be purchased.
3. Prepare the appropriate procurement paperwork to purchase the personal protective equipment.

LaRC Fire Department Station Officer shall

1. Develop the internal operating procedures in conjunction with the LaRC Fire Chief in accordance with this section.
2. Ensure the proper use, maintenance, and care of personal protective equipment.

10.3 FIRE FIGHTING FORCES

10.3.1 PURPOSE

This section provides specific requirements for establishing the manual fire fighting forces for the fire protection of LaRC and outlines supplemental forces and support units to assist the LaRC fire companies when needed.

10.3.2 SCOPE

This section shall apply to the LaRC fire fighting forces, whether career or volunteer.

10.3.3 REQUIREMENTS

10.3.3.1 Fire Fighting/Fire Department Staffing

Staffing shall be arranged so that a crew with a minimum of six fire fighters is maintained on duty at all times.

10.3.3.2 Training of Fire Department Personnel

First time entrants into the LaRC Fire Department shall attend training as outlined in Section 10.5 of this document.

Fire fighting personnel shall be thoroughly instructed in the hazards of fires, explosions, and radiation, and in the safety precautions to be taken and methods to be used in preventing fires.

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Continuing education of personnel shall be coordinated between the Hampton Fire Department training officer, station officers and LaRC Fire Chief.

Fire fighting personnel shall have completed NASA Hazardous Materials and Hazardous Waste Operations and Emergency Response (HAZWOPER) training.

10.3.3.3 Fire Department Personnel

Fire Department Personnel shall:

1. Fight fires in accordance with established procedures.
2. Maintain equipment and fire station in accordance with established procedures.
3. Inspect vehicles and operating areas.
4. Render basic and advanced life support in emergencies.
5. Perform other duties as deemed necessary by the Fire Department station officer.

10.3.4 RESPONSIBILITIES

LaRC Fire Chief shall:

1. Ensure that LaRC Fire Department personnel are trained to meet all fire emergencies.
2. Ensure that any assigned volunteer personnel are trained to a level equal to career staff typically assigned.

Hampton Fire Department will coordinate the training of fire fighting forces.

LaRC Fire Fighting Personnel shall perform the tasks delineated in this section.

LaRC Fire Department Station Officer shall assist in the implementation of training activities on his or her shift.

Command Structure and fire ground activity shall be conducted per NASA/City of Hampton Agreement.

10.4 FIRE SUPPRESSION

10.4.1 PURPOSE

This section defines the actions to be taken in the event of fires or other related perils to reduce exposure to personnel and to prevent damage to facilities and equipment from the products of combustion.

Actions are taken to prevent the spread of fire(s) originating outside the boundaries of LaRC from encroaching onto government property.

Precautions are taken to prevent the spread of fire(s) from government property onto private, state, or corporate property.

Measures are implemented to prevent the on-site or off-site release of hazardous materials from fires and other related perils.

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Specific precautions are taken to prevent products of combustion within production, assembly, warehouse, and mission-essential facilities.

10.4.2 SCOPE

This section shall be implemented when conditions are such that personnel, facilities, equipment, systems, or materials are jeopardized or at risk from fire within the boundaries of LaRC.

10.4.3 REQUIREMENTS

10.4.3.1 General

In the best interest of the government, the LaRC Fire Chief and Fire Department station officer shall implement the appropriate section(s) of this standard to protect life, property, materials, supplies, or equipment from fires. Fire protection of LaRC is of the utmost importance and shall not be jeopardized or compromised.

10.4.3.2 Fire Response

LaRC Emergency Fire Dispatcher shall:

1. Dispatch a LaRC Fire Department officer and fire suppression equipment with the proper staffing to prevent the spread of fire to areas that contain personnel, property, or equipment.
2. Notify the LaRC Fire Chief.

LaRC Fire Chief or Fire Department Station Officer shall:

1. Notify the applicable personnel or organizations to supply equipment that is to be used during suppression operations. Designates a staging area where equipment and personnel are to report.
2. Request that the mutual aid agreements be placed into effect, as appropriate.
3. Advise the Facility Coordinator and/or Facility Safety Head of existing and potential conditions and that this procedure may need to be implemented.

Facility Coordinator and/or Facility Safety Head shall ensure that preparations are made to complete the tasks as requested by the LaRC Fire Department station officer.

10.4.3.3 Post fire Response

LaRC Fire Department Station Officer shall:

1. Ensure that notifications are made to the appropriate persons: Facility Coordinator and/or Facility Safety Head; Duty officer; and LaRC Fire Chief.
2. Ensure that all equipment that was placed out of service is returned to normal or automatic position.

10.4.4 RESPONSIBILITIES

LaRC Fire Chief or Fire Department Station Officer shall:

1. Maintain, implement, and enforce guidelines in this section.

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2. Use all available manpower and equipment to prevent the spread of fire(s) from or onto government-owned property.
3. Request fire suppression assistance according to the mutual aid agreement.

LaRC Emergency Dispatcher shall:

1. Make appropriate announcements.
2. Inform the Facility Coordinator and/or Facility Safety Head of the shutdowns.
3. Notify the LaRC Fire Chief as directed by the LaRC Fire Department Station Officer.
4. Make the mutual aid requests as directed by the LaRC Fire Chief, LaRC Fire Department Station Officer, or incident commander.

Facility Coordinator and/or Facility Safety Head shall:

1. Take actions to secure/safeguard/protect operations and equipment when informed by the LaRC Fire Chief or LaRC Fire Department Station Officer.
2. Inform his or her managers and supervisors when the provisions of this section are placed into effect.
3. Maintain an up-to-date listing of disabled occupants and their locations.
4. Maintain an up-to-date listing of hazardous materials and their locations.

10.5 FIRE DEPARTMENT TRAINING

10.5.1 PURPOSE

This section provides specific requirements for development and implementation of LaRC Fire Department training.

10.5.2 SCOPE

This section shall apply to the development and implementation of training for the LaRC Fire Department personnel who serve LaRC.

10.5.3 REQUIREMENTS

10.5.3.1 Development of Fire Department Training

Hampton Fire Department and/or LaRC Fire Chief shall:

1. Develop training which covers each facet of emergency response:
   - Fire fighting
   - Emergency medical response
   - Hazardous materials response
   - Rescue

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2. Develop training for routine operations and skills according to the referenced National Fire Protection Association (NFPA) standards pertaining to professional fire fighter competencies.
3. Ensure that training meets or exceeds the minimum requirements established in the applicable referenced NFPA standards and Virginia Office of Fire Programs

10.5.3.2 Implementation of Fire Department Training

Hampton Fire Department shall:

1. Establish an annual training schedule for the LaRC Fire Department with concurrence of the LaRC Fire Chief. Note: NASA may fund and organize Center specific or other specialized training.
2. Schedule and conduct training classes according to the referenced NFPA standard pertaining to the specific training course.
3. Ensure that all LaRC Fire Department training courses are conducted under the supervision of qualified instructors and that each participant attains the established minimum Competency level.
4. Ensure that all live training evolutions are conducted according to the NFPA standard governing such training and are constantly under the supervision of the Hampton Fire Department safety officer.
5. Maintain LaRC Fire Department training records for each course.
6. Provide the LaRC Fire Chief with up-to-date training records for the personnel.

LaRC Fire Department Personnel shall:

1. Attend the scheduled fire department training sessions.
2. Maintain the minimum Competency level according to the referenced NFPA standard pertaining to professional fire fighter qualifications.
3. Conduct operations according to established training courses governing the specific operations.

Hampton Fire Department Safety Officer will ensure that all training courses are conducted according to established procedures and immediately terminates a training evolution when an unacceptable condition is detected.

10.5.4 RESPONSIBILITIES

LaRC Fire Department Personnel shall develop operating procedures and implement LaRC Fire Department operating procedures.

Hampton Fire Department shall schedule and conduct LaRC Fire Department operations procedure training.

Hampton Fire Department Safety Officer shall maintain minimum safety standards for all LaRC Fire Department training.

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10.6 FIRE DEPARTMENT MUTUAL AID AGREEMENTS

10.6.1 PURPOSE

This section provides specific requirements for the establishment of fire department mutual aid agreements.

10.6.2 SCOPE

This section shall apply to all fire department mutual aid agreements.

10.6.3 RESPONSIBILITIES

LaRC Director shall

1. Ensure that an active mutual aid agreement has been signed with the surrounding fire departments.
2. Ensure that the LaRC Fire Department is prepared and equipped to meet its obligation as specified in the mutual aid agreement.

LaRC Fire Chief shall ensure that the mutual aid agreement is up-to-date and implement the mutual aid agreement as necessary.

10.7 FIRE DEPARTMENT FACILITY INSPECTIONS

10.7.1 PURPOSE

This section establishes a program for inspecting and reporting unsafe conditions or acts pertaining to fire safety.

10.7.2 SCOPE

This section shall apply to all personnel and facilities at LaRC.

10.7.3 REQUIREMENTS

LaRC Fire Chief shall:

1. Ensure that facility inspections are conducted by qualified personnel.
2. Ensure that routine facility inspections are conducted according to the referenced fire department procedures pertaining to facility inspections and that all deficiencies are tracked to resolution.

Facility Coordinator and/or Facility Safety Head shall:

1. Aid the fire department in conducting facility inspections as requested, including the following: Unlocking doors and providing special escorts
2. Ensure timely correction of all noted unsafe conditions.
3. Ensure that the LaRC Fire Department has a complete up-to-date hazardous materials list.

LaRC Fire Department Personnel shall perform inspections and forward reports to the LaRC Fire Chief for review and resolution.

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10.7.4 RESPONSIBILITIES

LaRC Fire Chief shall establish a facility fire safety inspection program and implement the facility fire safety inspection program.

Facility Coordinator and/or Facility Safety Head shall support the facility fire safety program and address facility fire safety inspection findings.

LaRC Fire Department Personnel shall conduct fire safety inspections in accordance with the referenced documents.

10.8 EMERGENCY MEDICAL SERVICES

10.8.1 PURPOSE

This section establishes a program for emergency medical response at LaRC.

10.8.2 SCOPE

This section shall apply to emergency medical response at LaRC.

10.8.3 REQUIREMENTS

LaRC Fire Chief shall ensure that emergency medical responses are conducted by qualified personnel and shall ensure that emergency medical responses are conducted according to the referenced fire department procedures.

LaRC Fire Department Station Officer shall ensure that medical responses are conducted according to the referenced fire department procedures and shall ensure timely correction of all noted unsafe conditions.

10.8.4 RESPONSIBILITIES

LaRC Fire Chief shall establish and implement an emergency medical response program.

LaRC Fire Department Station Officer and Emergency Medical Responder shall support the emergency medical response program.

10.9 FIRE DEPARTMENT PREPLANS

10.9.1 PURPOSE

This section establishes a program for the development and maintenance of emergency response preplans.

10.9.2 SCOPE

This section applies to the LaRC Fire Department emergency response preplans.

10.9.3 REQUIREMENTS

10.9.3.1 Frequency

LaRC Fire Chief shall:

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1. Ensure the establishment of a fire department preplan for each facility and notes the date by which the preplan is to be updated.
2. Ensure that fire department preplans are performed for facilities based on the following frequencies:
   - Annually for facilities having a replacement cost value (including contents) in excess of $50 million, for special facilities, or for facilities with high programmatic value
   - Every 2 years for facilities having a replacement cost value (including contents) of $10 million to $50 million
   - Every 3 years for facilities having a replacement cost value (including contents) of less than $10 million, or
   - After major modifications are made to the building.

10.9.3.2 Development of Fire Department Preplans

LaRC Fire Department Station Officer shall:

1. Ensure that fire department preplans address the following items as a minimum:
   - Facility occupancy
   - Special hazards
   - Fire protection systems provided for the building
   - Location of fire hydrants
   - Location of fire department connections
   - Water supply available
   - Exposures
   - Plan of attack
   - Special salvage requirements
2. Transmit the complete fire department preplan to the LaRC Fire Chief for review and approval.

The LaRC Fire Chief forwards the fire department preplan to the Facility Coordinator and/or Facility Safety Head for review and comment.

Facility Coordinator and/or Facility Safety Head shall:

.

1. Provide facility specific support in the development of an accurate fire department preplan.

10.9.4 RESPONSIBILITIES

LaRC Fire Chief shall establish the schedule for the development of fire department preplans.

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LaRC Fire Department Station Officer shall

1. Develop the preplan as delineated in this section.
2. Work with the Facility Coordinator and/or Facility Safety Head to ensure the accuracy of the preplans.

Facility Coordinator and/or Facility Safety Head shall

1. Provide facility specific input for the development of the fire department preplans.

10.10 FIRE DEPARTMENT HAZARDOUS MATERIAL RESPONSE PROGRAM

10.10.1 PURPOSE

This section establishes and implements a program that will provide the required information on hazardous materials at LaRC and reduce personnel exposures.

10.10.2 SCOPE

This section shall apply to all the members of the LaRC Fire Department and to other non-LaRC Fire Department emergency responders, as applicable.

10.10.3 REQUIREMENTS

Hampton Fire Department shall develop instructional objectives and learning outcomes to support educational activities designed to train fire service personnel to the National Fire Protection Association (NFPA) Hazardous Materials First Responder level. Each objective is a statement of the skills and/or body of knowledge a person must achieve to attain this level of Competency

Response Personnel shall attend Hazardous Materials First Responder training offered by the LaRC Fire Department.

10.10.4 RESPONSIBILITIES

Hampton Fire Department shall develop the Hazardous Materials First Responder Training Program and conduct hazardous materials training.

Fire fighter shall attend hazardous materials training and meet the minimum established First Responder proficiency level.

10.11 FIRE DEPARTMENT SALVAGE PLANS

10.11.1 PURPOSE

This section establishes responsibilities for the emergency salvage of essential equipment exposed to products of combustion or fire fighting agents.

10.11.2 SCOPE

This section shall apply to all LaRC operations having essential equipment and equipment with programmatic value or long-term replacement times.

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Note: For equipment that does not fall within the above criteria, this standard shall be followed to the extent practicable.

10.11.3 REQUIREMENTS

10.11.3.1 Emergency Salvage Equipment

Emergency salvage equipment required for essential electronic equipment differs for the various locations; however, equipment that shall be provided includes:

1. Waterproof salvage covers (used to protect equipment).
2. Sprinkler stoppers (used to stop unnecessary flow from sprinklers).
3. Squeegees.
4. Mops and buckets.

10.11.3.2 Emergency Salvage Operations

LaRC Fire Chief shall ensure that preplans for salvage of essential equipment are developed and ensure salvage equipment is maintained. In the event of fire, particularly where there is considerable smoke or use of water, prompt salvage operations can greatly aid in the rapid restoration of operations and limitation of damage.

LaRC Fire Department Station Officer shall develop preplans for the salvage of essential equipment covered by this section.

LaRC Fire Fighting Forces shall perform prompt salvage and overhaul operations during emergencies and shall notify the Center Operations Directorate when salvage operations are required.

Center Operations Directorate shall assist the Facility Coordinator and/or Facility Safety Head in developing written procedures for reconditioning essential equipment.

Facility Coordinator and/or Facility Safety Head shall develop written procedures for salvage of essential equipment and shall ensure the necessary reconditioning of essential equipment as required.

10.11.4 RESPONSIBILITIES

LaRC Fire Chief shall:

1. Ensure that the required salvage equipment is maintained
2. Ensure the development of the salvage preplans and the performance of salvage operations.

Center Operations Directorate shall support the development of the procedures for reconditioning essential equipment.

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APPENDIX A
FORMAT FOR ANNUAL SUMMARY OF FIRE AND OTHER PROPERTY DAMAGE EXPERIENCE REPORT

1.0 Fire Related Deaths and Injuries
(Describe each incident relating to death or injury by fire.)

2.0 NASA Loss Experience for the Fiscal Year
- 2.1 Fire Loss Costs
- 2.2 Costs of Other Losses
  - 2.2.1 Explosions
  - 2.2.2 Natural Cause Events (earthquakes, tornadoes, etc.)
  - 2.2.3 Electrical Malfunctions
  - 2.2.4 Transportation Losses / On-Site Vehicular Accidents
  - 2.2.5 Mechanical Malfunctions
  - 2.2.6 Hazardous Materials Releases
  - 2.2.7 Miscellaneous Accidents (thermal, chemical, and corrosion related accidents)

3.0 Summary of Fire Damage Incidents (List each loss, including the category of loss, amount of loss [$], date, location, and type of accident.)
- 3.1 Losses of $50,000 or More
- 3.2 Losses of $1,000 to $49,999
- 3.3 Other Losses of Relevance

4.0 Significant Program Delays Due to Fire
(Describe all fire incidents that resulted in a significant programmatic delay.)

5.0 Incidents Actuating Automatic Fire Suppression Systems

- 5.1 Monetary Loss
- 5.2 Type of System
- 5.3 Number of Sprinkler Heads Activated
- 5.4 Quantity of Agent Discharged
- 5.5 Remedial Actions Taken to Prevent Future Accidental Discharge (if applicable)
- 5.6 Causative Factors
  - 5.6.1 Electrical
  - 5.6.2 Mechanical
  - 5.6.3 Human Error
  - 5.6.4 Acts of Nature
  - 5.6.5 Miscellaneous

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6.0 Halon Reduction Activities
- 6.1 Halon 1301
  - 6.1.1 Number of Fixed Systems
  - 6.1.2 Total Quantity of Halon 1301 at LaRC
    - 6.1.2.1 Active (in pounds) Including Reserve
    - 6.1.2.2 Inventory (in pounds)
  - 6.1.3 Number of Fixed Systems and System Quantity (in pounds) Deactivated in Last Year
  - 6.1.4 Number of Fixed Systems and System Quantity (in pounds) Converted to Manual Operation in Last Year
- 6.2 Halon 1211
  - 6.2.1 Total Quantity of Halon 1211 at LaRC
    - 6.2.2.1 Active (in pounds) Including Reserve
    - 6.2.2.2 Inventory (in pounds)
  - 6.2.2 Quantity (in pounds) Replaced by Other Agents in Last Year

7.0 Fire Protection Installations Completed During Fiscal Year (Include final engineering and construction costs for projects.)
- 7.1 Number, Type, and Status of Fire Protection Installations
- 7.2 Automatic Sprinkler Systems
- 7.3 Special Extinguishing Systems
- 7.4 Detection and Alarm Systems
- 7.5 Water Distribution System

8.0 Fire Department Activities
- 8.1 Number of Responses
  - 8.1.1 Fire
  - 8.1.2 Other Emergency
  - 8.1.3 Other Nonemergency
  - 8.1.4 Medical
- 8.2 Major Equipment Purchases
  - 8.2.1 Emergency Vehicles (Describe type and purchase price.)
  - 8.2.2 Other (Describe type of equipment and purchase price.)
- 8.3 In-House Training (Describe notable training programs sponsored during fiscal year.)
- 8.4 Inspection and Fire Prevention (Describe notable activities or programs conducted during previous fiscal year.)

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APPENDIX B
SAMPLE
FPE SURVEY DEFICIENCY DATABASE PRINTOUT

27Jul96

FPR Number: **II**

Violation Number	**Facility Number:**	**Year:**	**Violation Number**
1244-95-V01	1244	1995	V01

Violation Description: **Type of Violation:** FSD

The existing water deluge system within the hangar does not provide satisfactory protection per Section 3-1.1 of NFPA 409; and Chapter 7, Section 700 of STD 8719.11, NASA Safety Standard for Fire Protection.

Recommendation(s):

Provide an approved foam water deluge system(s) and supplemental protection systems designed in accordance with NFPA 16 and NFPA 11 or 11A, respectively. Enhanced fire detection should be provided with this system upgrade and be designed and installed in accordance with NFPA 72.

Status of Violation: **Status Description:**

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APPENDIX C

FIRE PROTECTION IMPAIRMENT

All impairments of LaRC fire alarm systems, fire suppression systems, control valves, initiating devices, notification appliances, supervisory equipment, water supply, power supply, communications equipment, gas monitoring systems, or other fire and life safety systems or parts thereof shall be promptly reported to the Emergency Dispatch Office (EDO) located at Facility1248 – NASA Fire Station by calling 864-5600. Information required shall include:

- Name of person reporting impairment
- Company, organization, or work group
- Telephone number
- Equipment impaired
- Equipment location (facility number, room or space number)
- Reason for impairment / outage
- Control Tag number
- Date / time equipment tagged out
- Anticipated date / time equipment to be placed back in service

EDO shall be promptly notified when equipment is restored back in service.

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Langley Research Center

LPR 1710.12
Effective Date: June 22, 2006
Expiration Date: June 22, 2011

POTENTIALLY HAZARDOUS MATERIALS-HAZARD COMMUNICATION STANDARD

National Aeronautics and Space Administration

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PREFACE

P.1 PURPOSE

a. The purpose of this Langley Procedural Requirement (LPR) is to define organizational requirements, procedures for the safe use of potentially hazardous materials, and to facilitate compliance with regulations promulgated by the Occupational Safety and Health Administration (OSHA) and other consensus standards that may be appropriate at LaRC.

b. These procedural requirements implement the requirements of OSHA 29 CFR 1910.1200, "Hazard Communication" and 29 CFR 1910.1450, "Occupational Exposure to Hazardous Chemicals in Laboratories." It outlines the procedures to be followed to obtain and maintain information on potentially hazardous materials and the requirements for training employees on the use of this information.

c. Organizational responsibilities and administrative procedures for the acquisition and use of potentially hazardous materials are stated within this LPR, including the requirement that a permit system shall be used for dangerous potentially hazardous materials including carcinogens and highly toxic gases.

d. General and specific health and safety information for various classes of potentially hazardous materials is included in these procedural requirements, which is intended to be used as a general reference and is not intended to necessarily furnish all information required to plan and execute the safe operation for a given material. A list of sources of additional information is maintained by the Safety and Facility Assurance Branch (SFAB), Safety and Mission Assurance Office (SMAO).

e. The intent of this procedural requirement is not to address all procedures and laws pertaining to potentially hazardous materials, such as the Department of Transportation shipping regulations for potentially hazardous materials sent off LaRC. For technical assistance in this area, employees shall contact the LaRC Transportation Officer, Logistics Management Team (LMT), Center Operations Directorate (COD). Environmental laws and requirements concerning the manufacture, emission, and disposal of hazardous materials are not detailed in this LPR, but are presented in LPR 8800.1, "Environmental Program Manual." For technical assistance on environmental requirements contact the Environmental Management Team (EMT), COD.

P.2 APPLICABILITY

a. The provisions of this procedural requirement are applicable within the LaRC organizational elements to both NASA contractors, to the extent required by their contracts, and resident organizations directly concerned with the procurement, handling, use, storage, disposal, and inspection of potentially hazardous materials. The training of employees to meet the basic hazard communication and laboratory standard requirements shall be the responsibility of NASA for civil servant employees and the

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contracting company for contractor employees. As a minimum, contractor requirements shall be in accordance with the LaRC requirements as described in these procedural requirements.

P.3 AUTHORITY

a. ANSI Z400.1, "Hazardous Industrial Chemicals - Material Safety Data Sheets - Preparation."
b. ANSI Standard Z87.1, "Practice for Occupational and Educational Eye and Face Protection."
c. Air Force Inter-service Manual 24-204, TM-38-250, NAVSUP PUB 505, MCO P4030.19H, DLA 414.3, Transportation, "Preparing Hazardous Materials for Military Air Shipments."
d. Code of Federal Regulations (CFR), Title 49, Subtitle B, Chapter 1, "Research and Special Programs Administration."
e. 49 CFR, Subtitle B, Chapter 1, Subchapter C, "Hazardous Materials Regulations," Parts 171-177.
f. 46 CFR, "Shipping."
g. Federal Supply Class (FSC), FED-STD-313C, "Material Safety Data Sheets."
h. National Fire Protection Association (NFPA) 30, "Flammable and Combustible Liquids Code."
i. NFPA 704, “Standard System for the Identification of Hazardous Materials for Emergency Response.”
j. NFPA 77, "Recommended Practice on Static Electricity."
k. OSHA 29 CFR, Subpart I, 1910.132, "General Requirements."
l. OSHA 29 CFR 1910.1200, "Hazard Communication."
m. OSHA 29 CFR 1910.1450, "Occupational Exposure to Hazardous Chemicals in Laboratories," including Appendix B, "References (Non-Mandatory).”

P.4 REFERENCES

a. International Agency for Research on Cancer
b. Matheson Gas Data Book,” “Handbook of Compressed Gas,” “Encyclopedia of Chemical Technology.”
c. National Institute for Occupational Safety and Health (NIOSH) Pocket Guide to Chemical Hazards.
d. National Toxicology Program.
e. OSHA Form 174, "Material Safety Data Sheet."
f. CID 1150.2, "Councils, Boards, Panels, Committees, Teams, and Groups."
g. LAPD 1700.1, "Safety Program."
h. LAPD 1700.2, "Safety Assignments."
i. LPR 1710.4, “Personnel Protection - Clothing and Equipment.”
j. LPR 1710.5, "Ionizing Radiation."
k. LPR 1710.7, "Use and Handling of Explosives and Pyrotechnics."
l. LPR 1740.6, “Personnel Safety Certification.”
m. LPR 8800.1, “Environmental Program Manual.”

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n. Langley Management System (LMS) CP-4505, "Purchase Requisition (PR) Initiation/Modification/Cancellation and Supporting Documentation."
o. LMS-CP-4540, "Purchase Card."
p. LMS-CP-4703, "Review of Purchase Requisitions by the Safety and Mission Assurance Office (SMAO)."
q. LMS-CP-4759, "Acquisition of Hazardous Materials."
r. LMS-CP-4760, "Reporting Injuries, Illnesses, Compensation Claims and Unsafe Working Conditions."
s. National Science Foundation, Article 49, "Government Performance and Results Act."
t. NASA Langley Form 44, "Hazardous Material--Procurement, Inventory, and Storage Record."
u. NASA Langley Form 52, "Shipping/Transfer Document."
v. NASA Langley Form 62, “Chemical Worker's Certification Card."
w. NASA Langley Form 66, “Worker Appointment and Certification Form."
x. NASA Langley Form 118, "Safety Permit Request - Hazardous Material."
y. NASA Langley Form 163, "Waste Material Data Sheet."
z. NASA Langley Form 131, "Receipt and Inspection Report (Non-stocked Items)."
aa. NASA Langley Form 175, "Material Safety Data Sheet Review Request."
bb. NASA Langley Form 498, "Safety Permit."

P.5 CANCELLATION

LPR 1710.12 dated October 3, 2004.

Original signed on file

Lesa B. Roe
Director

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Chapter 1

INTRODUCTION

a. Potentially hazardous materials (PHM) are defined as any substance having intrinsic properties, which can pose a risk of injury or illness to personnel or of destruction to property. That is, any material which is a health or physical hazard. Specifically, provisions of these procedural requirements are applicable to materials having toxic, flammable, corrosive, cryogenic, or asphyxiation properties. Radioactive and explosive materials are not included as they are covered in LPR 1710.5, "Ionizing Radiation," and LPR 1710.7, "Use and Handling of Explosives and Pyrotechnics," respectively.

b. PHM includes those substances defined by the Occupational Safety and Health Administration (OSHA) as hazardous chemicals. The OSHA definition includes as hazardous chemicals those for which there is statistically significant evidence, based on at least one study, conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. OSHA includes in its definition hazardous chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic systems, and agents which damage the lungs, skin, eyes, or mucous membranes. (Reference 29 CFR 1910.1450, Appendix B.)

1.1 DEFINITIONS AND TERMINOLOGY

Appendix E contains definitions and terminology used in these procedural requirements.

1.2 RECORDS

The following forms are completed when implementing requirements:

a. NASA Langley Form 44, "Hazardous Material--Procurement, Inventory, and Storage Record."
b. NASA Langley Form 52, "Shipping/Transfer Document."
c. NASA Langley Form 62, “Chemical Worker's Certification Card."
d. NASA Langley Form 66, “Worker Appointment and Certification Form."
e. NASA Langley Form 118, "Safety Permit Request - Hazardous Material."
f. NASA Langley Form 131, "Receipt and Inspection Report (Non-stocked Items)."
g. NASA Langley Form 163, "Waste Material Data Sheet."
h. NASA Langley Form 175, "Material Safety Data Sheet Review Request."
i. NASA Langley Form 498, "Safety Permit."

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Chapter 2

RESPONSIBILITIES

2.1 POTENTIALLY HAZARDOUS MATERIALS COMMITTEE

a. The Potentially Hazardous Materials Committee (PHMC) is established under the authority of LAPD 1700.1, “Safety Program,” and CID 1150.2, "Councils, Boards, Panels, Committees, Teams, and Groups." Any member of this committee is authorized to investigate any questionable use of a PHM, act in the name of the Center Director to stop work or to prevent use of the material, which is considered unsafe, and initiate action to eliminate the unsafe condition. Such action shall be documented within 24 hours by formal letter to the Chairperson, PHMC. However, if line management is not in agreement with the corrective action recommended by the official who stopped the work, these reasons shall be submitted to the Chairperson, Executive Safety Council (ESC), who shall make an appropriate review. In these cases, work shall not resume without the approval of the Chairperson, ESC.

b. Due to the need for the PHMC to maintain an overview of operations at LaRC involving PHM’s, a review system has been established. This review system includes NASA Langley Form 498, "Safety Permit" which is described in Chapter 5 of this procedural requirement. NASA Langley Form 498s are required before operations commence.

c. The PHMC shall also overview the activities of the Explosives Support Engineer for control of pyrotechnic materials.

2.1.1 Structure and Organization

a. The PHMC functions as a committee of the ESC. Its position in the organization for control of PHM’s is shown in Figure 2.1. Committee members, including the Chairperson, shall be appointed by the ESC, by virtue of their technical and/or educational expertise in such areas as chemistry, hazardous gases, and compatibility of materials. Members are appointed to serve for a three-year term. During the first meeting of a new calendar year, the committee shall elect a committee secretary from its full membership. The committee secretary's responsibilities include preparing and distributing committee minutes in addition to all other functional responsibilities. Representatives of the SFAB, SMAO shall serve as members of the committee. Typically, this representation shall consist of the SFAB Industrial Hygiene (IH) staff and the LaRC Safety Manager or his/her designated representative.

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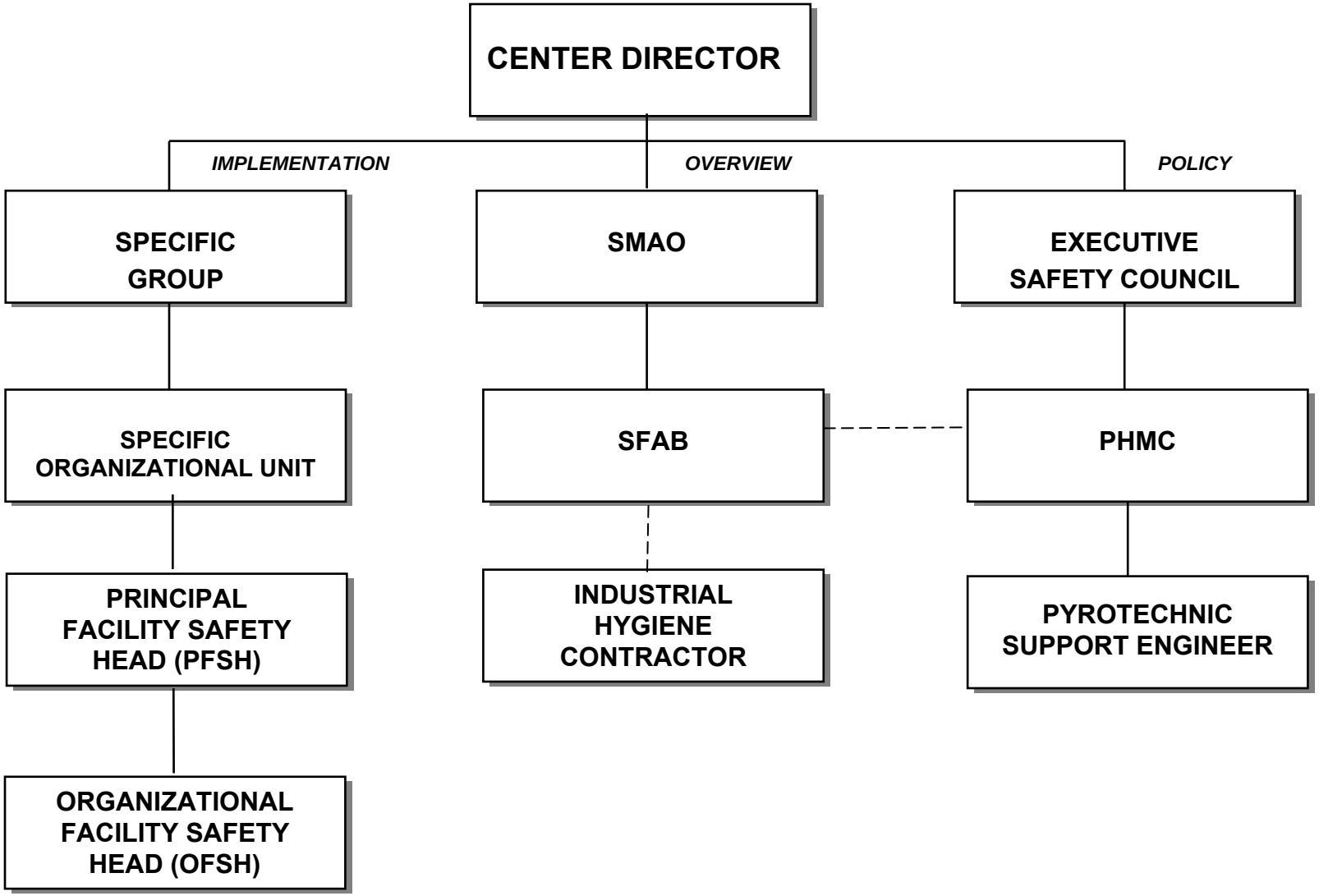

Figure 2.1, LaRC Organization for Control of Potentially Hazardous Materials.

2.1.2 Duties and Responsibilities

a. The duties and responsibilities of the committee are set forth in CID 1150.2. The committee functions as a review and guidance body providing recommendations in applicable areas as required. The committee shall:

(1) Prepare and distribute minutes of committee meetings, which shall contain, as a minimum, a record of persons present and a description of matters discussed and conclusions reached including the opinions of dissenting members, and copies of all reports issued or approved by the committee. Committee minutes shall be distributed to all members, the affected operations personnel, the Chairperson, ESC, and the Director, SMAO.
(2) Carry on official correspondence for the committee as needed.

b. Membership duties are:

(1) Be cognizant of matters pertaining to use of PHM's at LaRC. This is chiefly, but not entirely, achieved by attending the committee meetings and participating in the decisions made by the committee.
(2) Serve on ad hoc committees, which are appointed by the Chairperson as needed.

2.2 SAFETY AND HEALTH FUNCTIONS

a. The primary responsibility for the safe use of PHM's lies with the individual user. Although this responsibility cannot be delegated, various LaRC functions provide planning, management, and assistance.

2.2.1 Facility Safety Head (FSH)/Chemical Hygiene Officer (CHO)

a. The prime responsibilities of the Facility Safety Head (FSH) are the safe operation of the research apparatus and maintenance of a safe working environment. The scope of this responsibility encompasses such elements as the establishment and use of normal and emergency operating procedures, configuration control, safety training, preventative maintenance, and the other traditional institutional types of safety considerations.

b. The FSH may appoint an Organizational Facility Safety Head (OFSH) for each operation that is functionally distinct. Procedures for appointments are provided in LAPD 1700.2, "Safety Assignments." The FSH or OFSH shall, in each case, be a representative of line management who is thoroughly familiar with the operation.

c. FSH's and/or OFSH's shall be familiar with any NASA Langley Form 498s issued for their facilities. For laboratories operating under a Chemical Hygiene Plan (CHP), the FSH shall be the Chemical Hygiene Officer (CHO). The CHO is an employee who is

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qualified by training or experience to provide technical guidance in the development and implementation of the provisions of the CHP and applicable NASA Langley Form 498s.

2.2.1.1 Interfaces

a. The FSH or OFSH of the facility where the PHM is to be used shall be the first point of contact for the individual who has the need for the procurement, use, storage, or disposal of a PHM. The first point of contact for the FSH or OFSH for assistance with use of PHM's shall be the SFAB Industrial Hygiene (IH) staff.

2.2.1.2 Responsibilities

a. The basic responsibilities of the FSH or OFSH are described in LAPD 1700.2. The FSH or OFSH shall implement these requirements for the safe use of PHM's:

(1) Establish and review normal and emergency operating procedures. These procedures shall include cleanup of Class I ("Integrated Spill Contingency Plan") spills by facility personnel (normally, the using agency). Class II ("Integrated Spill Contingency Plan") spill assistance shall be sought from the LaRC Safety Manager (Chapter 2.2.4). All spills shall be reported to the LaRC Safety Manager.

(2) Supervise and coordinate the procurement, use, storage, and disposal of PHM's. Requirements for the initial identification and procurement of hazardous materials as contained in this chapter of this procedural requirement. Disposal is covered in detail in LPR 8800.1 and is mentioned in Chapter 6 of these procedural requirements.

(3) Maintain an inventory of hazardous materials using the Center's web-based Chemical Material Tracking System (CMTS). Specific requirements are covered in LPR 8800.1, Chapter 19.

(4) Maintain a file of Material Safety Data Sheets (MSDS's), (see Chapter 4) of all PHM's used in the facility. This MSDS file shall be one central file, (several small files in separate work areas in a large facility is permitted). The FSH shall determine the appropriate file location(s). Requirements for these files are as follows:

(a). These files shall include all appropriate MSDS's. For example, several containers of 100 percent acetone (even if from multiple vendors) need only one MSDS since acetones chemical makeup does not vary. However, files for the generic class "cleaning solvent" or class "black enamel paint, spray, 16 ounce," may contain several MSDS's for each of these items because several vendors may have supplied similar materials. The MSDS may vary from vendor to vendor since the chemicals, and hazards, will differ. **A MSDS IS REQUIRED FOR EACH POTENTIALLY HAZARDOUS CHEMICAL PRESENT.** This MSDS requirement includes "free" vendor samples as well as LaRC research and development test chemicals in use outside of their manufacturing location (e.g., laboratory hood, batch processor).

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(b). The MSDS file(s) shall be accessible to all employees working in the facility and its location(s) shall be made known.

(c). Exceptions exist for the maintenance of MSDS files under the chemical laboratory standard. Laboratories operating under a NASA Langley Form 498 shall maintain documentation on basic hazardous materials produced. The chemical laboratory safety program relies on process control through procedures, rather than identification of all hazardous components.

(d). Hazardous materials including research and development chemicals produced for processing or evaluation in facilities other than the point of manufacture shall have a MSDS completed, with one copy being forwarded for hazard review to the SFAB IH staff for PHMC and SFAB, SMAO review (See Chapter 4).

(5) Ensure that all employees who routinely work in the facility are aware of the physical or chemical hazards of the materials they routinely work with, and other hazardous materials in the facility that they may encounter in any foreseeable emergency. For facilities with highly toxic substances in use or in storage, visitors shall be apprised of special facility emergency procedures in the event of leaks or spills. For example, if warning lights are used to indicate hazardous conditions, visitors (including other on-site LaRC personnel who may periodically enter the facility) shall be informed of the meaning of the warning light and appropriate actions. Warning lights, bells, and so forth, shall include signs indicating the purpose of the alarm (e.g., "Fluorine Gas Alarm").

(6) Provide or acquire periodic refresher training for workers whenever significant changes occur for chemicals in use in the facility.

(7) Maintain a current list of employees in the organization who are trained and certified to use materials under NASA Langley Form 498 (Chapter 5).

(8) Ensure capabilities and procedures exist in the facility for cleanup of Class I spills of hazardous materials. Seek the assistance of the EMT and the LaRC Safety Manager's staff for containment and cleanup assistance of Class II spills involving hazardous materials.

(9) Accompany SFAB, SMAO, personnel and representatives during all surveys and audits of the organization.

2.2.2 Facility Coordinator (FC)

a. In the absence of the FSH, the Facility Coordinator (FC) shall accompany SFAB, SMAO personnel during surveys and audits of the organization.

2.2.3 SFAB Industrial Hygiene Staff

a. The SFAB IH staff has specific interfaces and responsibilities with regard to PHM’s. The SFAB IH staff shall be comprised of individuals who are Certified Industrial Hygienists by the American Board of Industrial Hygiene.

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2.2.3.1 Interfaces

a. The SFAB IH staff reports directly to the LaRC Safety Manager and serves on the PHMC. The SFAB IH staff shall be the primary committee contact for on-site users of PHM's.

2.2.3.2 Responsibilities

a. The SFAB IH staff responsibilities are to:

(1) Provide technical and administrative guidance to LaRC personnel for the safe use of PHM's where such material may pose a health hazard. Assist personnel in the interpretation of MSDS technical data.
(2) Provide monitoring services to document personnel exposures. Results of these surveys shall be provided to the individual (or to the facility for posting) within 15 business days of receipt of results of laboratory analysis.
(3) Perform pre-operational surveys to identify potential health hazards and recommend control procedures. This shall include assisting in the determination of industrial ventilation to control health hazards.
(4) Perform periodic inspections to assure the effectiveness of control procedures and identify the need for a NASA Langley Form 498. Ventilation systems (fume hoods and paint booths) used to control health hazards shall be surveyed annually. Audit all NASA Langley Form 498s at least annually for compliance and report results to the PHMC.
(5) Provide training and indoctrination of personnel in health hazard control measures such as personal protective equipment (e.g., respirators, gloves).
(6) Review PHM purchase requests for compatibility with approved policies and procedures and to help identify changes in use, which may require new or additional health hazard control measures.
(7) Advise the LaRC Safety Manager of non-health related hazards associated with the use of PHM's.
(8) Advise the PHMC, the Occupational Health Services (OHS), and SFAB, SMAO of developments in statutory requirements and standards of good practice for the control of PHM's where such materials may pose health hazards.
(9) Supply MSDS's, to NASA Langley Form 44 Coordinator, from MSDS databases or assist in the acquisition and technical interpretation of proprietary or trade secret MSDS information.

2.2.4 LaRC Safety Manager (Head, SFAB, SMAO)

a. The LaRC Safety Manager has specific interfaces and responsibilities with regard to PHM's.

2.2.4.1 Interfaces

a. The LaRC Safety Manager shall:

(1) Report directly to the Director, SMAO
(2) Serve on the PHMC as a member (or assign a designee)

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(3) Be the principal LaRC contact with federal safety and health regulatory agencies.

2.2.4.2 Responsibilities

a. The responsibilities of the LaRC Safety Manager are described in LAPD 1700.2, Safety Assignments." The LaRC Safety Manager's responsibilities for the safe use of PHM's are to:

(1) Provide technical and administrative guidance for the safe storage and use of PHM's where such material poses hazards not primarily health related.
(2) Ensure the SFAB IH staff conducts pre-operational reviews of new PHM activities to identify hazards and their control procedures.
(3) Use annual facility safety and health audits to assure the effectiveness of the NASA Langley Form 498 control measures.
(4) Review training data and/or provide training and indoctrination of personnel through the SFAB IH staff, as needed, to assure understanding of the LaRC hazard communication requirements.
(5) Serve as the final reviewing and/or certifying authority for the following:
  (a). NASA Langley Form 66, "Worker Appointment and Certification Form" (Chapter 5).
  (b). NASA Langley Form 44, "Hazardous Material--Procurement, Inventory, and Storage Record" (Chapter 3).
  (c). NASA Langley Form 498, "Safety Permit".
(6) Provide assistance to facility personnel in Class II spills control (Class II spills are environmentally reportable) through the use of supplies and manpower available on-site or through prior planning and arrangements by SFAB, SMAO with off-site response teams. These activities are outlined in "Integrated Spill Contingency Plan," and LPR 8800.1, "Environmental Program Manual."

2.2.5 LaRC Safety Manager Designated Representative, SFAB, SMAO

a. In the absence of the LaRC Safety Manager in matters regarding PHM's, full signature authority shall be granted to the LaRC Safety Manager's designated representative.

2.2.6 Occupational Health Services

a. The Office of Human Capital Management (OHCM) through the Occupational Health Officer (OHO) and the Occupational Health Services (OHS) contractor shall be the primary contact for LaRC employees for matters relating to occupational health. Responsibilities are described in LAPD 1700.2. The Director, OHCM shall implement these responsibilities for the safe use of PHM's:

(1) Recommend and implement medical surveillance of users of PHM's.
(2) Maintain appropriate records of such surveillance.
(3) Serve as a qualifying official on NASA Langley Form 66.

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(4) Stay alert for adverse health incidents, such as possible chemical related contact dermatitis, involving PHM's.

2.2.7 Logistics Management Team, Capital Assets Management

a. The Capital Assets Management (CAM) shall ensure Logistics Management Team (LMT):

(1) Maintain a file of MSDS's for all materials available through the stores stock, and provide a copy of the MSDS to users upon chemical issue.
(2) Transmit to users a copy of the MSDS provided by suppliers for materials obtained by Purchase Request.
(3) Attach NFPA 704A labels to items issued from supply.
(4) Only issue store stock items that have an approved Langley Form 44.

2.2.8 Employ ee Responsibilities

a. Employees shall:

(1) Participate in training. The OHCM shall incorporate basic hazard communication training information into its NASA LaRC employee indoctrination program.
(2) Review MSDS's prior to using PHM's. New MSDS's on existing materials from vendors shall be changed when the ingredients are changed or technical information is changed. New MSDS's shall be reviewed when received.
(3) Not cover or mark any warning labels used on containers or products received or in use. For transfers to other containers, place labels or legibly mark the containers with the LaRC warning label and the name of the PHM. (NOTE: This marking is not required if the transfer container is used immediately [usually within a few minutes] in the process.)

2.3 OFF STANDARD HOURS LABORATORY WORK

a. Standard-shift working hours for laboratory areas are permitted between 6:00 am and 6:00 pm, Monday through Friday, excluding holidays. During standard hours, employees shall not be alone when conducting their work; laboratory procedures performed outside of the standard shift are affected by the following requirements:

(1) Routine laboratory operations are permitted during off standard working hours if the "buddy system" is used. The "buddy system" requires having a designated, qualified LaRC employee or "buddy" present in the area that will remain in the same laboratory/room as the employee performing the laboratory operation. The FSH or Branch Head shall maintain a list of qualified persons who may act as a "buddy." Examples of routine laboratory operations include wet chemistry, film casting, composite preparations, hydraulic systems, any machinery or shop equipment, and permitted operations. Questions concerning whether an operation requires use of the "buddy system" shall be referred to the FSH.

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(2) Non-hazardous laboratory operations not requiring the “buddy system” during off standard hours shall be limited to non-invasive type tasks such as making visual checks of experimental apparatus, turning instruments or controls on or off, and data recording. Characterization experiments also shall be performed if the procedure does not involve the handling of hazardous materials (e.g., liquid nitrogen).

(3) All office work is permitted during off standard hours and shall not require using the “buddy system.” Employees performing office work during off standard working hours are reminded to adhere to the Center’s security and safety procedures.

(4) Non-emergency assistance during off standard working hours shall be obtained by calling the Duty Officer at 864-4927. Medical and fire emergency assistance may be obtained by calling 911 from any Center phone or 864-2222 from a cellular phone.

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Chapter 3

ACQUISITION, RECEIPT, HANDLING, STORAGE, MARKING, PRESERVATION AND DELIVERY OF POTENTIALLY HAZARDOUS MATERIAL

a. This chapter describes the procedural requirements for the procurement, acquisition, and on site transfer of PHM's and MSDS's. PHM may be brought on site and stored or used in facilities after approval of the Langley Form 44. Procedures for the shipment of PHM's off-site are briefly outlined in Chapter 6 of this procedural requirement. Requirements for the storage of PHM's at LaRC are also briefly outlined in Chapter 6.

3.1 ACQUISITION AND TRANSFER OF POTENTIALLY HAZARDOUS MATERIAL

a. Refer to Langley Management System (LMS) Center Procedures (CP) 4505, "Purchase Requisition (PR) Initiation/Modification/Cancellation and Supporting Documentation," LMS-CP-4540, "Purchase Card," LMS-CP-4703, "Review of Purchase Requisitions by the Safety and Mission Assurance Office (SMAO)," and LMS-CP-4759, "Acquisition of Hazardous Materials." These CP's shall be followed for all PHM's brought on-site including purchasing from commercial sources, through contractor sources, research and development engineering samples, and commercial product samples. All PHM's brought on-site shall have an MSDS.

b. The use of facility maintenance PHM's (e.g., solvent, paints, hydraulic fluids) and cleaning supplies are normally done by on-site contractors. Electronic NASA Langley Form 44s and MSDS's shall not be required for the transfer of maintenance or custodial PHM's between the operating site MSDS file and files at individual job sites. These support contractors shall provide appropriate PHM MSDS's for material in use or stored in the facility to FSH's or their representatives.

3.2 IDENTIFICATION OF HAZARDOUS ITEMS BY FEDERAL SUPPLY CLASS

a. Federal Supply Class (FSC), FED-STD-313C, "Material Safety Data Sheets," contains lists identifying hazardous items. Any FSC item could contain a PHM. The listings in Tables I and II of FED-STD-313C are not intended to be inclusive listings of all hazardous items, but to identify the major classes, which contain PHM's and provide examples of hazardous items in other classes. Contact the SFAH IH staff to obtain the most recent version of these Tables.

b. MSDS's shall be submitted for all items in the FSC-STD-313C, Table I. MSDS's shall be submitted for the PHM's in FSC-STD-313C not listed in Table I. Some examples of PHM's in other FSC are listed in Table II of FSC-STD-313C.

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3.3 PROCEDURE FOR ACQUISITION, RECEIPT, STORAGE, ISSUE AND DISPOSAL OF HAZARDOUS MATERIALS

3.3.1 Acquisition

a. The following procedures shall be used for the acquisition of PHM's. The process for purchasing hazardous material is described within this chapter.

3.3.1.1 NASA Purchase Requisition and SAP

a. Reference LMS-CP-4505, "Purchase Requisition (PR) Initiation/Modification/Cancellation and Supporting Documentation."

3.3.1.2 Material Handling

a. Reference LMS-CP-4759, "Acquisition of Hazardous Materials."

3.3.1.3 NASA Procurement Card Order

a. Reference LMS-CP-4540, "Purchase Card."

3.3.1.4 Contractor Purchase

a. Contractor order, procurement, handling, and disposal of PHM's shall be done in accordance with the Statement of Work (SOW) and the terms/conditions of the contract. Requirements in this section shall still be adhered to.

3.3.1.5 Free Engineering Samples

a. Many companies will send free samples of materials they normally only sell in bulk quantities. Use this method if the user needs only a small amount of material to test for an application and the supplier is willing to send a free sample. NASA Langley Form 44 and a MSDS shall be used for this transaction. Be sure to indicate in the obtained by box of the NASA Langley Form 44 that the material is a free sample. Provide the vendor with an accurate delivery location within your facility, which shall not include office areas. Receipt of free engineering samples shall be conducted by Receiving or by the individual, depending on where the item was sent. Notify the FSH (or designated Hazardous Material Inventory Manager) when the item is received so it can be added to the facility chemical inventory. For more information contact the SFAB IH staff.

3.3.2 Transfer of Hazardous Materials Between NASA Langley Research Center Facilities

a. Reference LMS-CP-4759, "Acquisition of Hazardous Materials."

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3.3.2.1 Shipping Hazardous Materials to an Off-Site Location

a. When a hazardous material must be shipped to an off-site location, use NASA Langley Form 52, "Shipping/Transfer Document", a NASA Langley Form 44, and a MSDS. If the item is research material, a MSDS shall be prepared prior to delivery of the material to the Shipping Office (Chapter 4). For more information contact the Shipping Office or the CMTS Administrator.

3.3.2.2 Transfer of Hazardous Materials to and From an Off-site Location

a. Personally transporting PHM's to an outside source shall not be permitted. If at all possible these products shall be shipped off-site. Personally transporting PHM's from an outside source shall also not be permitted. If at all possible, these products shall be shipped.

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Chapter 4

MATERIAL SAFETY DATA SHEETS

a. This chapter contains information for technical assistance in the preparation of MSDS's. The format presented meets basic OSHA requirements and is in accordance with ANSI Z400.1, "Hazardous Industrial Chemicals - Material Safety Data Sheets - Preparation" requirements. Different countries may have additional technical or procedural requirements for this type of information. All LaRC created MSDS's shall be entered in the CMTS. LaRC created MSDS's should be sent to CMTS administrator at cmts@larc.nasa.gov.

b. MSDS's are required for all PHM's. A copy of the MSDS for each PHM used in facility research or maintenance operations shall be readily accessible to employees in that facility. The location and set up of MSDS files shall be the responsibility of FSH's. PHM's include metals, solvents, paints and fiberglass. Review Paragraph 4.3 of this section of "Material Safety Data Sheets," for additional information on which materials require MSDS's.

c. MSDS recordkeeping of facility cleaning and maintenance PHM (including solvents, paints, and hydraulic fluids) is normally done by on-site contractors. These contractor operations can maintain either a central operating site MSDS file or files at individual job sites. These support contractors shall provide appropriate PHM MSDS's for materials in use or stored in the facility to FSH's or their representative, if requested.

d. For PHM requested by the facility from LaRC supply stock, MSDS information shall be maintained and forwarded by supply personnel when requested by the facility. NASA Langley Form 44, "Hazardous Material--Procurement, Inventory, and Storage Record." shall be noted in the supply catalog when required.

e. Trade secret and proprietary MSDS's exist and their access and distribution is limited (under OSHA regulations) to medical and other selected personnel. In these situations, the SFAB IH staff shall be contacted to acquire the necessary information to assist in working with authorized personnel to determine safe use of the materials planned for use. MSDS's so acquired shall be maintained by the SFAB IH staff.

4.1 PREPARATION OF MSDS FOR CENTER-DEVELOPED MATERIALS

a. MSDS's shall be prepared to provide basic hazard warning information for PHM's being transferred between facilities or as operations are scaled up for testing in facilities. MSDS's shall be required by off-site facilities using the material in other applications. These MSDS's shall be shipped with the material.

b. All MSDS's prepared shall be reviewed by the SFAB IH staff, LaRC Safety Manager, and the PHMC. MSDS's shall be forwarded to the LaRC Safety Manager to start this process.

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c. Copies of the reviewed MSDS's shall be maintained by the LaRC Safety Manager's staff. The 24 hour emergency point of contact required by OSHA shall be the Emergency Dispatch Officer at the Fire Department. The Fire Department provides a telephone service only and shall forward emergency calls to the technical researcher/expert on the item.

4.2 NASA LaRC MSDS LIBRARY

a. The EMT shall maintain an electronic library of MSDS's for all known PHM's at the Center through the CMTS. Information from MSDS's along with inventory information collected in the CMTS shall be used to perform calculations for regulatory reports. These reports shall be submitted to federal, state, and local agencies to keep the Center in compliance with environmental as well as health and safety regulations and permits. The procedures for accessing, searching, and adding MSDS's to the MSDS Library are described herein.

4.2.1 Accessing and Searching the Library

a. The Library can be accessed by anyone at the Center on-line at the following address:

http://osemant1.larc.nasa.gov/cmts/

Instructions on how to use the Library are on-line or you may contact the CMTS Administrator at the following e-mail address:

cmts@larc.nasa.gov

The Library is not meant to be a replacement for the Center's MSDS's book, but rather a supplement.

4.2.2 Adding MSDS's to the Library

a. LaRC continues to purchase new items to accomplish its research mission. In order to keep the Center's MSDS Library up-to-date, Center personnel shall ensure that MSDS's for new materials are submitted to EMT for entry.

b. A MSDS shall be submitted for entry to the MSDS Library one of the following ways:

(1) Mail a copy of the MSDS to the CMTS Administrator at MS 320.
(2) E-mail an electronic copy of the MSDS to the CMTS Administrator at:

cmts@larc.nasa.gov.

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4.3 SCOPE AND APPLICATION

a. 29 CFR 1910.1200, "Hazard Communication Standard" defines the requirements by which MSDS's shall be prepared for chemicals or mixtures of chemicals that are hazardous. The procedural requirement at NASA LaRC is to prepare MSDS's for all hazardous materials and chemicals, resins, adhesives, powders, fibers, prepreg, towpreg, abrasive materials, ceramic powders, metal alloys, foams, colloids, solutions, oils and lubricants, and gases produced by NASA or on-site contract employees. MSDS's shall be required to transfer materials from the area of origin, or to be shipped off-site.

b. Preparation of a MSDS shall require specific information on the ingredients of a newly developed material. If the researcher or engineer has new, useful or unusual intellectual property, and is uncomfortable about disclosure of such information, they shall seek patent protection for their product. Because review of a MSDS will take approximately 30 days, it is necessary for researchers and engineers to anticipate the need for MSDS's prior to shipment of their product off-site. MSDS's shall be prepared in advance for materials that may be needed for technology transfer operations.

c. This chapter shall be used by persons responsible for developing MSDS's for chemicals produced at NASA-LaRC. This step-by-step procedural requirement shall aid in the preparation of MSDS's for materials that are invented on-site. Because the information included in a MSDS is from many diverse areas, a team approach shall be used to produce the MSDS, with researchers and engineers collaborating with IH's, occupational physicians, environmental and fire safety engineers, and the shipping officials who have regulatory knowledge in their appropriate fields. The originator (or responsible researcher) of the material shall have primary responsibility for the production and review of the MSDS with contributions made from a number of different individuals. When the final document is completed, a NASA Langley Form 175, "Material Safety Data Sheet Review Request" shall be attached to the document and sent for approval to the Chairperson of the PHMC.

d. A MSDS template has been developed to standardize the MSDS's being produced at LaRC. The specific sections of the MSDS are detailed below. Unknown or unavailable information or data shall be indicated as such. Information in this document has been taken from ANSI Z400.1 and many of the terms and acronyms used here are found in the glossary of that document. The full document contains many useful examples of phrases that may be used in the sections below.

4.4 DETAILED TEMPLATE DESCRIPTIONS

a. Detailed descriptions of each section of the LaRC MSDS template are:

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4.4.1 CENTER IDENTIFICATION

a. This information shall be provided by the originator or responsible researcher or engineer who developed the material. This section identifies the specific source of the material at LaRC, identifies a 24-hour contact for emergency information and identifies a technical information contact. If the MSDS is intended for foreign distribution, an indication that the telephone numbers are United States telephone numbers shall be included.

b. The format used on the LaRC MSDS template is as follows:

NASA Langley Research Center
_____ Branch or Organizational Unit
Mail Stop _____, _____
Hampton, VA 23681-2199
Emergency Telephone: (___) ___-____ (24-hr contact)
Information Telephone: Area code and telephone number of the responsible researcher of the material (Monday-Friday, 9:00 AM to 3:99 PM EST)

4.4.2 SECTION 1: MATERIAL IDENTIFICATION

a. This information shall be provided by the responsible researcher of the material. This section links the MSDS's to the specific material by listing the trade name, as it appears on the label and a specific product code reference, for example a notebook number, work order number, batch or run number which can be used to provide more specific information on the materials. Synonyms or alternate names shall also be included here, although the trade name shall always be the name listed on the product label.

b. The format used on the LaRC MSDS template is as follows:

Trade Name:
Product Code:

4.4.3 SECTION 2: COMPOSITION

a. The information on components, Chemical Abstract Service (CAS) Number, and weight percent shall be provided by the responsible researcher of the material. Exposure limit information shall be provided by the SFAB IH staff. This section lists the OSHA hazardous components (as defined in OSHA 29 CFR 1910.1200(g) Appendix A). All ingredients that contribute to the hazards of the material or which otherwise meet the OSHA 29 CFR 1910.1200 criteria shall be identified. If this compound is formed from the chemical reaction of more than one chemical, these ingredients only need to be listed if they are present in the final product in quantities greater than 1percent (0.1 percent for carcinogens).

b. The format used on the NASA LaRC MSDS template is as follows:

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			EXPOSURE LIMITS		
COMPONENT	CAS #	WT %	OSHA PEL	ACGIH TLV	OTHER LIMITS

4.4.4 SECTION 3: HAZARDS IDENTIFICATION/POTENTIAL HEALTH EFFECTS

a. This section provides information from the SFAB IH staff and the responsible researcher on the potential adverse human health effects and symptoms that might result from reasonably foreseeable use or misuse. The format used on the LaRC MSDS template is as follows:

Emergency Overview:	List the most significant concerns for emergency response personnel. It is listed first in this section, so that it will be easy to find.
Route(s) of Entry:	List the probable routes of entry. Include as applicable: inhalation, absorption through the skin and eyes, and accidental ingestion.
Signs And Symptoms of Overexposure:	List any known signs or symptoms of overexposure to materials or components.
Immediate or Acute Effects:	List effects that will appear a short time after a single exposure.
Long Term or Chronic Effects:	List effects of product or of any hazardous components that may occur over persistent, prolonged or repeated exposure. Target organ information may also be included here.
Carcinogenicity:	Products or components of products, which are listed as carcinogens or potential carcinogens by OSHA, IARC, NTP or NIOSH, shall be specified here. This information is required for components in quantities $\geq$ 0.1percent. Specify the source of information and class of carcinogen if available.
Reproductive Hazards:	Products or components of products, which are, listed as reproductive hazards or potential reproductive hazards by REPROTEXT, TERIS, REPROTOX or Shepard's Catalog of Teratogenic Effects shall be specified here. Specify source of information and what type of hazard is shown.

4.4.5 SECTION 4: FIRST AID MEASURES

a. This information is provided by the OHCM OHS contractor physician. It shall provide instructions to be taken if accidental exposure requires immediate treatment. It may also include special instructions to medical personnel. This section shall provide information for each applicable route of entry, in lay language, when the results of

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exposure require immediate treatment (first aid) and when simple measures may be taken before professional medical assistance is available. Include simple remedial measures such as washing exposed area, removing clothing, or removing exposed individuals from the area of exposure if it will lessen the exposure. Also include information on first aid for a specific method of handling as opposed to the toxicity of the material, for example, frostbite from cryogenic liquids. Include any known antidotes that may be administered by a layperson. Indicate whether immediate medical attention is required and if delayed effects can be expected after exposure.

b. The format used on the LaRC MSDS template is as follows:

Eyes:
Skin:
Inhalation:
Ingestion:
Medical Conditions Aggravated by Exposure:

4.4.6 SECTION 5: FIRE FIGHTING MEASURES

a. This section shall provide basic fire-fighting requirements, including appropriate extinguishing media. It also describes other fire and explosive properties useful for fighting fires involving the material, such as flash point and explosive limits. This information shall be provided by the SFAB, SMAO Fire Protection Engineer. The responsible researcher shall provide known or anticipated hazardous products of combustion. The format used on the LaRC MSDS template is as follows:

Flashpoint, º F:	List the flashpoint of the material as tested by open or closed cup methods. If the product as a whole has not been tested, state this and list the component with the lowest flash point in the material.
Method Used:	List the flashpoint test used.
Auto ignition Temperature, º F:	List the temperature at which a flammable gas or vapor/air mixture will ignite without necessity of a spark or flame.
Flammable or Combustible Classification (NFPA 30):	Calculate the class of flammable or combustible liquid using the flashpoint and boiling point of the material. These classifications may be found in NFPA 30, "Flammable and Combustible Liquids Code" and 29 CFR 1910.1200. If the item is a flammable solid or gas, state this here.
Explosive Limits Upper/Lower (UEL/LEL):	List UEL's and Ells for the product if available, or for its components.
Extinguishing Media:	List extinguishing media here. The logic shall be similar to that found in the latest edition of the NFPA 704, "Stand System for the Identification of Hazardous Materials for Emergency Response."

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Known or Anticipated Hazardous Products of Combustion:	The responsible researcher shall provide this information.
Fire Fighting Instructions:	Instructions shall be directed at protecting lives of those in the fire area (including firefighters), and noting unusual impact on the environment and minimizing property loss. Special environmental warnings, such as toxicity of firewater runoff, shall be made.
Unusual Fire And Explosion Hazards:	List known or anticipated hazards of flammable and nonflammable materials that initiate or uniquely contribute to the intensity of a fire, such as strong oxidizers (providing fuel), any pyrophoric materials or reaction products, or materials that may form organic peroxides that may be shock or temperature sensitive. Also list the potential for dust explosions, any reactions (with metals for example) which produce flammable gases or vapors, and reactions or conditions with a potential for release of flammable vapors that could cause flash back. Reactivity hazards that enhance the fire and explosion potential shall be listed in this section. Dangerous or explosive reactions with specific chemicals shall be covered in Section 10: Stability and Reactivity.

4.4.6 SECTION 6: ACCIDENTAL RELEASE MEASURES

a. This section describes actions to be taken to minimize the adverse effects of an accidental spill, leak or release of the material. This information shall be provided by the EMT Environmental Engineer. The responsible researcher shall suggest a neutralizing agent, if known, based on the chemical properties of the material. The format used on the LaRC MSDS template is as follows:

If Material Spills or Leaks:	Include information on containment techniques, cleanup procedures, equipment and other emergency advice relating to spills and releases. There may be specific reporting requirements to reference information in this section or in Section 15: Regulatory Information.
Neutralizing Agent:	This shall be provided by the responsible researcher based on the chemical properties of the material. The EMT Environmental Engineer shall assure that the neutralizing agent will not create a greater hazard than the material.

4.4.7 SECTION 7: STORAGE AND HANDLING

a. This information shall be provided by the responsible researcher of the material. It provides information on appropriate practices for safe handling and storage. This

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section shall be reviewed by the SFAB IH staff. The format used on the LaRC MSDS template is as follows:

Storage Precautions:	Emphasize precautions relating to the unique properties of the material. List storage practices that minimize risks from fire for flammable and combustible materials or dangerous reactions with incompatible materials and that minimize the release to the environment. Note or reference specific federal regulatory requirements on the safe storage requirements for the material. Storage temperatures and light conditions shall be listed to extend the life of the material. List hazards of materials that form reactive organic peroxides with time and exposure to air. Hygroscopic materials and specified shelf life shall also be indicated here.
Handling Precautions:	List handling practices that minimize contact between the worker and the material, minimize risks from fire for flammable and combustibles or dangerous reactions with incompatible materials that could cause harm to the worker. Include handling practices such as how to prevent vapor release, the need for a totally enclosed system and safe practices for unloading and moving the material. Include statements about the use of non-sparking tools, explosion proof equipment and grounding when handling flammable materials. List practices that shall be followed to prevent dangerous reactions, such as inert blanketing, avoiding oil in equipment used with strong oxidizers, or careful opening of containers that may be under pressure. Include precautions for handling cryogenic or hot materials.
Repair and Maintenance Precautions:	This section shall be used to anticipate the material's use in structural systems, such as using composite materials to fabricate aircraft. Anticipated hazards from dust generated by grinding and drilling, welding fumes generated, or exposure to maintenance personnel shall be listed.

4.4.8 SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

a. This information shall be provided by the SFAB IH staff. It provides information on practices and/or equipment to minimize worker exposure. It also provides guidance on selection of personal protective equipment. The format used on the LaRC MSDS template is as follows:

Eye Protection:	Recommend eye and face protection based on the properties of the materials. For example, corrosive materials shall require protective goggles and a face shield.
Skin Protection:	Recommend protective clothing and gloves of the best barrier material to prevent skin absorption of the material.

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Respiratory Protection:	Identify different types of respiratory protection anticipated for different conditions and exposure ranges. If air-purifying respirators are used, the proper cartridge or canister shall be specified. If an air-purifying respirator is not adequate protection, a pressure-demand, air-supplied respirator shall be specified.
Engineering Controls:	This section discusses engineering controls required to help minimize chemical or physical hazards and to control exposures during it's anticipated use.
Other Protective Measures:	As stated.

4.4.9 SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

a. This information shall be provided by the responsible researcher. This section provides additional data that can be used to help characterize the material and design safe work practices. Any other properties of the material that have been measured shall also be included here. The following characteristics shall appear in this section. Clearly identify if specific characteristics do not apply (NA) or for which data are not available. The format used on the NASA LaRC MSDS template is as follows:

Appearance:
Odor:
Physical State:
pH:
Vapor Pressure, mmHg:
Vapor Density, air = 1:
Boiling Point, º F:
Freezing/Melting Point (specify which), º F:
Specific Gravity:
Solubility in Water:

Other characteristics, which may apply only to certain materials, shall be included if known:

Specific heat:
Particle size, microns:
Softening point, º F:
Evaporation rate, g/min:
Viscosity, dL/g or poise:
Bulk density, g/cm^3:
Octanol/water partition coefficient:
Saturated vapor concentration:
Molecular weight, g/mol:
Molecular formula:
Fiber area weight, g/m^2:
Tg, º C:

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Corrosion rate:
Decomposition temperature:
Volatile organic content (VOC), g/L (TEST METHOD):

4.4.10 SECTION 10: STABILITY AND REACTIVITY

a. This information shall be provided by the responsible researcher based on the material's chemical properties. This section describes the conditions to be avoided or other materials that may cause a reaction, which would change the intrinsic stability of the material. The format used on the LaRC MSDS template is as follows:

Stability:	Indicate if the material is stable or dangerously unstable under normal ambient and anticipated storage and handling conditions of temperature and pressure.
Hazardous Polymerization:	State if the material will polymerize releasing excess pressure, heat, or creating other hazardous conditions. State under what conditions the hazardous polymerization could occur.
Conditions To Avoid:	List conditions such as heat, pressure, shock, exposure to light or air or other physical stresses that might result in a hazardous situation.
Incompatibility:	Address chemicals and other materials that the substance could react with to produce a hazardous situation, for example explosion, release of toxic or flammable materials, liberation of excessive heat or sudden change of physical state. In determining incompatibility, consider the materials, containers, and contaminants the substance might be exposed to during transportation, storage and use.
Hazardous Decomposition Products:	List known or anticipated hazardous materials produced as a result of oxidation (except burning), heating, or reaction with another material, including the production of flammable and toxic materials.

4.4.11 SECTION 11: TOXICOLOGICAL INFORMATION

a. This section gives a background of toxicological data on the material or its compounds. If data is not available on the material or its components, it shall be stated. This information, if available for components of the system, or the substance as a whole, shall be provided by the SFAB IH staff. If special toxicological tests have been conducted on the material or it's components that are not currently listed on the available national databases this information shall be given to the SFAB IH staff.

b. The format used on the LaRC MSDS template is as follows:

COMPONENT	ORAL	DERMAL	INHALATION	OTHER

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4.4.12 SECTION 12: ECOLOGICAL INFORMATION

a. This information, if available for components of the system, or the material as a whole, shall be provided by the EMT Environmental Engineer. This section provides information on the effects the material may have on plants, animals, and its environmental fate. Provide information if the material or its components have the potential to be toxic in land, water or air. Indicate the potential adverse effect and the species. Indicate if the material or its components have the potential to persist or bio-concentrate, reaching levels that may have an adverse environmental impact. State if the material or its components have the unique potential to be harmful to wastewater treatment facilities. If data is not available on the material or its components, it shall be so stated.

4.4.13 SECTION 13: DISPOSAL CONSIDERATIONS

a. This section includes information that is relevant to and will assist in determining the proper and permissible waste management options of disposal, recycling or reclamation. The information shall be provided by the EMT Environmental Team.

b. The following information shall be included:

- Classification under RCRA and 40 CFR 261,
- US EPA Waste Identification Number and descriptions,
- Physical/chemical properties related to disposal option, for example heat value particle size, VOC content,
- Special instructions or specific limitations,
- Advice that 40 CRF 261may also apply to empty containers,
- Advice that laws may change,
- Advice that state and local regulations are complex and may be different from federal regulations, and
- Advice that the owner of the waste has the responsibility for proper disposal.

c. A disclaimer closure statement may be included as follows:

Chemical additions, processing, or otherwise altering this material may make the waste management information herein incomplete, inaccurate, or otherwise inappropriate. Additionally, state and local requirements for waste disposal may be more restrictive or otherwise different from federal laws and regulations. Consult state and local regulations regarding disposal of this material.

4.4.14 SECTION 14: TRANSPORT INFORMATION

a. This section provides basic shipping classification information. This information shall be provided by the Shipping Official or EMT Environmental Engineer. The format used on the LaRC MSDS template is as follows:

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US DOT SHIPPING INFORMATION:
PROPER SHIPPING NAME: UN _____ HAZARD CLASS: PG:

REPORTABLE QUANTITY:
POSTAL SERVICE:
IATA SHIPPING INFORMATION:
PROPER SHIPPING NAME: UN_____ PG:

b. OTHER CLASSIFICATIONS: May include classifications/descriptions under International Transportation Regulations, including International Maritime Organization (IMO), International Civil Aviation Organization (ICAO), Transport Canada, Environmental Protection Agency (EPA), and Rapid Inventory Development (RID).

4.4.15 SECTION 15: REGULATORY INFORMATION

a. As regulatory databases are cited in the above sections, they shall be included here in a list as they apply to the material. This section shall also be used to provide additional information on regulations affecting materials that are not listed in the previous sections.

US Federal Regulations, Statutes, and Agencies:	The following shall be searched for information regarding the material and its components: OSHA, Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), Toxic Substances Control Act (TSCA), Comprehensive Environmental Response Compensation (CERCLA), EPA Superfund Amendments and Reauthorization Act (SARA) Title III, EPA Clean Air Amendment (CAA), EPA Clean Water Act (CWA), EPA Safe Drinking Water Act (SDWA), Consumer Specialty Products Association (CSPA), Drug Enforcement Agency (DEA), and Food and Drug Administration (FDA//United States Department of Agriculture (USDA).
US State Regulations:	Most states have adopted the OSHA 29 CFR 1910.1200, but may have additional information requirements. Massachusetts, Pennsylvania (PA), Rhode Island and California (CA) require inclusion of state listed substances on the MSDS. PA requires disclosure of non-hazardous ingredients. CA requires listing of volatile organic compounds (VOC) and Vermont requires listing of environmental effects.
International Regulations:	The following regulations can be searched for the material and its components: Workplace Hazardous Materials Information System (WHMIS), Canadian Environmental Protection Agency (CEPA), European Inventory of Existing Commercial Chemicals (EINECS), Ministry of International Trade and Industry (MITI).

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4.4.16 SECTION 16: SUPPLEMENTAL INFORMATION

a. This section is used to list any other information known about the material. Additional information shall also be included in the previous sections where appropriate. The SFAB IH staff shall be responsible for assigning this code after the information in the previous sections is completed. The hazard rating system shall be included in this section using the following format:

NFPA HAZARD RATING SYSTEM:
HEALTH =
FIRE =
REACTIVITY = (scale of 0-4, 4 being most severe)

b. The responsible researcher shall list his/her name as the preparer. Other contributors shall also be listed. The date that the MSDS was prepared or revised shall also be included.

Prepared by: Responsible researcher's name
Date prepared: Date originally prepared
Revision date: Latest date MSDS was changed (Revisions shall be italicized in the body of the document to make changes easy to find.)

4.4.17 SECTION 17: DISCLAIMER

a. This information shall be provided by the NASA LaRC Office of Chief Counsel and shall end each MSDS produced at LaRC. The disclaimer statement shall be as follows:

The information and recommendations contained herein are based upon data believed to be correct. However, since much of the information has been received from sources outside NASA Langley Research Center, we cannot guarantee its accuracy or completeness. Health and safety precautions contained within this data sheet may not be adequate for all individuals and/or situations. It is the user's obligation to evaluate and use this data in order to comply with all applicable laws and regulations. Additionally, no guarantee or warranty of any kind, expressed or implied, is made with respect to the information contained herein.

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Chapter 5

POTENTIALLY HAZARDOUS MATERIAL PERMIT PROCESS

a. NASA Langley Form 498s issued for PHM's shall be one of the administrative controls available to identify the employees and procedures in use for higher risk PHM operation. The need for and use of NASA Langley Form 498 shall be determined by the FSH and/or the LaRC Safety Manager.

b. All materials for which OSHA has promulgated a standard based on carcinogenic potential of the material shall be considered for NASA Langley Form 498. Conditions of use, storage and quantity of material used shall be considered when determining the need for a PHM permit. Other potential high risk PHM where a NASA Langley Form 498 shall be needed are those materials for which data is not fully available. These include research and development research material where toxicity data is limited (including prepreg material still under research and development and laser dyes). Further information on high hazard material is presented in Chapters 6 and Appendices A and B of this procedural requirement.

c. CHP's shall be used in all laboratories that routinely synthesize chemicals. The CHP is an OSHA process for the control of hazards used in chemical laboratories. Process controls and procedures, rather than PHM specific MSDS's, shall be used to manage the risks from the PHM and their chemical intermediaries.

d. The PHMC or the LaRC Safety Manager shall also require submission of NASA Langley Form 118, "Safety Permit Request - Hazardous Material," and issuance of a NASA Langley Form 498 to use any material it deems significantly hazardous.

e. NASA Langley Form 498s shall be used to standardize procedures and identify training and personnel involved with high-risk operations associated with PHM. Other options permitted for determining the same risk reduction controls shall be to use other committees of functional risk management organizations available at LaRC. These include the Systems Operation Committee (SOC) and/or the Configuration Management Program (CMP), however the use of SOC and CMP to determine risk reduction controls does not alleviate the requirement for a NASA Langley Form 498. The FSH and/or the LaRC Safety Manager shall determine which of these techniques or combination of programs are best for the situation under consideration. These individuals shall disapprove operations or procedures where they consider the risks to be unacceptable and not issue a NASA Langley Form 498.

f. The FSH or designated representative, such as the OFSH, shall complete NASA Langley Form 118 and a NASA Langley Form 66, shall be submitted to the Safety Office for each person actively involved in the operation. After completion of any special training or medical requirements, these workers shall be certified as "Chemical Workers" under NASA Langley Form 498.

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g. After review and approval, a NASA Langley Form 498 shall be issued to the facility. A NASA Langley Form 62, “Chemical Worker's Certification Card" shall be issued to each qualified employee. The worker shall have the card on-hand or readily accessible, as proof of his/her certification, while conducting applicable tasks. The cards shall be revalidated annually by the SFAB IH staff, immediate supervisor and the LaRC Safety Manager.

h. NASA Langley Form 118 shall be prepared by the FSH, the lead test engineer and/or the researcher performing the work. All NASA Langley Form 118s shall be reviewed and resubmitted by the PFSH who has overall responsibility for the entire facility safety program.

5.1 SUMMARY OF TOPICS INCLUDED IN NASA LANGLEY FORM 498 ISSUED FOR POTENTIALLY HAZARDOUS MATERIALS

a. A summary of topics to consider during the preparation of NASA Langley Form 118 are as follows:

(1) Brief description of activity objectives,
(2) Brief description of the PHM or process to be controlled,
(3) Type and amounts of material present (maximum at site), and
(4) Amount of material in use during the process (including hazardous material quantity, application rate, flow),
(5) List of all operators in the controlled area during use of PHM and their operator responsibilities,
(6) Additional training planned for use of PHM named in NASA Langley Form 498. The minimum training in accordance with NASA Langley Form 498 procedures shall be required for each individual named. For example, if LaRC safety videos (such as Gloves for Composite Materials) shall be required, describe the additional training to be required, and
(7) Regulatory requirements: A NASA Langley Form 66 for each civil servant shall be forwarded with NASA Langley Form 118. These forms document training and alert the OHCM OHS contractor to possible new medical exam requirements. For each person added after the issuance of a NASA Langley Form 498, forward an additional NASA Langley Form 66. Non-NASA personnel wishing to operate under the NASA Langley Form 498 shall forward equivalent requests through the FSH to the SFAB, SMAO. Personnel shall not operate under the NASA Langley Form 498 until training, medical exams, and LaRC Safety Manager approvals have been obtained.

b. The Safety Operating Plan is the main narrative on how the hazards of the PHM are to be controlled through operational procedures and hazard awareness by workers. The goal of the plan is to describe controls to reduce personnel and facility risks. Narratives submitted with NASA Langley Form 118 shall address the following topics as applicable:

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(1) How the PHM is to be used and controlled. (Note: Use PHM with lower fire or health hazards where possible.)
(2) Planned schedule of operations and estimated frequency of operations. Include comments on weekend operations, and overnight or continuous process schedules, if applicable. These affect risk control procedures. Standard operations shall involve operators always present during normal day shift unless otherwise noted.
(3) Ventilation system use (including, but not limited to, laboratory hoods exhausting to outside with flow monitoring devices, dedicated exhaust systems, low flow alarms, as needed). Ventilation alarm device descriptions shall state whether they alarm locally only or to other Center control points (Duty Officer or Fire Department). Responsibilities for calibration of monitoring devices shall be specified.
(4) Procedural controls planned (e.g., Will hazardous gas piping systems be tested with inert gases for leaks prior to using toxic or flammable gases? Are gas systems to be vented and shut off after each use or remain pressurized? Where will low use PHM's, such as calibration gases or materials be stored [outside for hazardous gases] during prolonged non-use periods?).
(5) Personal protective equipment planned for routine operations. (Note: LaRC procedures require that the Fire Department perform all rescue operations in the event of an accident involving personnel.)
(6) Warning alarms and monitoring devices planned for use in control of leak detection procedures (e.g., hydrogen gas alarm, HF gas alarm for fluorine gas). Plans shall include how these alarms shall be used to alert operators, other facility personnel, and/or the Fire Department. System shutdown or facility evacuation procedures shall be addressed in conjunction with these alarm set points.
(7) PHM spill or leak procedures shall be addressed. Minor spills are usually handled by the operators. Specialized training (OSHA requires a HAZWOPER 8 hour or longer course) shall be required for chemical spills. LPR 8800.1 Chapter 14, "Oil and Hazardous Material Spill Control," contains spill cleanup information.
(8) Sketches of the operational area, the experimental layout, or piping and valve controls, as applicable.

5.2 NASA LANGLEY FORM 498 APPROVALS, DURATION, AND RENEWALS

a. The PHMC shall determine the approval duration of NASA Langley Form 498. Normally, FSH's or OFSH's shall request approvals for the duration of the research and development activity, if known. Initial approvals shall be for a maximum of one year, and the FSH/OFSH/Project engineer shall reapply for NASA Langley Form 498. Reapplications to continue work shall be submitted to a PHMC representative (normally, the SFAB IH staff) at least 30 days before expiration. Maximum renewal periods for existing NASA Langley Form 498's shall be determined by the PHMC and shall be up to four years.

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b. Modification to existing NASA Langley Form 498's can be submitted at any time during the issuance. When reviewed and approved, the PHMC shall issue a modified form and a PHMC representative from SFAB, SMAO or the SFAB IH staff, shall do initial reviews of new and renewal NASA Langley Form 498's. Final approval of NASA Langley Form 498 shall be conducted by the PHMC and the LaRC Safety Manger.

5.3 WORKER TRAINING AND CERTIFICATION

a. The NASA Langley Form 498 process shall include a determination of and requirements for PHM employee training and certification including hazard communication, CHP, periodic refresher, and medical surveillance. Employee training and certification shall be conducted in accordance with LPR 1740.6, "Personnel Safety Certification."

5.3.1 Hazard Communication Standard Training

a. The following information shall be provided or made available to each employee where a PHM is stored or used. This information is considered part of the basic hazard communication program and shall be required for all new employees. NASA personnel shall receive basic hazard communication training within 90 days of being hired and, if needed, through courses provided by SFAB, SMAO. Contractors shall provide an equivalent program for on-site operations.

b. Employees shall receive this training on LaRC procedures for:

(1) Means of identification of PHM's (i.e., labeling and posting, Chapter 6),
(2) Health hazard data,
(3) Fire, explosion, and reactivity data,
(4) Precautions for safe use, handling, storage, and disposal,
(5) Required protective clothing and equipment, and
(6) Emergency and first aid procedures.

c. The MSDS's shall be used as a primary source for this information. Personnel shall be cognizant of this information prior to actually handling the material.

5.3.2 Chemical Hygiene Plan Training

a. Training for laboratory workers operating under a CHP is in addition to the preceding. All workers involved in processes conducted under the CHP shall be familiar with the basic NASA Langley Form 498 procedures for their operation and/or facility. This training shall be the responsibility of the designated CHO. Support shall be provided by the SFAB IH staff as appropriate.

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5.3.3 Periodic Refresher Training

a. Periodic refresher training shall be required if the hazardous materials change or the processes generating hazardous materials change. This training shall be the responsibility of the FSH and/or the CHO, with SFAB, SMAO assistance as needed.

5.4 MEDICAL SURVEILLANCE

a. Medical monitoring of civil service personnel at risk from exposure to PHM's shall be done by the OHCM OHS contractor located at 10 West Taylor Street, Building 1149. The requirements for medical surveillance are identified by Occupational Medical Examination Protocols (OMEP's) determined by the OHCM OHS contractor physician and assessments of risk by the LaRC Safety Manager and his/her staff through periodic audits or special surveys of workplaces when requested by FSH's. Other site or OSHA requirements, such as those determined in past labor management agreements or specific OSHA standards, shall also be used in determining the need for, and procedures in, examinations. Medical surveillance requirements for contract employees shall be the responsibility of the contracting company. The SFAB IH staff shall perform all assessments of site PHM health risks and report these to FSH's and the LaRC Safety Manager.

b. FSH's and their designated representatives shall establish procedures for periodic reviews of their at-risk employee population for the use of PHM's. At-risk workers shall be identified to the OHCM OHS contractor at the time of initial assignment to work with PHM's through the use of NASA Langley Form 66. Pre-certification and annual examinations, as well as examinations required due to exposure shall be scheduled and conducted by the OHCM OHS contractor in accordance with the applicable OMEP. The completed NASA Langley Form 66's shall be maintained in individual medical records at the OHCM OHS contractor location.

c. The determination of the need for periodic medical surveillance of workers shall depend on several factors, including the PHM in use, toxicity, manner and duration of use, and potential routes of entry into employees. Depending on the nature of the hazards, medical surveillance shall be recommended. FSH's shall request assistance from the SFAB IH staff in the risk assessments. Occasionally, such as in the use of research and development mutagenic material, additional input from the OHCM OHS contractor physician may be needed to determine OMEP needs.

d. FSH's shall identify temporary or transient personnel (civil servant and contractor) who periodically come into their facility to work with PHM's. For example, an engineer may come into their laboratory for 5 days per month over a 6-month period to perform "hands-on" work in PHM research and development of a new process. If the risks warrant clinical monitoring, these temporary or transient personnel shall be identified to the OHCM OHS contractor using NASA Langley Form 66 or equivalent contractor forms. As a general rule, if other workers receive clinical examinations for

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exposure for their daily work with low to moderately toxic material, these temporary personnel shall also be referred to the OHCM OHS contractor for monitoring if they receive more than one month's (20 working days) exposure in a year.

e. All workers named on NASA Langley Form 498 shall be considered Chemical Workers. Specific clinical examinations for Chemical Workers shall be determined by the OHCM OHS contractor physician. Procedures for the use of NASA Langley Form 498, NASA Langley Form 62, and clinical examinations are presented in LPR 1740.6. Chemical Workers shall be the individuals who physically use the material or are, or could be, involved in the permitted operations. Administration and management personnel shall not be considered unless they actually work with the material named.

f. Reviews or updates to identify personnel needing, or no longer needing, PHM-related clinical examinations shall be conducted by FSH's after consultation with facility personnel, as circumstances warrant. These clinical examination-listing updates shall be conducted during periodic industrial hygiene audits, conducted by the SFAB IH staff, of facility operations.

g. The OHCM OHS contractor shall, as circumstances warrant, notify the LaRC Safety Manager and FSH's on trends seen in the worker population monitored through its OMEP program.

h. Clinical examinations required because of workplace exposures to PHM's can be either recommended or mandatory by law. If medical surveillance is recommended and the employee declines to participate, the OHCM OHS contractor shall obtain a statement, which shall be included in the employee's medical records. The statement shall indicate that the employee understands the risk involved by declining to participate in the surveillance program. The LaRC Safety Manager and FSH's shall be notified concerning trends or an individuals declining to participate.

i. If the medical examination is mandatory by law, appropriate personnel (including supervisors and FSH's) shall be notified if the individual fails to complete medical monitoring examinations for the workplace PHM exposure.

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Chapter 6

USE AND HANDLING OF POTENTIALLY HAZARDOUS MATERIALS

a. Prior to initial acquisition or transfer of PHM's, FSH's shall make the initial decision on the use of a particular PHM or PHM process in their facility, the amount to be stored in the facility, and the initial assessments for further safety and process control measures. In cases where PHM's pose a significant hazard because of their toxicity, flammability, or other potentially hazardous properties, control procedures and other operational details shall be documented and approved through the NASA Langley Form 498 process. The NASA Langley Form 498 process is discussed in Chapter 5 of this procedural requirement.

b. Additionally, assistance can also be provided by the LaRC Safety Manager, his/her staff, the PHMC, other LaRC committees, and other technical area experts.

6.1 LABORATORY OPERATIONS AND PRODUCTION OF POTENTIALLY HAZARDOUS MATERIALS

a. Laboratory operations and the production of PHM's includes chemical synthesis in laboratories and the transfer of test chemicals.

6.1.1 Chemical Synthesis in Laboratories

a. Production or synthesis of chemicals and their intermediaries are usually involved processes. Laboratories performing these processes shall have a CHP. The NASA Langley Form 498 process shall be used for each laboratory CHP. Laboratories operating under a CHP shall not be required to have MSDS's for each chemical intermediary involved in the chemical process. Federal law requires annual review of the CHP.

6.1.2 Transfer of Test Chemicals

a. On-site operations that produce test specimens of PHM's for use in other facilities and/or special projects shall provide MSDS's for use by other personnel working with the material. The LaRC MSDS template is discussed in Chapter 4 of this procedural requirement. MSDS's produced shall be forwarded to the SFAB IH staff for review and submittal to the PHMC and LaRC Safety Manager.

6.2 WARNING LABELS AND HAZARD INFORMATION

6.2.1 Original Manufacturers' Containers (Primary Containers)

a. The material or its container shall be clearly labeled to identify the material (chemical or trade name) and to provide precautionary statements required by regulatory agencies or LaRC. OSHA 29 CFR 1910.1200 requires manufacturers, importers or distributors to label

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each container of hazardous chemicals. Therefore, each container of PHM's received on the Center shall have existing labels that comply with the OSHA requirements.

b. All PHM used and stored at the Center shall have a CMTS label with its inventory record number. Detailed information on CMTS labels is available on-line at:

http://osemant1.larc.nasa.gov/cmts/instruct/

6.2.1.1 Secondary Containers

a. If PHM's are transferred into unmarked containers, these containers shall bear the name of the chemical, along with the diamond symbol of the NFPA in accordance with NFPA 704 (Figure 6.1). This symbol indicates the severity of the hazard on a numerical scale of 0 to 4, and the type of hazard (health, flammability or reactivity) according to a color code. The ranking of severity of the health hazard is based upon acute exposures, and therefore, may not adequately reflect the actual hazard associated with chronic exposures to relatively small quantities of the material. LaRC shall use the NFPA diamond as a warning symbol to increase worker awareness of hazardous materials. For example, a laboratory squeeze bottle used to hold the cleaning solvent methyl ethyl ketone will have an NFPA diamond label with numbering for HEALTH = 1, FLAMMABILITY = 3, and REACTIVITY = 0, along with the name "methyl ethyl ketone", or "MEK".

b. Any material subject to a specific OSHA labeling standard shall be labeled in accordance with those requirements in addition to those given above.

c. Figure 6.1 shows the diamond label and the rationale for assigning codes. Codes for several chemicals are found in NFPA 704. Assistance in assigning these codes shall be obtained from the SFAB IH staff. The diamond code information shall be entered on NASA Langley Form 44, when the request for PHM's is submitted.

d. Labeling of all containers of experimental chemical materials shall be in compliance with OSHA 1910.1450. For items that are to be stored and retained within a laboratory where the properties of materials are likely to be well understood, only the sample identification and/or name shall be needed. Samples that will be transferred outside the laboratory, or that may be handled by individuals not generally familiar with the type of material involved, shall be labeled as completely as possible, including the name, address, and telephone number of the sender and recipient for samples in transit.

6.2.2 Hazard Survey Information

a. The NFPA diamond symbol is intended to increase worker awareness of the presence of PHM's. The actual hazard from a material depends on how it is used. Periodic audits and surveys shall be conducted by the SFAB IH staff to determine actual health hazards from hazardous material operations. The results of these audits shall be

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reported back to the facilities. Workers can request information on past surveys by contacting their supervisors, LaRC Safety Manager or the SFAB IH staff.

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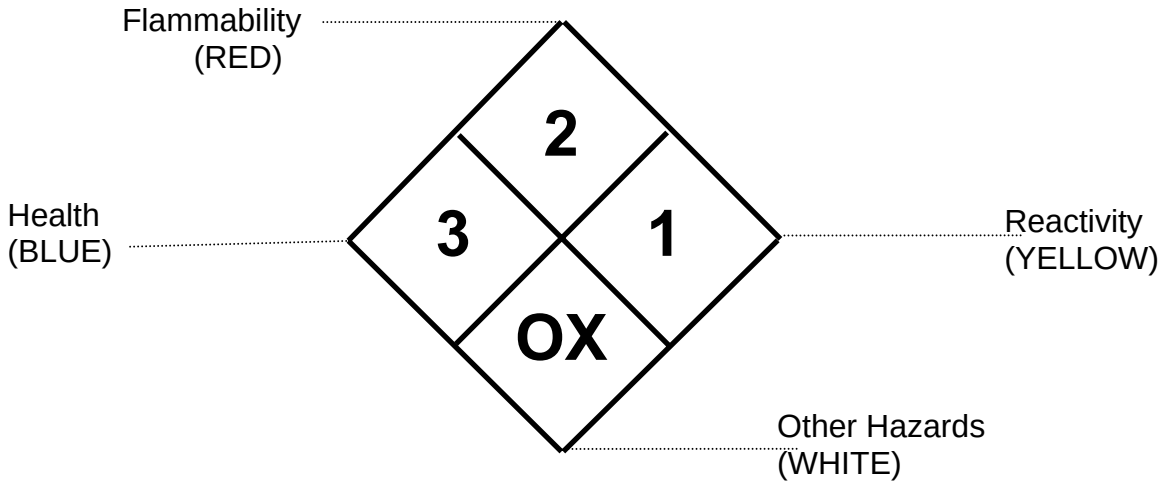

Identification of Health Hazards Color Code: BLUE		Identification of Flammability Color Code: RED		Identification of Reactivity Color Code: YELLOW	
Signal	Type of Possible Injury	Signal	Susceptibility of Materials to Burning	Signal	Susceptibility to Release of Energy
4	Materials, which on very short exposure could cause death or major residual injury even though prompt medical treatment, is given.	**4**	Materials, which will rapidly or completely, vaporized at atmospheric pressure and normal ambient temperature, or which are readily dispersed in air and which will burn read	**4**	Materials, which in themselves are readily capable of detonation or of explosive decomposition or reaction at normal temperatures and pressures.
3	Materials, which on short exposure could cause serious temporary or residual injury even though prompt medical treatment, is given.	**3**	Liquids and solids that can be ignited under almost all ambient temperature conditions.	**3**	Materials which in themselves are capable of detonation or explosive reaction, but require a strong initiating source or which must be heated under confinement before initiating, or which react explosively with water.
2	Materials, which on intense or continued exposure could cause temporary incapacitation or possible residual injury unless prompt medical treatment, is given.	**2**	Materials that must be moderately heated or exposed to relatively high ambient temperatures before ignition can occur.	**2**	Materials, which in themselves are normally unstable and readily undergo violent chemical change but do not detonate. Also materials, which may react violently with, water or which may form potentially explosive mixtures with water.
1	Materials, which on exposure could cause irritation but only minor residual injury, even if no treatment is given.	**1**	Materials that must be preheated before ignition can occur.	**1**	Materials, which in themselves are normally stable, but which can become unstable at elevated temperatures and pressures, or which may react with water with some, release of energy, but not violently.
0	Materials, which on exposure under fire conditions, would offer no hazard beyond that of ordinary combustible materials.	**0**	Materials that will not burn.	**0**	Materials, which in themselves are normally, stable, even under fire exposure conditions, and which are not reactive with water.

Other Hazards - Color Code: WHITE
Ox - Oxidizer
~~W~~ - Use no water

Figure 6.1, National Fire Protection Association Symbols.

6.3 STORAGE AND POSTING AREAS WITH POTENTIALLY HAZARDOUS MATERIAL

a. PHM, particularly compressed gases and flammables or combustibles, shall be stored in accordance with Figure 6.2, "Suggested Shelf Storage Pattern," Figure 6.3, "Partial List of Incompatible Compounds (Toxic Hazards)," and Figure 6.4, "List of Incompatible Chemicals" of this procedural requirement. Before using and planning of new operations involving PHM's, the individuals shall incorporate all statutory requirements as promulgated by OSHA and any other national consensus standards. These include recommendations of the NFPA, Compressed Gas Association (CPA), and American National Standards Institute (ANSI).

b. Requirements for the storage of flammable materials are addressed in this chapter. Contact the LaRC Safety Manager or the LaRC Fire Chief if assistance is needed in determining flammable storage needs and requirements.

6.3.1 Storage of Potentially Hazardous Materials

a. The requirements for the storage of PHM's in a facility, or adjacent to a facility, are to minimize risks in the event of a fire or an accident. Technical guidance for gases are detailed in Appendix B of this procedural requirement. Material quality storage requirements, such as the use of refrigerated storage to prolong the quality of the substance, are not considered or detailed in this chapter. For storage of environmentally regulated hazardous wastes, consult LPR 8800.1

b. Fire codes for the storage of flammable materials in facilities have been incorporated into OSHA standards. These mandatory OSHA requirements are included in this chapter. For assistance in interpreting these laws, contact the LaRC Safety Manger or LaRC Fire Chief.

6.3.2 Flammable and Combustible Liquids Storage

a. This section applies to the storage of flammable or combustible liquids in drums or other containers not exceeding 60 gallons of individual capacity and portable tanks not exceeding 660 gallons of individual capacity. For further interpretation, contact the SFAB, SMAO.

6.3.2.1 Design and Capacity of Containers

a. Only approved containers and portable tanks shall be used. Metal containers and portable tanks meeting the requirements of and containing products authorized by Department of Transportation (DOT) 49 CFR, "Transportation," Subtitle B, Chapter 1, "Research and Special Programs Administration, Department of Transportation", shall be deemed to be acceptable. The LaRC Fire Chief shall be available to provide guidance in these areas.

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6.3.3 Suggested PHM Shelf Storage Pattern

a. Figures 6.2 and 6.3, contain information obtained from a NASA Course on Laboratory Safety and Health. No current regulatory requirements exist for storage lockers; however, the data presented is suggested for use to help avoid storing incompatible materials on the same or adjacent shelves.

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INORGANIC	ORGANIC
INORGANIC # 10 SULFUR, PHOSPHORUS, ARSENIC, PHOSPHORUS PENTOXIDE	ORGANIC # 2 ALCOHOLS, GLYCOLS (Store flammables in dedicated cabinet)
INORGANIC # 2 HALIDES, SULFATES, SULFITES, THIOSULFATES, PHOSPHATES	ORGANIC # 3 HYDROCARBONS, ESTERS (Store flammables in a dedicated cabinet)
INORGANIC # 3 AMIDES, NITRATES. (Not AMMONIUM NITRATE). Nitrates	ORGANIC # 4 ETHERS, KETONES (Store flammables in a dedicated cabinet)
INORGANIC # 1 METALS AND HYDRIDES (Store away from water)	ORGANIC # 5 EPOXY COMPOUNDS, ISOCYANATES
INORGANIC # 4 HYDROXIDES, OXIDES, SILICATES	ORGANIC # 7 SULFIDES, POLYSULFIDES
INORGANIC # 7 ARSENATES, CYANIDES (Store above acids)	ORGANIC # 8 PHENOL, CRESOLS
INORGANIC # 5 SULFIDES, SELENIDES, PHOSPHIDES, CARBIDES, NITRIDES	ORGANIC # 6 PEROXIDES, AZIDES
INORGANIC # 8 BORATES, CHROMATES, MANGANATES, PERMANGANATES	ORGANIC # 1 ACIDS, ANHYDRIDES, PERACIDS
INORGANIC # 6 CHLORATES, PERCHLORATES, CHLORITES, PERCHLORIC ACID, PEROXIDE	MISCELLANEOUS
INORGANIC # 9 ACIDS, except NITRIC (Acids are best stored in dedicated cabinets)	MISCELLANEOUS (Nitric Acid)

Figure 6.2, Suggested Shelf Storage Pattern

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Arsenical Materials	Any Reducing Agent	Arsine
Azides	Acids	Hydrogen Azide
Cyanides	Acids	Hydrogen Cyanide
Hypochlorites		Chlorine or Hypochlorous Acid
Nitrates	Sulfuric Acid	Nitrogen Dioxide
Nitric Acid	Copper, Brass, Heavy Metals	Nitrogen Dioxide
Nitrites	Acids	Nitrous Fumes
Phosphorus	Caustic Alkalis/Reducers	Phosphine
Selenides	Reducers	Hydrogen Selenide
Sulfides	Acids	Hydrogen Sulfide
Tellurides	Reducers	Hydrogen Telluride

Figure 6.3, Partial List of Incompatible Chemicals (Toxic Hazards)

b. Substances in the left hand column shall be stored and handled so that they cannot under any circumstances accidentally contact corresponding substances in the center column, as toxic materials (right hand column) would be produced.

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Chemical	Potentially Incompatible Chemicals/Materials/Conditions
Acetic acid	Chromic acid, nitric acid, perchloric acid, hydroxyl-containing compounds, ethylene glycol, peroxides, and permanganates
Acetone	Concentrated nitric, sulfuric, perchloric, and chromic acid mixtures, and certain plastic materials
Acetylene	Chlorine, bromine, copper, silver, brass (red), fluorine, mercury, and oxygen
Ammonium nitrate	Acids, metal powders, flammable liquids, chlorates, nitrates, sulfur, finely divided organics, or combustibles
Ammonium hydroxide	Acids
Ammonium iodine	Acids and oxidizing agents
Ammonium sulfide	Acids
Arsenical materials	Any reducing agent
Bromine	Ammonia, acetylene, butadiene, butane, and other petroleum gases; hydrogen; sodium carbide; turpentine; benzene; and finely divided metals
Carbon, activated	Calcium hypochlorite and ruthenium tetroxide
Carbon tetrachloride	Sodium
Chlorates	Ammonium salts, acids, metal powders, sulfur, finely divided organics, or combustibles
Chlorine	Ammonia, acetylene, butadiene, butane, methane, propane (or other petroleum gases), hydrogen, sodium carbide, benzene, finely divided metals, and turpentine
Chromic acid	Acetic acid, acetone, naphthalene, camphor, glycerin, turpentine, alcohol, and most flammable organic compounds
Copper	Acetylene of hydrogen peroxide
Cyanides	Acids
Diethyl ether	Nitric acid (concentrated and fuming) and other strong oxidizing agents (dichromate, permanganate), heat, or aluminum
Flammable liquids	Ammonium nitrate, chromatic acid, hydrogen peroxide, nitric acid, sodium peroxide, and halogens

Figure 6.4, List of Incompatible Chemicals (page 1 of 2)

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Chemical	Potentially Incompatible Chemicals/Materials/Conditions
Hydrochloric acid	Bases or manganese dioxide
Hydrocyanic acid	Nitric acid or alkalis
Hydrogen peroxide	Copper, chromium iron, most metals or their salts, and flammable liquid, combustible materials, aniline, and nitromethane
Hydrofluoric acid (anhydrous)	Ammonia, aqueous, or anhydrous
Hydrogen sulfide	Fuming nitric acid, oxidizing gases, heat, and most common metals
Hydrocarbons (benzene, butane, propane, gasoline, turpentine)	Fluorine, chlorine, bromine, chromic acid, and sodium peroxide
Mercury	Acetylene, fulminic acid, ammonia, and concentrated nitric acid
Methyl isobutyl ketone	Nitric acid (concentrated and fuming), dichromate, and (hexane) permanganate
Nitric acid (conc.)	Acetic acid, aniline, chromic acid, Hydrocyanic acid, hydrogen sulfide, flammable liquids, flammable gases, nitratable substances such as organic compounds, including diethyl ether and methyl ketone (hexane), and bases
Oxygen	Oils, grease, hydrogen, flammable liquids, solids, or gases
Oxalic acid	Silver and mercury
Perchloric acid	Acetic anhydride, acetone, alcohol, bismuth and its alloys, charcoal, paper, wood, bases, or organic compounds
Potassium chlorate	Acids and organic compounds
Potassium perchlorate	Acids and organic compounds
Potassium permanganate	Glycerine, ethylene glycol, benzaldehyde, and sulfuric acid
Sodium carbide, acetylene	Water (also see acetylene, which is liberated from sodium carbide on exposure to moisture)
Sodium hydroxide	Acids, organic materials, most common metals, and water
Sodium nitrate	Ammonium nitrate and other ammonium salts
Sodium peroxide	Any oxidizable substance, such as ethanol, methanol, glacial acetic acid, acetic anhydride, benzaidehyde, carbon disulfide, glycerine, ethylene glycol, ethyl acetate, methyl acetate, and furfural
Sulfuric acid	Chlorates, perchlorates, permanganates, water, and bases
Strong bases	Strong acids, organic materials, water and most common metals

Figure 6.4, List of Incompatible Chemicals (page 2 of 2)

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6.3.4 Storage Time Limits of Peroxidizable Compounds

a. Some chemicals form peroxides upon prolonged storage and/or contact with air. Peroxides are compounds, which are sensitive to shock, heat, friction, or accidental ignition (sparks). Peroxidizable compounds slowly deteriorate into peroxides when exposed to air. A list of some of these chemicals is provided in Figure 6.5, "Storage Time Limits of Peroxidizable Compounds." To ensure that the storage time limit of the peroxide-forming compound is not exceeded, the date the container is opened shall be prominently displayed on the container. Expired chemicals shall be disposed of immediately. When possible, order peroxidizable compounds containing an inhibitor to slow the formation of peroxides. If research requires the use of an unstabilized solvent the FSH shall be notified prior to ordering. Distillation or purification of a peroxidizable compound, either stabilized or unstabilized, shall also require the permission of the FSH. Only distill or purify the amount of solvent that will be immediately used, DO NOT STORE distilled or purified peroxidizable solvents. If crystals are noticed on a container of peroxidizable compounds exercise extreme caution and notify the FSH and LaRC Safety Manager for assistance as soon as possible. On site treatment of a peroxidizable compound is strictly prohibited.

6.4 TRANSPORTATION OF POTENTIALLY HAZARDOUS MATERIAL

Specific requirements for off- and on-site transport of PHM's are detailed in this section.

6.4.1 PHM Transportation Off-Site

a. PHM's shall not be introduced into interstate commerce unless in full compliance with applicable regulations of 49 CFR, Subtitle B, Chapter 1, parts 171-177, "Hazardous Materials Regulations." For example, materials containing cyanides shall not be transported in vehicles containing acids.

b. Contact the LMT for assistance on shipment and for restrictions on the movement of PHM's off-site. LMT personnel can assist in authorized type of shipments (e.g. pounds of PHM's that are air transportable, performance oriented packaging requirements, PHM transportation packaging, and vehicle placarding).

c. PHM's transported off-site shall be accompanied by a NASA Langley Form 44 and the appropriate MSDS. The NASA Langley Form 44 shall be used to track LaRC PHM's.

d. Shipments of minor (less than 10 gram) quantities of PHM laboratory samples for off-site testing shall not require a NASA Langley Form 44. The package label for these items shall clearly identify the name, address, and telephone number of the individual knowledgeable about the test specimen, a brief description of the samples, and the date shipped, in order to meet federal requirements for shipment of laboratory samples as defined in DOT 49 CFR 173, "SHIPPERS—General Requirements for Shipments and Packagings." Check for other PHM limits on quantity, transportation methods, and packaging that apply to the shipment.

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e. Any person transporting PHM's off-site shall be subject to the motor vehicle laws of the federal government and the Commonwealth of Virginia. Current laws require certain classes of motor vehicle operators to have Commercial Driver's Licenses with a Hazardous Materials endorsement for transport of PHM's.

RED LABEL - PEROXIDE HAZARD ON STORAGE
DISCARD AFTER THREE MONTHS

isopropyl ether
divinyl acetylene
vinylidene chloride
potassium metal
sodium amide

YELLOW LABEL - PEROXIDE HAZARD ON CONCENTRATION
DISCARD AFTER ONE YEAR

diethyl ether	dicyclopentadicene
tetrahydrofuran	diacetylene
dioxane	methyl acetylene
acetal	cumene
methyl isobutyl ketone	tetrahydronaphthalene (TetraUn)
ethylene glycol dimethyl ether (glyme)	cyclohexene
vinyl ethers	methylcyclopentane

YELLOW LABEL - HAZARDOUS DUE TO PEROXIDE INITIATION OF POLYMERIZATION*
DISCARD AFTER ONE YEAR

methyl methacrytate	chlorotrifluoroethylene
styrene	vinyl acetylene
acrylic acid	vinyl acetate
acrylonitrile	vinyl chloride
butadiene-	vinyl pyridine
tetrafluoroethylene	chloroprene

*Under conditions of storage in the liquid state, the peroxide-forming potential increases and certain of these monomers (especially butadiene, chloroprene, and tetrafluorethylene) should then be considered as A-list compounds.

From H. L. Jackson, W. B. McCormack, C. S. Rondestvedt, K. C. Smeltz, and I. E. Viele: "Safety in the Chemical Laboratory. LXI: Control of Peroxidizable Compounds." *J Chem. Educ.* 47(3): A176 (March, 1970).

Figure 6.5, Storage Time Limits of Peroxidizable Compounds

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6.4.2 PHM Transportation On-Site

a. The on-site transportation of PHM's shall be conducted by personnel trained in hazardous material transportation. Contact the LMT for assistance in hazardous material transfer. NASA personnel without a Commercial Drivers License may use NASA vehicles for the limited on-site transfer of PHM's. An example would be an emergency transfer of hydraulic fluid from stock or another on-site facility to support pump repair work for a wind tunnel.

6.5 EXCESS PHM, ACCIDENTS INVOLVING PHM, AND DISPOSAL OF WASTE PHM

a. Information on various other topics associated with the storage, excess turn in, spills, documenting information of new materials (i.e. MSDS), OSHA carcinogens, and hazardous gases is outlined in more detail in other chapters of this procedural requirement, in other safety-related documents or in LPR 8800.1. Additional general procedures are included herein.

b. Users shall consider the use of alternative material, ventilation, and personal protective equipment in all processes. Whenever possible, less hazardous material shall be substituted first in processes. If substitution is not possible, process ventilation shall be used to minimize hazards. Ventilation design guidelines, as found in the American Conference of Governmental Industrial Hygienists Ventilation Manual, shall be used. As a last resort, personal protective equipment shall be relied on to minimize risks from PHM. Procedures for obtaining individual personal protective equipment (e.g. gloves, eye wear, respirators) are presented in LPR 1710.4, "Personnel Protection - Clothing and Equipment." FSH's shall contact the SFAB IH staff for recommendations.

6.5.1 Accidents, Spills, and First Aid Involving PHM

a. All accidents involving PHM, no matter how small, shall be reported to the CAM and the FSH. Personnel using the material shall be responsible for the clean up of minor spills in their work area. Minor accidents, when reported, can lead to a recognition of potential trends and the identification of needs for better equipment or procedures. For example, a minor break and splash of a PHM from a beaker in a laboratory hood could lead to the identification of a need for laboratory chemical splash barriers.

b. Establishing accident and first aid procedures is an integral part of planning for the use of PHM's. It shall be the responsibility of the user to effectively contain PHM's in the event of a minor spill and to perform clean-up operations. Consultation with EMT in developing emergency procedures shall be required. All spills of PHM shall be reported by calling 911 from any Center phone or 864-2222 from an off Center (cell phone) line. PHM's shall be deleted from inventory via the CMTS.

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c. Professional first aid services are available from the OHCM OHS contractor located at 10 West Taylor Street (Building 1149), 7:00 a.m. – ~~3:30~~3:00 p.m., Monday through Friday. On-site ambulance service can be obtained at anytime by calling 911 from any Center telephone or by calling 864-5600 from a cellular telephone.

d. Preplanning for accidents involving PHM's shall always be required. Specialized training (OSHA HAZWOPER 8 hour or longer course) shall be required for chemical leaks of PHM, depending upon the situation involved. Spill clean up information and procedures to request assistance for spills beyond facility capabilities shall be in accordance with LPR 8800.1, Chapter 14, "Hazardous Material Spill Control and Contingency Plan," and on-line at:

http://osemant1.larc.nasa.gov/

6.5.2 Waste PHM

a. Waste PHM disposal shall be in accordance with federal, state, and local regulations, and LaRC procedural requirements presented in LPR 8800.1. Contact the EMT for more information or the EMT web page listed above.

6.6 OSHA/IARC/NTP SELECT CARCINOGENS

a. Carcinogenic materials shall be used only under an approved NASA Langley Form 498. Carcinogenic materials include any material for which OSHA has promulgated an emergency temporary or permanent standard that reflects its carcinogenic potential. A list of materials having this status is provided in 29 CFR 1910.1450, Appendix B, and thereby are regulated chemicals. Additions to this list may occur. The PHMC shall include any other materials it deems appropriate.

b. OSHA has worked with other agencies on a list of "select carcinogens." These materials are suspect as possible human carcinogens. These suspect carcinogens are defined in 29 CFR 1910.1450(b) and published by the International Agency for Research on Cancer (IARC) and the National Toxicology Program (NTP). Additions to the list may occur. It shall be noted that materials appearing in OSHA carcinogen standards, on NTP lists, and on IARC lists are on the select list presented. Under the OSHA 29 CFR 1910.1200, materials having OSHA carcinogen standards, or appearing on the NTP Carcinogen Report, or being listed in IARC Group 1 or 2A, shall have references to their carcinogenic effects in both MSDS's and on material labels.

c. At LaRC, these "select carcinogens" shall be considered for use under a NASA Langley Form 498, issued to define the procedures for use.

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6.7 BIOLOGICAL AGENTS

6.7.1 Scope and Application

a. All operations requiring the use of biological agents at LaRC shall be permitted through the PHMC. This committee reviews the Standard Operating Procedures (SOP) drafted by the researcher for the control and use of biological agents. This SOP shall identify hazards, specify standard and specific micro bacterial laboratory techniques, create regulated areas, provide for employee training and medical monitoring, detail the requirements for exposure monitoring, list the required personal protective equipment, specify the proper procedures for the disposal of wastes, and anticipate spills and emergency response actions that may be required. Each different etiological species or new activity shall require an individual NASA Langley Form 180, "Biological Agent Approval Form."

b. At present, biological agent use is restricted to biosafety level (BSL) 1 operations; however, facility requirements shall be built and maintained at BSL-2. No research involving human body fluids or blood, human or primate cells, animals, whole plants or toxic gene products shall be permitted. Work with ionizing or non-ionizing radiation materials shall require clearance through the Ionizing or Non-ionizing Radiation Committee in addition to the PHMC.

6.7.2 Principles of Biosafety

a. Levels of protection based on the relative ability of the organism to cause disease in normal healthy adult humans and the potential for transmission during laboratory manipulation are assigned to all biological agents. Based on the biosafety levels, laboratory employees shall be protected from hazards by employing specific and special microbiological laboratory practices, using containment and barriers and assuring personal safety through training, medical surveillance and immunization when applicable. The following procedures have been adapted from “Biosafety in Microbiological and Biomedical Laboratories”, fourth edition, Centers for Disease Control (CDC) and Prevention and National Institutes of Health (NIH), and “NIH Guidelines for Research Involving Recombinant DNA Molecules." Some practices are stricter than in the CDC or NIH recommendations because their application seems appropriate for all microbiological laboratories.

b. In addition to the risk level of the organism, it is also important to evaluate the operation to determine additional hazards. The biosafety level of the entire operation shall be raised if aerosols or splashes could be released, large amounts of materials are used, or hazardous gene products are produced during an operation.

c. Biosafety Level 1 is suitable for work involving well-characterized agents not known to cause disease in healthy adult humans. These agents are of minimal potential hazard to laboratory personnel and the environment. These agents are not known to cause disease in healthy adults.

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d. Biosafety Level 2 is suitable for work involving agents of moderate potential hazard to personnel and the environment. These agents are associated with human disease and hazards exist from percutaneous injury, ingestion, and mucous membrane exposure to the agent. It differs from BSL-1 in that (1) laboratory personnel have specific training in handling pathogenic agents and are directed by a competent scientist; (2) access to the laboratory is limited when work is being conducted; (3) extreme precautions are taken with contaminated sharp items; (4) certain procedures where infectious aerosols or splashes may be created are conducted in biological safety cabinets or other physical containment equipment.

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6.7.3 Biosafety Level Operational Conditions and Procedures

Standard operation procedures for BSL-1 and 2 are outlined below:

BIOSAFETY LEVEL 1

Practices

Standard Microbiological Practices

1. Access to the laboratory is limited or restricted at the discretion of the principal investigator when experiments or work with cultures and specimens are in progress.

2. Hand washing shall be required after handling viable materials, after removing gloves and prior to leaving the laboratory.

3. Eating, drinking, smoking, handling contact lenses, applying cosmetics and storing food for human use shall be prohibited in the laboratory. Contact lenses shall not permitted to be worn in the laboratory.

4. Mechanical pipetting devices shall be used, mouth pipetting shall be prohibited.

5. An effective “sharps” handling program shall be used.

6. All procedures, which could produce splashes, spills or aerosol formation, shall be documented and procedures shall be followed to eliminate or minimize the hazards of these operations.

7. Prior to the start of project, decontamination methods shall determined and these procedures shall be used to decontaminate all cultures, stocks and other regulated wastes prior to proper disposal. Materials to be decontaminated shall be placed in a durable, leak proof container and closed when not in use.

8. Work surfaces shall be decontaminated upon completion of work, at the end of the day and after a spill of any viable organism. The workstation shall be left decontaminated at the end of the work shift and all viable organisms stored in proper storage areas.

9. A biohazard sign shall be posted on the entrance to the laboratory whenever biological agents are being used. In addition, a biohazard sign shall also be posted on all areas where biological agents are stored. The name of the principal investigator, telephone number, classification and names of agents shall be listed on all signs

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10. An insect and rodent control program shall be in effect.

Safety Equipment (primary barriers)

1. Special containment devices or equipment such as biological safety cabinets are generally not required for manipulations of BSL-1 agents.

2. Lab coats and gloves shall be recommended to prevent contamination of street clothes and skin. These items shall be left in the laboratory and not worn into other work areas to prevent cross contamination. All protective clothing shall be either disposed of in the laboratory, or placed in special bins to be laundered by the employer. It shall never be taken home.

3. Protective eyewear shall be worn in the laboratory at all times.

Facility Requirements (secondary barriers)

1. Laboratories shall have doors that allow access control.

2. An open bench top sink for hand washing shall be required.

3. The materials of the laboratory shall be designed to be easily cleaned and decontaminated. Bench tops, walls and floors shall be impervious to water and resistant to moderate heat and the organic solvents, acids, alkalis and chemicals used to decontaminate the work surfaces and equipment. Chairs and other furniture used in the laboratory shall be covered with a non-fabric material that can be easily decontaminated. Carpets and rugs are not appropriate.

4. Laboratory furniture shall be capable of supporting anticipated loading and uses. Spaces between benches, cabinets, and equipment shall be accessible for cleaning.

5. An eyewash station shall be readily available and inspection conducted and documented ~~monthly~~weekly.

6. If the laboratory has windows that are open to the exterior, they shall be fitted with fly screens.

7. Mechanical ventilation systems shall be balanced to provide an inward flow of air without recirculation to spaces outside the laboratory.

8. Illumination shall be adequate for all activities, avoiding reflections and glare that could impede vision.

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BIOSAFETY LEVEL 2

Practices

Standard Microbiological Practices listed under BSL-1 in addition to

1. If materials are required to be transported outside the laboratory for decontamination or disposal, they shall be packaged in accordance with applicable local, state and federal regulations prior to moving from the laboratory.

2. The principal investigator shall establish policies and procedures, which insure that only persons who have been advised of the potential hazards and meet specific entry requirements (i.e. immunizations) may enter the laboratory.

3. In addition to the information listed in BSL-1, any required immunizations, personal protective equipment, and special procedures needed to exit the laboratory shall be listed on all biohazard signs.

4. Laboratory personnel shall receive all appropriate immunizations or tests for the agents handled or potentially present in the laboratory. When appropriate, baseline serum samples for laboratory and other at risk personnel shall be collected and stored. Additional periodic sampling shall be required.

5. The principal investigator shall insure that laboratory and support personnel receive and document appropriate training on the potential hazards associated with the work involved, the necessary precautions to prevent exposures and the exposure evaluation procedures. Annual refresher training shall be required.

6. Needles and other sharp instruments shall be restricted in the laboratory for use only when then is no alternative. Plastic ware shall be substituted for glassware whenever possible. Only needle locking units or disposable syringe-needle units (needle is integral to the syringe) shall be used when needed.

7. Cultures, and other materials containing biological agents or potentially infectious wastes shall be placed in a container with a cover that prevents leakage during collection, handling, processing, storage, transport or shipping.

8. In addition to BSL-1 decontamination procedures, any equipment that could be contaminated shall be decontaminated according to any local, state or federal regulations before it is sent for repair or maintenance or packaged for transport before removal from the laboratory.

9. Spills and accidents that could result in exposures to infectious materials shall be immediately reported to the FSH. The employer shall provide medical evaluation, treatment and surveillance as appropriate and written records of the event shall be maintained.

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Safety Equipment (primary barriers)

Safety equipment listed under BSL-1 in addition to

1. Class II Biological Safety Cabinets (BSC's) or other personal protective equipment and containment devices shall be used whenever work with BSL-2 agents can create aerosols or splashes. These activities could include centrifuging, grinding, blending, vigorous shaking or mixing, sonic disruption, or opening containers of materials whose internal pressures may be different from ambient pressures. High concentrations or >10 liters of infectious agents shall also require containment to prevent spills or aerosol release. These materials shall be centrifuged in the open laboratory if sealed rotor heads or centrifuge safety cups are used and if these rotors or safety cups are opened only inside a biological safety cabinet. Biosafety cabinets shall be evaluated on an annual basis and comply with standards listed in National Science Foundation, Article 49, "Government Performance and Results Act."

2. Face protection (goggles, mask, face shields or other splatter guards) shall be used for anticipated splashes or sprays of infectious material when microorganisms must be manipulated outside the BSC.

3. Protective laboratory coats designated for laboratory use only shall be used while in the laboratory. Glove use shall also be required during manipulations. Disposable gloves shall not be washed and reused or used to touch “clean” surfaces such as keyboards, telephones, writing utensils or notebooks.

Facility Requirements (secondary barriers)

Facility requirements in addition to those listed under BSL-1

1. Install and locate biological safety cabinets to ensure that fluctuations of the room supply and exhaust air do not cause the cabinets to operate outside the regulated levels for containment bases on NSF-49.

2. Facilities that house restricted agents (as defined by 42 CFR 72.6, 42 CFR 73.3, and 42 CFR 73.4) shall provide lockable doors.

6.7.4 Addition of Biologically Active Materials to a Permitted Operation

a. New agents or projects shall be added by the Principal Investigator and the FSH by submitting a NASA Langley Form 118 and a NASA Langley Form 180, "Biological Agent Review Form," to the PHMC. Since biological agent research is of a continuously changing nature, the review of these materials shall be accomplished in 3 months to enable the research to remain flexible and workable.

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6.7.5 Addition of Certified Workers

a. A list of Certified Workers shall be included in each NASA Langley Form 180. New workers shall be added by the FSH by submitting a NASA Langley Form 66 to the PHMC and OHCM OHS contractor. A copy of the NASA Langley Form 180 shall accompany the NASA Langley Form 66. The submission and approval of these forms shall be required before the person can conduct work with this agent. Upon approval, the PHMC and OHCM OHS contractor physician shall sign the form. Contractors shall submit equivalent information to the SFAB.

6.7.6 Recordkeeping for the Biological Agent Operations

a. The records required for Biological Agent Operations:

(1) The laboratory shall keep a copy of the current permit and a list of approved NASA Langley Form 180 in the laboratory. These forms shall be amended as required and submitted to the PHMC for review.
(2) A list of personnel trained to use the particular agent, the date of the training and the person conducting the training. These records shall be maintained in a computer database in the FSH or his/her designee's office and the dates of the training shall be listed on the NASA Langley Form 180 for the project.
(3) The time personnel will be working with the specific agents shall be specified. This information shall be logged on a NASA Langley Form 62, "Chemical Worker's Certification Card," attached to each fact sheet. Copies of this form shall be sent to the PHMC and to OHCM OHS contractor. This NASA Langley Form 62 shall be attached to the PHM permit behind each the NASA Langley Form 180.

b. Biological agent permits shall be reviewed annually during the SFAB IH audit.

6.8 STORAGE, USE AND DISPOSAL OF "SHARPS"

a. Exposure to chemicals and biological agents can occur by several different routes: (1) inhalation, (2) ingestion, (3) absorption through skin or eyes and (4) injection. The purpose of this section is to control exposures caused by injecting chemicals or biological agents through the skin barrier.

b. Exposure to toxic agents by injection does not happen frequently in the laboratory, but it can occur inadvertently by mishandling "sharps" such as glass, syringes or metals contaminated with toxic agents. The intravenous route is especially dangerous because it introduces the toxicant directly into the bloodstream, eliminating the process of absorption. Non-laboratory personnel such as custodial or maintenance workers, as well as laboratory workers shall be protected from this form of exposure.

c. Hand injuries are the most common injuries in laboratories. Keeping all cutting and puncturing devices fully protected, and employing utility knives instead of single edge razor blades as cutting tools can prevent many of these injuries. Syringes with

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needles shall be used once, if possible, and then placed in a suitable disposal container. Injuries are more likely if the syringes are used more than once. Kevlar gloves of different thicknesses shall be made available and shall be used when handling sharp objects, such as metal foil or picking up broken glass. If a cutting tool does not do the job, users shall select a better tool and should not simply apply more pressure.

d. When ordering razor blades, foil or syringes with needles, order only the amount that will be used in the project. Do not stockpile these materials. Items shall be stored in protective boxes out of sight, inside drawers or cabinets, and shall not be left out on countertops or workstations where they could cause injury to others. Special holding devices shall be ordered if the needles are required to be used over and over. Always order the blunt tip needles for laboratory work, if possible. Beveled tip needles are usually used in medical situations where easy injection into the skin and tissues is desirable. Special attention shall be paid to the storage of disposable sterile hypodermic syringes that could be pilfered for illegal uses.

e. The janitorial/custodial staff shall not pick up glass, even unbroken glass drink containers, from the regular trash. Use large cardboard disposal boxes to dispose of broken glass, bottles, capillary tubes and Pasteur pipettes. These boxes shall be purchased specifically for this purpose and shall have printed on the exterior of the box “broken glass” warnings. When full, these boxes shall be taped shut, and placed in the hallway for pickup.

f. There are two types of red “sharps” containers that may be found in the work area, those labeled with the universal biohazard label and those not so labeled. The chemically contaminated sharps shall be collected separately from the biologically contaminated sharps. Biological agents shall never be placed inside the cardboard "broken glass" boxes. Used hypodermic syringes shall never be recapped and shall be dropped into the properly marked red “sharps” containers for disposal. Special one-handed safety devices shall be ordered if the recapping of needles is required by the project.

g. Razor blades and scalpels shall be placed in the red “sharps” containers after use. They shall not be left out on countertops in the work area.

h. All types of sharps containers shall be turned in to the Chemical Manager for proper disposal when almost full. Never overfill the box because this increases the possibility of accidental injury. The Chemical Manager shall issue a replacement container acceptable to the regulatory requirements with proper warning labels attached. Sharps shall not be collected in containers that have not been approved by the Chemical Manager or FSH.

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APPENDIX A

GENERAL TECHNICAL INFORMATION ON TYPES OF POTENTIALLY HAZARDOUS MATERIALS (EXCLUDING GASES)

a. This appendix provides general technical data to assist LaRC employees in recognizing and controlling health and safety related problems that may arise from the use of PHM's. It contains information on solvents, acids, bases, OSHA carcinogens, and so forth. Information on selected gases is in Appendix B of this procedural requirement.

b. Additional information on PHM's can be found in the MSDS for items in use. This is typically the first reference for PHM users in facilities. Prior to the use or acquisition, site personnel shall check existing databases on PHM's to include current MSDS's on the materials proposed for use, or other existing facility process information. The Center has an on-line MSDS Library at:

http://osemant1.larc.nasa.gov/cmts/

Assistance in interpreting information on this site shall be obtained from the EMT, the SFAB IH staff, and the PHMC.

c. For research and development operations, additional review on the reaction products during the process, or possible accidental reaction process hazards, shall be performed prior to starting the operation. For example, work with gallium arsenide semiconductor chips may result in small releases of lethal arsine gas with little or no associated odor. Cyanide compounds used in metal etching or photographic processes can form lethal cyanide gas if a spill occurs with acids and cyanide compounds present. Also, work with hydrogen gases involves high flammability risks. All of these are examples of PHM with risks controllable through the use of training, process control (ventilation - fume hoods), gas leak testing and monitoring devices when these measures are put in place and used with PHM operations.

GENERAL INFORMATION ON CLASSES OF PHM

Flammable Liquids

a. The handling of solvents requires trained personnel. Because of the nature and variety of these chemicals, poisoning, evaporation, fire, and explosion hazards exist. Incompatible solvents shall not be stored together and all containers shall be properly sealed and kept in suitable areas. (Requirements for storage are provided in Chapter 6 of this procedural requirement.) Protective clothing shall be worn and the laboratory or use area shall be equipped with safety equipment commensurate with the hazards of the solvent. It may be necessary to also have a spill cleanup kit on hand and readily available to handle small spills (Chapter 6). Some operations involving the handling of solvents require shielding, special hoods or special protective clothing such as gloves,

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aprons, face shields, goggles, coats, or other special garments. Information or assistance on the selection of these devices shall be obtained from the FSH or by contacting the SFAB IH staff.

Acids and Bases

a. The handling of acids, bases, corrosives, and toxic chemicals demands adequately trained personnel. Untrained persons shall not be granted access to the stores or permitted to handle such materials. Because of the nature and variety of these chemicals, their hazards range from poisoning, burning, and gassing through explosion. Care shall be exercised to assure that incompatible chemicals are not stored together. All containers shall be properly sealed and kept in appropriate storage areas. Suitable protective clothing shall be worn and the laboratory shall be equipped with safety equipment commensurate with the hazards of the acid or base, such as an eyewash station, a safety shower, and a fume hood. It shall be required to have a spill cleanup kit on hand and readily available to neutralize small spills. Most chemicals of this class are capable of inflicting severe burns when spilled on skin or clothing. Pending medical treatment, initial first aid for every chemical burn is to wash off the chemical by flooding the burned area with very large amounts of water as quickly as possible. This is the only method for limiting the severity of the burn, and the loss of even a few seconds can be vital. Following complete washing, the burn should be covered with a clean, preferably sterile, cloth or sheet, and the victim should be taken to a physician. No ointment, salve, grease, stimulant or other remedy shall be used without the physician's advice, except for the use of calcium gluconate for treatment of hydrofluoric acid burns. Dial 911 from any Center telephone or 864-2222 from a cellular telephone to obtain medical assistance. Some operations involving the handling of this class of chemicals shall require shielding, special hoods, or special protective clothing such as gloves, aprons, face shields, goggles, coats, or other special garments.

Acids

a. As a group, acids are highly reactive. This reactivity adds to their usefulness but it also demands that laboratory spills be given special attention. Three factors should be remembered when considering methods to clean up minor acid spills:

(1) Reactivity with water,
(2) Corrosiveness of the chemical and its decomposition products, and
(3) Irritability of the chemical and its decomposition products.

Problems associated with these factors can be easily solved with common sense and general laboratory safety.

b. Water **shall not** be used on most concentrated acid spills unless the water can be delivered in deluge quantities. Most concentrated acids react vigorously with water, producing corrosive products. In addition, the exothermic reaction will cause increased vaporization of the reagent, which may have a pungent irritating odor even under the best of ventilation conditions. Reagent spills shall first be absorbed with the appropriate

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spill cleanup kit. The damp mixture can then be scraped up with a plastic, ceramic, or metal scoop. Successful use of this technique requires that the spill cleanup kit be readily accessible. The EMT shall be contacted for disposal of the cleanup material.

c. As in the handling of most chemical spills, safety glasses and rubber gloves are required to safely clean up acid spills. Gloves do not permit prolonged contact but they offer adequate protection for the removal of most spills. Splashes on the skin or in the eyes shall be rinsed immediately with a heavy flow of water. Clothing splashed with acids shall be removed and washed before reuse.

d. **Avoid acid mists in air.** Small spills, which occur in a clear open area, such as the floor or the center of a laboratory bench, can be cleaned by personnel with only a brief exposure to mists. Other spills may be larger or occur in an inconvenient spot with poor ventilation, causing higher exposures and necessitating use of a self-contained breathing apparatus.

e. The occurrence and effects of spills can be minimized by observing a few general precautions:

(1) Limit the size of reagent bottles in the laboratory. Generally, only a one-month supply of chemicals shall be kept in the laboratory area. Larger quantities shall be kept in approved facility storage vaults.
(2) Leave adequate headspace in bottles.
(3) Do not store reagents in a warm spot.
(4) Keep the bottles in a tray, preferably ceramic or glass lined.
(5) Keep an acid spill kit on-hand.
(6) Do not use water to fight a fire involving acids. Use a dry chemical or CO_2 extinguisher. Water can be used for small spill amounts if the water is delivered in deluge quantities.
(7) Use approved bottle carriers when necessary to transport chemicals.

Bases

a. The major hazard in the use of bases is their corrosive action on tissue. Severe, painful tissue damage can rapidly result from acute exposures in which significant amounts of bases are inhaled, splashed on the skin, or swallowed.

b. Contact with the skin or eyes are the most common hazard. Unlike inhalation exposures, contact injuries occur frequently in the laboratory. Only small amounts of concentrated bases are needed to cause damage, which may range from annoying irritation to deep flesh burns and permanent visual impairment. Mist or spray, which is too light to cause a skin break, may cause dermatitis. If the exposure is constant, more serious skin problems may develop, requiring prolonged medical treatment.

c. Workers shall be cautioned to check themselves over thoroughly after working around bases to ensure that no clothing or skin has been attacked. There is no warning

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sting with bases, as with acids, and an unattended burn can make considerable headway before it is noticed.

d. The most important aspect of any spill is the prompt removal of the chemical, which contacts the skin or eyes. Concentrated bases are not easily rinsed from the skin and continuous flushing with water is needed. The same is true for material splashed in the eyes--use eyewash or a gentle flow of water from a hose. Flushing for at least 15 minutes is recommended. Small splashes on the fingers, hands, or arms usually will not cause any irritation if the material is promptly washed off. These body parts can be easily held in a heavy and continuous flow of water from a sink faucet. Other parts of the body will be more difficult to flush thoroughly and medical attention should be promptly obtained. Obtain medical attention for eye splashes by dialing 911 from any Center telephone or 864-2222 from a cellular telephone.

e. Ingestion is unlikely in the laboratory but sudden direct releases or an explosive reaction may cause involuntary swallowing of material sprayed in the face. Neutralizing solutions may be taken if they are immediately available and if prior medical approval has been granted for their use. If these solutions are not available, a large amount of water should be taken at once to afford dilution. Immediately obtain medical attention by dialing 911 from any Center telephone or 864-2222 from a cellular telephone.

f. Laboratory spills of bases shall be cleaned using the appropriate spill cleanup kit. The damp mixture can then be scraped up with a plastic, ceramic, or metal scoop. Spill cleanup kits shall be kept available throughout the laboratory. Personnel in the EMT shall be contacted for disposal of the cleanup materials.

g. For technical information on specific bases, refer to the MSDS or contact the SFAB IH staff or the EMT.

GENERAL LABORATORY SAFETY PROCEDURES

a. Laboratory fume hoods are in use at several locations at this Center. Basic posting guidelines for the safe use of laboratory hoods are in Figure A.1, "Work Practices for Laboratory Hoods." Additionally, a quick posting guide to general laboratory safety is shown in Figure A.2, "Recommended Unit Operations Laboratory Safety Rules."

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No large, open-face hood with a low face velocity can provide complete safety for a worker standing at the face against all events that may occur in the hood. The hood may not adequately protect the worker from volatile or otherwise airborne contaminants with a TLV in the low-part-per-billion range. For more ordinary exposures, a properly designed hood in a properly ventilated room can provide adequate protection. However, certain work practices are necessary in order for the hood to perform capably. The following work practices are generally required; more stringent practices may be necessary in some circumstances.

1. Conduct all operations that may generate air contaminants at or above the appropriate TLV inside a hood.

2. Keep all apparatus at least 6 inches back from the face of the hood. A stripe on the bench surface is a good reminder.

3. Do not put your head in the hood when contaminants are being generated.

4. Do not use the hood as a waste disposal mechanism except for very small quantities of volatile materials.

5. Do not store chemicals or apparatus in the hood. Store hazardous chemicals in an approved safety cabinet.

6. Keep the hood sash closed as much as possible.

7. Keep the slots in the hood baffle free of obstruction by apparatus or containers.

8. Minimize foot traffic past the face of the hood.

9. Keep laboratory doors closed (exception: some laboratory designs require lab doors to be open).

10. Do not remove hood sash or panels except when necessary for apparatus set-up; replace sash or panels before operating.

11. Do not place electrical receptacles or other spark sources inside the hood when flammable liquids or gases are present. No permanent electrical receptacles are permitted in the hood.

12. Use an appropriate barricade if there is a chance of explosion or eruption.

13. Provide adequate maintenance for the hood exhaust system and the facility supply system. Use static pressure gauges on the hood throat, across any filters in the exhaust system, or other appropriate indicators to ensure that exhaust flow is appropriate.

14. If the hood sash is supposed to be partially closed for the operation, the hood should be so labeled and the appropriate closure point clearly indicated.

Figure A.1, Work Practices for Laboratory Hoods.

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1. "Horseplay" is hazardous and shall not be tolerated.
2. Do not work alone in the laboratory at any time except to prepare flow diagrams and operating procedures for equipment.
3. Use required personal protective equipment (PPE) whenever specified by the laboratory director.
4. Do not wear contact lenses when vapors or fumes are present.
5. Wear safety glasses with side shields and plastic lenses (shall meet ANSI Standard Z87. 1) at all times. Wear splash goggles or face shields as prescribed by the director.
6. Do not wear sandals, open shoes, high-heeled shoes, shoes (or boots) with holes in the soles, or shoes with vas uppers; do not wear shorts or skirts. Wear shirts or blouses.
7. Secure long hair and loose items of jewelry or clothing when working with rotating machinery.
8. Know the use and location of all emergency equipment in the laboratories, shops, and storage areas.
9. Know to call 911 to summon emergency response personnel. This 911 number shall be posted at every phone throughout the facility.
10. Be familiar with all the elements of fire safety: alarm, evacuation and assembly, fire containment and suppression, rescue, and facilities evaluation.
11. Do not use ungrounded wiring and two-wire extension cords. Do not use worn or frayed extension cords or those with broken connections or exposed wiring. Check that electrical devices are grounded before they are turned on.
12. Be familiar with an approved emergency shutdown procedure before initiating any experiment.
13. Do not deviate from approved equipment operating procedures.
14. Keep all laboratory aisles and exits clear and unblocked.
15. Do not sniff, breathe, or inhale any gas or vapor unless directed to do so by the laboratory director.
16. Label all containers as to content and composition with an appropriate hazard warning. Label the container with the workers name and the date the container was filled.
17. Read and obey the instructions on all warning signs.
18. Segregate all liquid and solid waste for disposal according to the instructions of the laboratory director. Neutralization of all acidic and basic wastes is prohibited unless a permit is obtain from the DEQ. Place organic waste material in the designated waste disposal cans; do not pour into any sink or floor drain.
19. Practice good housekeeping in the laboratories, shops, and storage areas.
20. Do not eat, drink, use tobacco, chew gum, or apply makeup in the laboratories, shops, and storage areas.
21. Place only chemicals in the "Chemicals Only" refrigerator and place only food items in a "Food Only" refrigerator. Do not use ice from the ice machine for human consumption or to cool any food or drink
22. Report any glassware breakage or malfunctioning instruments or equipment to the teaching assistant.
23. Report all injuries, accidents, and "close calls" to the laboratory director. Complete the accident report as soon as possible.
24. Report spills of any chemicals to the laboratory director. Follow his/her directions for containment and cleanup. Report all mercury spills to the laboratory director. Follow the prescribed instructions for cleanup and decontamination of all spill areas.
25. All personnel shall wash hands their before leaving the laboratories or shops.
26. Do not toss tools, supplies, or any other items from one person to another.
27. Do not pipette or siphon any material, even water, by mouth.
28. Secure compressed gas cylinders at all times. Follow proper safety procedures when moving compressed gas cylinders.
29. Use only gauges that are marked "Use no oil" for oxygen cylinders. Do not use an oiled gauge for any oxidizing or reactive gas or any gas that has not been "water pumped."
30. Never play with compressed gas hoses or lines, or point their discharges at any person.
31. Do not use open flames or heating elements when volatile chemicals are exposed to air.
32. Only expose toxic chemicals to the air under a hood. Only expose flammable chemicals to the air under a hood or in an adequately ventilated area.
33. Limit personal items brought into the laboratory to those things necessary for the experiment.
34. Discourage casual visitors to the laboratory; obtain permission from the laboratory director for visitors to enter. All visitors and invited guests shall adhere to all laboratory safety rules, with adherence being the responsibility of the person visited.

Figure A.2, Recommended Unit Operations Laboratory Safety Rules.

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APPENDIX B

GENERAL TECHNICAL INFORMATION ON GASES AND CRYOGENS

a. Most gases including inert gases have some hazards associated with their use. ALL CYLINDERS ARE TO BE CONSIDERED PHM AND TRACKED THROUGH THE CMTS. Any gas stored or used from a compressed gas cylinder has the hazard normally associated with that of high-pressure vessels or systems, that is, rupture and/or explosive force on release. Some gases have chemical properties, which make them hazardous in other ways, for example, gases that may be flammable, toxic, or explosive when released in a working environment. Other gases (i.e., liquid nitrogen or Helium), though chemically inert, can displace the oxygen of the air and cause asphyxiation of personnel in an area not well ventilated with fresh outside air. Also, any gas, which reacts with O_2, can cause suffocation under circumstances where O_2 is not replenished. The gases, which are flammable over wide composition ranges with air or oxygen, include hydrogen, carbon monoxide, methane, ethane, acetylene, and propane. The same gases may form explosive mixtures with air or O_2 under certain conditions.

Toxic Gases and Cryogens

a. Some gases normally used in the form of cryogenic liquids or solids have other hazards associated with their use. The low temperatures present local freezing hazards to personnel exposed for a sufficient length of time. Liquid H_2, O_2, and F_2 are very hazardous materials due to the high local concentration of these normally active gases. The powerful oxidizers, liquid O_2 and F_2, shall be protected from contact with organic materials or fuels as explosive reactions may result. Liquid N_2, although a relatively inert gas, has its hazards also: (1) the low temperature, (2) (in common with other liquefied gases) if spilled or allowed to evaporate quickly in large quantities in confined areas, can so dilute or replace the O_2 of the air that asphyxiation will ensue, and (3) the liquid N_2 can condense the O_2 from the air making a mixture of liquid N_2 and O_2 which may assume some of the hazards of liquid O_2, that is, violent reaction with organic compounds.

b. General safety precautions, for most of the gases covered herein, are to provide good positive ventilation and in the case of the flammable and explosive gases, provide spark and explosion-proof fan motors and electrical equipment. The ventilation system shall be designed with the density of the gas relative to air as a prime consideration. For minor leakage, the gas will follow air streams. For large leaks, separation of gases from air due to density will occur. Normal design for catastrophic failure is for density effects. The American Conference of Governmental Industrial Hygienists (ACGIH) industrial ventilation manual can be used as a technical reference, or contact the SFAB IH staff. It is recommended that gas bottles being used be secured in outside, covered but not enclosed areas, and appropriate lines be used to pipe the gases to the use point. Detection alarm monitors and automatic cut-off valves are also recommended when operating inside the facilities where the hazardous gas is being used. The Fire Department shall conduct all rescue operations requiring Self-Contained Breathing

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Apparatus (SCBA). The prime safety precaution shall be to limit concentration of these gases so that the risk of damage is minimized at all times.

c. For cryogenic liquid gases the precautions shall be to use equipment (e.g. cryogenic gloves, aprons, eye protection) to guard against freezing and avoid spills or very rapid evaporation into an enclosed area. Oxygen deficiency alarm monitors shall be located in areas where spills may occur.

d. The information furnished here may not provide enough detail for some of the gases listed, particularly H_2 gas and cryogenic liquids. Additional data is available from SFAB, SMAO.

IMMEDIATELY DANGEROUS TO LIFE OR HEALTH (IDLH) CONCENTRATIONS FOR GASES AND SELECTED HAZARDOUS SUBSTANCES

a. Immediately Dangerous to Life or Health (IDLH) concentrations of gases represent the exposure concentrations at which, in the event of a respirator or ventilation system failure, the exposure is likely to cause death, immediate or delayed permanent adverse health effects, or prevent escape from such an environment. Information on IDLH gas concentrations can be obtained from the National Institute of Occupational Safety and Health (NIOSH) Pocket Guide to Chemical Hazards. As a guide, processes involving gases with IDLH's of 5,000 ppm or less shall have a NASA Langley Form 498. For example, operations involving 0.5 percent (5,000 ppm) methyl bromide (IDLH of 250 ppm) shall require a NASA Langley Form 498. Others above 5,000 may require a NASA Langley Form 498 depending on the volume and use conditions.

b. For additional information on these substances, contact SFAB,SMAO.

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Appendix C

CENTERWIDE CHEMICAL HYGIENE PLAN

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I. PURPOSE

a. These Chemical Hygiene Plan (CHP) requirements have been developed in accordance with OSHA 29 CFR 1910.1450. The CHP outlines specific workplace practices and procedures to ensure that all employees are protected from health hazards associated with the use of chemicals with which they work.

b. These CHP requirements have been prepared expressly for LaRC. The purpose of the CHP is to inform personnel (especially new employees, co-ops, grantees, contractors, and technicians) of a facility's safety organization, its requirements, its resources, and particular hazards that a worker can expect to find. It is not a substitute for existing safety handbooks, regulations, or operating procedures – but rather a summary or a supplement, relevant to LaRC laboratories.

c. It is important for all personnel to read this plan and a number of other required safety-related documents. No one is expected to retain all of this material. Everyone is expected to know: (1) who to contact concerning safety related matters, and (2) where to find safety-related documentation and reference materials.

II. RESPONSIBILITY

a. The CHP is a part of LaRC's overall safety program. The following is an outline of individual responsibilities:

LaRC Safety Manager - Head, Safety and Facility Assurance Branch

(1) Responsible for the development of safety programs as outlined in LaRC directives and procedural requirements, including overall responsibility for CHP.
(2) Monitor the procurement, use and disposal of chemicals used.
(3) Approve all safety permits and chemical worker certifications.
(4) Provide regular, formal chemical hygiene and housekeeping inspections, including routine inspections of emergency equipment.
(5) Assist project directors develop precautions and adequate facilities.
(6) Determine the required levels of protective apparel and safety equipment.
(7) Conduct periodic ventilation measurements to assure proper functioning of fume hoods and other local exhaust ventilation equipment.

Chemical Hygiene Officer - Facility Safety Head

(1) See that appropriate audits are conducted.
(2) Know the current legal requirements concerning regulated substances.
(3) Seek ways to improve the chemical hygiene program.

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(4) Coordinate necessary training in accordance with the CHP.
(5) Establish and review normal and emergency operating procedures.
(6) Consult with the SFAB IH staff concerning chemical control measures including ventilation and personal protective equipment.

Laboratory Supervisors

(1) Ensure that workers know and follow the chemical hygiene rules that personal protective equipment is available and in working order and that appropriate training has been provided.
(2) Plan each operation in accordance with the facility's chemical hygiene procedures.
(3) Know the current legal requirements concerning regulated substances.

Laboratory Personnel

(1) Each individual shall be required to have read and understand this CHP and supplements applicable to their work areas.
(2) Conduct each operation in accordance with the facility's chemical hygiene procedures.
(3) Know the hazards associated with each chemical used by the individual by reviewing MSDS information prior to use and periodically as deemed appropriate.
(4) Know and use required personal protective equipment for each operation.
(5) Develop good personal hygiene habits.

III. GENERAL SAFE LABORATORY PRACTICES

To achieve safe conditions for the laboratory and laboratory workers the following safety procedures shall be followed:

A. DRESS CODE

Clothing worn by laboratory personnel will protect the body from chemical exposure or burns. Shorts, cut-off sleeves, fish net shirts and tank tops shall not be permitted at any time. No employees shall be permitted to work bareback or barefoot. Personnel are encouraged not to wear sandals in the laboratory. Wearing laboratory coats over street clothing is also recommended, to prevent the transfer of hazardous materials from the work to home environment.

B. EATING

Consumption of food and/or beverages shall not be permitted in the laboratory and process areas. Glassware or utensils that have been used for laboratory operations shall never be used for food or beverages. Laboratory

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refrigerators and ice machines shall not be used for food storage. The crushed ice from these machines shall not be used in beverages. Labels shall be posted on all refrigerators and ice machines indicating whether or not they are safe for food use.

C. EMERGENCY REPORTING

All emergencies shall be reported by dialing 911 from any Center telephone or 864-2222 from a cellular telephone or by contacting the SFAB, SMAO at 864-7233. All telephones have labels bearing emergency number.

1. First-Aid

In the event of a medical emergency, Fire Department personnel will respond. The location of all safety showers and eye wash stations are indicated in the laboratory specific supplement. Basic first aid procedures to be used are as follows:

a. Eye Contact - Promptly flush eyes at an eyewash station for at least 15 minutes. Be sure to open lids while flushing.

b. Skin Contact - Promptly flush and wash the affected area with soap and water. If only the face is involved, the eye/face wash fountains can be used to flush the area with water. Remove all contaminated clothing in a manner that will not cause further contact with the skin.

c. Inhalation - Immediately remove from the exposure area to fresh air.

2. Accidents

In the event of a serious accident or illness, proceed immediately to the OHCM OHS contractor located at 10 West Taylor Street (Building 1149), for treatment. If possible, all minor incidents should be reported to the FSH and supervisor before reporting to OHCM OHS contractor location. If not possibly the incident shall immediately be reported to the FSH and supervisor upon returning from the OHCM OHS contractor location. The FSH shall be responsible for notifying the SFAB, SMAO all accidents, close calls, health related incidents or spills that could cause serious health hazards, therefore, all incidents shall be reported as soon as possible.

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3. Chemical Spills

a. In the event of a small-scale spill (less than 1 liter) or airborne release of a non-toxic chemical, notify the FSH, his/her designee or alternate immediately. The location of all spill kits shall be indicated on the facility diagrams in the laboratory specific supplement. All laboratory personnel working with chemicals shall be familiar with the proper use of these spill kits and their location.

b. Determine the severity of the spill and possible means of temporarily containing the spill with spill pads, absorbent booms or socks. If the spill is too large to handle on an individual basis, notify personnel in the immediate area to evacuate the facility. After contacting emergency personnel, including the FSH, his/her designee or alternate, keep the area clear and await further instructions.

c. In addition to notifying the FSH, his/her designee or alternate, the EMT shall be notified, at 864-3500, in the event of a toxic chemical or oil spill which may end up contaminating the sewer system or, which represents a serious health hazard. Spill responses are mentioned in Chapter 15 of LPR 8800.1. User responsibilities as outlined in this CHP are to maintain containment and clean-up supplies, identify the material and estimate the volume, and clean up the spill (Class I); use special precautions or seek assistance for Class II spills. In the case of toxic spills, the area shall be cleared and the Fire Department notified immediately by dialing 911 from any Center telephone or by dialing 864-5600 from a cellular telephone. This CHP does not supersede LPR 8800.1 or other LaRC directives and procedural requirements concerning spill control.

D. HYGIENE/HOUSEKEEPING

a. Do not use mouth suction to pipe chemicals or to start a siphon; a pipette bulb or an aspirator shall be used to provide vacuum.

b. Always wash hands and exposed skin with soap before leaving the laboratory area and before and after glove use. Do not use solvents for washing skin. They remove the natural protective oils from the skin and can cause irritation and inflammation. In some cases, washing with a solvent might facilitate absorption of toxic chemicals. Use protective gloves and clothing to keep chemicals off skin.

c. The laboratory area shall be kept clean and free from obstructions. Clean up shall follow the completion of any operation at the end of the day.

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d. Access to exits, emergency equipment and/or controls shall never be blocked.

e. All chemicals and containers shall be properly identified and labeled with CMTS inventory numbers, hazard warning labels and NFPA diamond labels. The NFPA diamond label with the material name or trade name shall be placed on transfer containers (e.g., beakers, flasks) whenever possible. Unlabeled containers shall not be permitted in the laboratory. MSDS's shall accompany all laboratory chemicals when entering or exiting the facility. See Chapter 3 of this procedural requirement for the proper methods to bring chemicals into or ship chemicals out of a facility.

f. Wastes shall be labeled properly and deposited in appropriate containers. Waste labels are available from the EMT (864-3500).

E. LABORATORY HOODS

a. Operations involving toxic gases, vapors, aerosols, and dusts shall be performed in a hood. Laboratory hoods offer significant employee protection. They prevent toxic, offensive or flammable vapors from entering the general laboratory atmosphere, they place a physical barrier between the workers and the chemical environment, and they provide an effective containment device for accidental spills of chemicals. Laboratory hoods shall remain on at all times and the sash shall be lowered when not in use or when physical protection is needed.

F. MATERIAL SAFETY DATA SHEETS (MSDS's)

a. OSHA requires all employers to maintain a complete and accurate MSDS for each hazardous chemical that is used at their worksite. Manufacturers/ suppliers shall supply this information when a material is purchased. These MSDS's shall be updated whenever new and significant information becomes available concerning a product's hazards or ways to protect against these hazards. All chemicals entering a facility shall be accompanied by a MSDS, whether the material was purchased or obtained as a complimentary sample. If the MSDS's are missing, it shall be the individual's responsibility to obtain these from the manufacturer and supply copies to the FSH or his/her designee.

b. These MSDS's provide an excellent source of specific information about chemicals, which employees handle. MSDS's shall be readily available in designated notebooks. In addition, MSDS's shall be found on the web at the following web sites:

http://osemant1.larc.nasa.gov/cmts/
http://www.fishersci.com

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http://www.ilpi.com/msds/index.chtml.

c. These sites can be bookmarked in your computer for quick and easy access. It shall be each employee's responsibility to review the hazards associated with all chemicals that they use. Additional MSDS's and information on possible hazards shall be obtained from the SFAB IH staff at 864-7233.

d. A MSDS and a NASA Langley Form 44 shall accompany any chemical substance, either commercial or experimental, leaving or entering a facility. If a MSDS for the compound does not exist, then it shall be the individual's responsibility to create one with the support of the SFAB IH staff.

G. MEDICAL CONSULTATION/EXAMINATION

a. Personnel at LaRC are entitled to medical attention because of their potential exposure to hazardous materials in accordance with various LaRC health and safety requirements. In general, personnel identified as chemical workers shall receive examinations from the OHCM OHS contractor or other qualified medical personnel. The exact requirements are in other directives, but these medical services are generally outlined as follows:

(1) New employee physical examinations. If possible, exit exams upon termination of employment.

(2) Examination for chemical worker certification.

(3) When an employee develops signs or symptoms associated with a hazardous chemical that he or she may have been exposed to in a laboratory.

(4) When an occurrence, such as a spill, leak, explosion, or other type of emergency occurs in a laboratory resulting in the likelihood of hazardous exposure.

(5) When monitoring indicates an exposure level exceeding the Action Level or Permissible Exposure Limit for a chemical as cited by OSHA, ACGIH or NIOSH.

b. Consultation with a medical professional shall be provided free to the employee, as is any examination or other attention recommended by the consulting physician, at a reasonable time and place. This laboratory standard also requires the keeping of records of medical consultations and exposure evaluations. Any individual, including civil servants, apprentices, co-ops, and temporary employees, working with PHM's shall be certified

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through the safety and certification process. Contact the CHO for the appropriate certification forms.

H. PERSONAL PROTECTIVE EQUIPMENT

Personal protective equipment that shall be worn in laboratories includes, but is not limited to:

1. Gloves - When handling any chemical, gloves shall be worn. The specific chemical characteristics shall determine the glove type to be worn. Contact the SFAB IH staff at 864-7233, for glove selection guidelines and chemical incompatibilities.

2. Hard Hats - Hardhats shall be required in designated hardhat areas.

3. Hearing Protection - Whenever employee noise exposure exceeds the 8-hour time weighted average of 85 decibels, the employee shall wear hearing protection. All high noise areas and equipment generating high noise levels shall be posted. Hearing protection shall be worn if operating any posted equipment or if working in a high noise area.

4. Respirators - When exposures to dust, fumes, mist, radionuclides, gases and vapors exceed established limits of exposure, respiratory protection shall be required.

5. Safety Glasses - To protect eyes from laboratory hazards, employees shall wear safety glasses with side shields at all times in laboratories, any laboratory with a fume hood, when working with hazardous materials, and the shop areas. Operations that require improved protection against impact, liquid splash and other eye hazards shall require safety goggles and/or face shields. Safety glasses can be obtained from the FSH. All visitors entering laboratories shall be required to wear plastic safety glasses.

   Contact lenses shall not be worn in work areas. If contact lenses are needed for medical reasons, they shall be used in conjunction with goggles and during an emergency shall be removed before eye irrigation. Contact the FSH or SFAB IH staff if you have a doctor's recommendation to wear contact lenses.

I. ROUTES OF EXPOSURE

Exposure to hazardous chemicals can be minimized by understanding the common routes of exposure.

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1. Inhalation - Inhalation of toxic vapors, mists, gases or dusts can produce poisoning by absorption through the mucous membrane of the mouth, throat and lungs and can seriously damage these tissues by local action. The degree of injury resulting from inhalation exposure depends upon the toxicity of the material and its solubility in tissue fluids, the depth of respiration and the amount of blood circulation. To prevent inhalation exposure, adequate ventilation shall be provided.

   The American Conference of Governmental Industrial Hygienists (ACGIH) produces annual lists of Threshold Limit Values (TLV's) and Short Term Exposure Limits (Steels) for common chemicals used in laboratories. The National Institute of Occupational safety and Health (NIOSH) has developed recommended exposure standards. OSHA has also developed regulatory standards (PEL's) for employee exposure. These standards represent conditions, which nearly all workers can be exposed without adverse health effects.

2. Ingestion - Many chemicals used in the laboratory are extremely dangerous if they enter the mouth and are swallowed. To prevent entry of toxic chemicals into the mouth, laboratory workers shall wash their hands before eating, smoking, or applying cosmetics, immediately after use of any toxic substance, and before leaving the laboratory. Chemicals shall not be tasted and pipetting shall never be done by mouth. Eating, drinking and the application of cosmetics shall not be allowed in a laboratory or process areas of a facility.

3. Skin and Eye Absorption - Contact with the skin is a common mode of chemical injury. Chemicals enter the skin through hair follicles, sweat glands, and cuts or abrasions on outer layers of the skin. Some chemicals can be absorbed directly through the skin into the bloodstream. Skin can also be damaged by corrosives, which then allows chemicals to enter the body. Skin contact can be prevented by use of appropriate protective equipment.

4. Injection - Exposure to chemicals through injection is the least common exposure route. However, it is possible through mechanical injury from glass or sharp metal, (such as needles or razor blades) contaminated with chemicals. Safe work practices are the best preventive measure for avoiding exposure through injection. Broken glass shall be carefully placed in the cardboard disposal boxes located in each wet laboratory. Used razor blades shall be disposed of in special containers located in each laboratory and not thrown in the trash. Contact the Chemical Manager for special containers for needle disposal. Needles shall not be recapped prior to disposal. There are two types of red "Sharps" containers available for the work area, those labeled with the universal biohazard label and those without. Biologically contaminated sharps

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shall be collected in "Sharps" containers bearing the biohazard-warning label and separate from the chemically contaminated sharps. All types of sharps containers shall be turned in for proper disposal when almost full. Never overfill the container as this increases the possibility for accidental injury.

J. SMOKING

Smoking is prohibited in all laboratories. Smoking is only permitted outside a facility.

K. TRAINING

a. LaRC has made provisions for informing and training employees about potential health hazards and measures they can take to protect themselves when working with chemicals in a laboratory environment. Training is in accordance with OSHA 29 CFR 1910.1450, as well as OSHA 29 CFR 1910.1200. Training requirements of all the standards are similar.

b. All new employees shall receive instruction, utilizing both audiovisual material and classroom training. All employees shall be required to be familiar with the CHP for their facility. Supervisors and safety heads shall be trained regarding hazards and appropriate protective measures so they can be available to answer questions from employees and provide daily monitoring of safe work practices. As new hazards are introduced additional training shall be provided.

c. Currently, laboratory personnel, shall be required to attend a chemical hygiene training class, as required by and in accordance with OSHA 29 CFR 1910.1200 and OSHA 29 CFR 1910.1450, provided by the FSH and to attend regular safety meetings. In addition, all workers in the laboratory and process areas shall be required to attend a PPE training class as required by and in accordance with OSHA 29 CFR 1910.132, "General Requirements." Laboratory and process area workers shall also be required to attend glove use training, respirator training, or additional PHM permit training as necessary. Contact the FSH for the schedule of training classes offered.

d. The training program shall emphasize the following:

(1) Summary of OSHA 29 CFR 1910.1200, "Hazard Communication." All employees shall be required to watch a video explaining the purpose of a CHP. The current video, which is in the LaRC Safety Awareness Library, shall be obtained from the SFAB, SMAO located on the second floor of Building 1232.

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(2) Chemical and physical properties of PHM's (e.g., flash point, reactivity, potential for fire or explosion).

(3) Health hazards, including signs and symptoms of exposure, associated with exposure to chemicals and any medical condition known to be aggravated by exposure to chemicals.

(4) Procedures to protect against hazards (e.g., personal protective equipment required, proper use and maintenance, work practices or methods to ensure proper use and handling of chemicals, and procedures for emergency response).

(5) Work procedures to follow to ensure protection when cleaning hazardous chemical spills and leaks, including location and proper use of spill kits.

(6) Where MSDS's are located, how to read and interpret the information on both labels and MSDS's, and how employees may obtain additional hazard information.

(7) OSHA's Permissible Exposure Levels (PEL's) and American Conference of Governmental Industrial Hygienists' Threshold Limit Values (TLV's).

e. For more information on PHM's contact the SFAB IH staff at 864-7233.

L. WASTE HANDLING AND DISPOSAL

The laboratory shall be required by federal and state regulations to manage all hazardous waste in a specific manner.

1. General

a. All containers, which contain materials, designated as hazardous waste shall be marked with the words "Hazardous Waste" and the identity of the waste. All hazardous waste containers shall be accumulated in a Satellite Accumulation Area (SAA). Specific SAA requirements can be found in LPR 8800.1.

b. Only chemically compatible containers of sufficient strength shall be used to accumulate waste. The containers shall be kept closed at all times except to add waste. The containers shall be arranged so that easy access to them exists. This will ensure that containers will not be damaged during handling. Care shall be taken during all handling to maintain the integrity of the container.

c. Containers used for accumulation of waste shall be labeled from the outset so that anyone working in the area will be aware of

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the contents. It is best to keep waste separated based on particular operations as much as possible, (i.e. do not mix all solvents from different operations or chemical syntheses together). Containers shall not be filled completely to allow for expansion of contents.

d. A NASA Langley Form 163, "Waste Material Data Sheet," shall be filled out on each item to be disposed of by the generator of the waste .Specific waste disposal procedures can be found in LPR 8800.1...

e. The FEC or EMT shall be contacted whenever questions occur about the proper disposal methods for an item.

2. Petroleum Hydrocarbons

Petroleum hydrocarbons constitute a major portion of the waste stream at LaRC. Used oils (from vacuum pumps) shall be kept separate from other chemical wastes. All hydraulic fluids or other synthetic silicone oils and vacuum pump oils shall be kept in separate containers.

IV. RULES FOR WORKING WITH SPECIFIC CHEMICAL CLASSES

A corrosive is defined as a chemical with a pH greater than 12 or less than 2.5.

1. Acids

a. General Information - An acid is a substance that yields hydrogen ions when dissolved in water. Acids commonly encountered in laboratory environments include:

Name	Formula	Gloves
hydrochloric acid	HCl	neoprene or butyl rubber
nitric acid	HNO_3	neoprene or butyl rubber
hydrofluoric acid	HF	nitrile or butyl rubber
sulfuric acid	H_2SO_4	natural rubber
acetic acid	CH_3CO_2H	neoprene or butyl rubber

b. Safety Precautions - Use acids under well-ventilated conditions. Prevent all contact of vapor or liquid with skin, eyes, or mucous membranes. PPE shall include safety glasses, goggles, or a face shield. Contact lenses shall NOT be worn. Full-length sleeves and the appropriate gloves (see above or contact the SFAB IH staff, 864-7233) shall be worn. Wear aprons shall be made of acid resistant material. Respirators shall be used when required. When diluting acids with water, be sure to add the acid to the water, not

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the water to the acid. Be aware of the nearest safety shower and eye wash station before beginning work.

c. Accident Response - In case of a medical emergency exposure, dial extension 911 from any Center telephone or 864-2222 from a cellular telephone. Have an appropriate spill plan for large (> 1L) and small (< 1L) quantities. Anticipate potential spills and use spill pads to make clean up easier. Have appropriate containment materials on hand in case of large spills. Notify the FSH or his/her designee immediately.

d. Transfer and Transport - Use the appropriate PPE as mentioned above and check chemical compatibility of transfer pumps and receiving vessels. When transporting small quantities use bottle carriers to prevent breakage and to act as a containment vessel should breakage occur.

e. Storage - Acids shall be segregated, preferably in separate cabinets, from active metals, oxidizing acids, organic acids, flammables and combustibles, bases and chemicals which react with acids to form toxic gases.

2. Bases/Caustics

a. General Information - Bases are substances, which yield hydroxyl ions when dissolved in water. Bases typically encountered under laboratory conditions include:

Name	Formula	Gloves
potassium hydroxide	KOH	nitrile or neoprene
sodium hydroxide	NaOH	nitrile, neoprene, natural rubber
ammonia	NH_3	nitrile, neoprene, natural rubber

b. Safety Precautions - Bases are extremely corrosive and shall be handled similar to acids with chemical specific changes. Prevent all contact of vapor or liquid with skin, eyes, or mucous membranes. PPE shall include safety glasses, goggles, and/or a face shield. Full-length sleeves and appropriate gloves (see above or contact the SFAB IH staff, 864-7233) shall be worn. Wear aprons made of base resistant material. Respirators shall be worn if necessary. Be aware of the nearest safety shower and eye wash station before beginning work.

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c. Accident Response - In case of a medical emergency exposure dial 911 from any Center telephone or 864-2222 from a cellular telephone. Have an appropriate spill plan for large (> 1L) and small (< 1L) quantities. Anticipate potential spills and use chemically resistant tray and spill pads to make clean up easier. Have appropriate containment materials on hand in case of large spills. Notify the FSH or his/her designee immediately.

d. Transfer and Transport - Use the appropriate PPE as mentioned above, determine chemical compatibility of transfer pumps and receiving vessels. When transporting small quantities use bottle carriers to prevent breakage and to act as a containment vessel should breakage occur.

e. Storage - Don't store bases with acids. The reaction between the two will generate large quantities of heat. As most bases are non-volatile, special storage cabinets are not necessary.

3. Oxidizers

a. General Information - These compounds will react violently with flammables and combustibles, and shall be separated from these substances as well as reducing agents. Oxidizers often seen in laboratories include:

Name	Formula	Gloves
perchloric acid	$HClO_4$	nitrile, neoprene, PVC
chromic acid	CrO_3	butyl rubber
nitric acid	HNO_3	neoprene, butyl rubber
30% hydrogen peroxide	H_2O_2	butyl rubber

b. Safety Precautions - Unintentional contact with organic and other oxidizable substances shall be avoided. Reaction vessels containing significant quantities of these reagents shall be heated using fiberglass mantles or sand baths rather than oil baths. Prevent all contact of vapor or liquid with skin, eyes, or mucous membranes. PPE shall include safety glasses, goggles, and/or a face shield. Contact lenses shall NOT be worn. Full-length sleeves and the appropriate gloves (see above or contact the SFAB IH staff, 864-7233) shall be worn. Wear aprons of the appropriate resistant material. Respirators shall be used when required. Be aware of the nearest safety shower and eye wash station before beginning work.

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c. Accident Response - In case of a medical emergency exposure dial 911 from any Center telephone or 864-2222 from a cellular telephone. Have an appropriate spill plan for large (> 1L) and small (< 1L) quantities. Anticipate potential spills and use chemically resistant trays and spill pads to make clean up easier. Stock amounts reflective of quantities likely to be encountered in spill situations. Have appropriate containment materials on hand in case of larger spills. Notify the FSH or designee immediately.

d. Transfer and Transport - Use the appropriate PPE as mentioned above, check chemical compatibility of transfer pumps and receiving vessels. When transporting small quantities use bottle carriers to prevent breakage and to act as a containment vessel should breakage occur.

e. Storage - Oxidizers shall not be stored with organics or other oxidizable compounds as they present fire and explosion hazards. They shall be stored in glass or unbreakable, inert containers. Corks and rubber stoppers shall NOT be used.

B. TOXICS

Always handle these compounds with adequate ventilation. Store in properly labeled, non-breakable containers. These substances have been divided into a number of categories.

1. Reproductive Hazards

a. General Information - Exposure of both male and female workers to specific chemicals during the reproductive cycle can have an effect on the development of the fetus. In women, toxic chemicals can have a direct effect on the female reproductive system, affect conception, cause changes in maternal hormone secretions, cause genetic damage to the egg cell, or pass through the placenta to directly affect the fetus. In men, toxic chemicals can cause changes in the testes, interfere with the production of male hormones, or cause genetic damage to the sperm cells. These conditions can act on a developing child to cause death, spontaneous abortion, malformation, retarded growth and postnatal functional deficits. In particular, an embryo toxin or fetotoxin is a substance that causes death or abnormal development of one or more body systems of the unborn child. A mutagen is a substance that causes a genetic change in the unborn child. A teratogenic agent is a substance that causes physical defects in the developing baby.

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b. Safety Precautions - The period of greatest susceptibility to reproductive hazards is prior to conception and during the first twelve weeks of pregnancy, when the majority of the baby's organ systems are formed. This is also the period when a woman may not know she is pregnant, therefore special precautions shall be taken at all times. Both men and women of childbearing age shall always take adequate precautions to guard against inhalation, direct skin contact or accidental ingestion of chemicals known to be reproductive hazards. Operations shall always be carried out using impermeable containers in adequately ventilated areas (inside laboratory fume hoods or ventilated equipment.) Appropriate PPE shall be worn, especially gloves. Laboratory hoods shall be inspected for proper operation before works begins.

Chemicals, which may be reproductive hazards, shall be labeled. Some of the reproductive hazards that may be found in laboratories are classified below:

Metals:	Mercury, lead, arsenic, cadmium, aluminum, lithium (metals and salts), and chromium
Gases:	Ethylene oxide
Organic Chemicals:	N-methyl-2-pyrrolidone, N,N-dimethylacetamide, y-butyrolactone, polychlorinated biphenyls (PCBs), dibenzofurans, benzene, xylene, cyclohexanone, glycol ethers and glycol ether acetates, alkanesulfones, acetamides, formamides, dibromochloropropane, and methanol

The FSH and supervisor shall be notified of pregnancy as soon as possible. Pregnant employees shall only be allowed to work in the laboratory after a thorough evaluation of the hazards has been conducted by the supervisor and the employee's doctor.

c. Accident Response - In case of a medical emergency exposure dial 911 from any Center telephone or 864-2222 from a cellular telephone. Notify your supervisor and the FSH or his/her designee immediately concerning all incidents of exposure or spills.

d. Transfer and Transport - Use appropriate precautions whenever transferring or transporting these materials to eliminate exposure.

e. Storage - Store these substances, properly labeled, in a well-ventilated area, preferably in an unbreakable container.

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2. Allergens or Sensitizers

   a. General Information - Allergens are substances, which produce skin and lung hypersensitivity. Examples include dianhydrides, most resin curing agents, diazomethane, chromium, nickel, bichromates, formaldehyde, isocyanates, and certain phenols. There is a wide variety of response from one individual to another so contact with chemicals of unknown activity should be avoided.

   b. Safety Precautions - Wear suitable gloves and clothing to prevent skin contact with allergens or substances of unknown allergenic potential. Work with adequate ventilation.

   c. Accident Response - In case of a medical emergency exposure dial 911 from any Center telephone or 864-2222 from a cellular telephone. If a major spill occurs outside a hood, evacuate the area and contact the FSH or his/her designee and EMT at 864-3500. Only individuals wearing the appropriate protective clothing shall clean up spills. If a spill involves a significant quantity of a toxic material, a full-face supplied air respirator shall be used.

   d. Transfer and Transport - Take normal precautions during transfer and transport to avoid exposure and breakage.

   e. Storage - Store breakable containers in chemically resistant trays. Store contaminated waste in labeled impervious containers. For liquid waste, store in glass or plastic bottles.

3. Chemicals of High Chronic Toxicity

   a. General Information - These substances include, but are not limited to, methanol, certain heavy metals, their derivatives, and potent carcinogens. Contact the FSH or his/her designee for more information concerning the safety permit or the use of suspected carcinogens.

   b. Safety Precautions - Use of these chemicals shall occur only in a controlled area (a laboratory, or portion of a laboratory or a facility such as an exhaust hood, which is designated for use of highly toxic substances). The controlled area shall be conspicuously marked with warning and restricted access signs. Use of this area shall not be limited to toxic substances but all personnel who have access to it shall be aware of the substances being used and the necessary precautions.

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Protect vacuum pumps against contamination by scrubbers or cold traps and vent them into the hood. Decontaminate vacuum pumps or other contaminated equipment, including glassware, in the hood before removing them from the controlled area. Decontaminate the work area before normal work is resumed.

On leaving a controlled area remove any protective apparel, place it in an appropriate labeled waste container, and thoroughly wash hands, forearms, face, and neck.

c. Accident Response - In case of a medical emergency exposure dial 911 from any Center telephone or 864-2222 from a cellular telephone. Contingency plans equipment, and materials to minimize exposures of people and property in case of an accident shall be readily available. Use chemical decontamination whenever possible. If dry powder is used, use wet mops or a High Efficiency Particulate Air (HEPA) exhausted vacuum cleaner instead of dry sweeping. Hand-held vacuum cleaners are not HEPA exhausted units. Ensure that containers of contaminated waste, including washings from contaminated flasks, are transferred from the controlled area in a secondary container.

d. Transfer and Transport - Conduct all transfers in the controlled area. Make sure all materials are properly labeled with chemical name and “high chronic toxicity” or "carcinogen" before being transported.

e. Storage - All containers shall be labeled with the appropriate identification and warning labels. Labels shall at the least include chemical name, NFPA code, and the words "Carcinogen" or “High Chronic Toxicity.” Store containers of these chemicals only in ventilated limited access areas in labeled, unbreakable, chemically resistant, secondary containers. Keep accurate records of the amounts of these substances stored and used, the dates of use, and the names of all users

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C. FLAMMABLES/EXPLOSIVES

1. Flammables

a. General Information - Flammable substances are those, which catch fire readily and burn in air. Examples include acetone, ethanol, methanol, isopropanol, toluene, ethyl ether, dioxane and tetrahydrofuran.

b. Safety Precautions - These substances shall only be handled in areas free of ignition sources. They shall never be heated by using an open flame. Use a steam, water, oil or air bath or a heating mantle. Use adequate ventilation to prevent the formation of flammable atmospheres.

c. Accident Response - In case of a medical emergency exposure dial 911 from any Center telephone or 864-2222 from a cellular telephone. Follow appropriate first aid procedures. For small spills (< 1L), clean up promptly using appropriate absorbent materials and PPE. For large spills (> 1L) evacuate the area and notify the FSH or his/her designee immediately. Know the location of the nearest spill kit and how to use it.

d. Transfer and Transport - When transferring these substances in metal containers, static generated sparks shall be avoided by bonding and the use of ground straps

e. Storage - Store these materials in flammable solvent cans approved by NFPA. These substances shall be kept in special cabinets designed for this purpose.

2. Highly Reactive Chemicals and Explosives

a. General Information - This class of compounds includes peroxide forming compounds and explosives. Important to LaRC are the peroxide forming compounds. These react with oxygen present in the atmosphere to form peroxides. Peroxides are unstable and there are risks of explosion. The concentration of the peroxide contaminant plays an important role and can change through evaporation and distillation processes. Heat, shock, and friction can create dangerous situations, which can lead to explosions. Classes, which can form peroxides, include aldehydes, ethers, most alkenes, and vinyl and vinylidene compounds. Specific chemicals include cyclohexene, cyclooctene, decalin, p-dioxane, diethyl ether, diisopropyl ether, tetrahydrofuran (THF), and tetralin. Aging of the chemical is a significant factor in the production of

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peroxides. These compounds often contain additives to prevent the formation of peroxides, however, the addition of additives does not eliminate the hazard and only delays it. The procurement, storage, handling, use, and disposal of explosive materials is referenced in LPR 1710.7, “Use and Handling of Explosives and Pyrotechnics.”

b. Safety Precautions - These substances shall be purchased in small quantities, not stockpiled. Unused peroxides shall not be returned to the container. Organic peroxide forming materials are issued by the Chemical Manager and shall be returned prior to the expiration date for testing. The sensitivity of most peroxides to shock and heat can be reduced by dilution with inert solvents, such as aliphatic hydrocarbons. Solutions of peroxides in volatile solvents shall be handled so as to prevent evaporation of the solvent as the peroxide concentration will increase. Metal spatulas shall not be used to handle peroxides because metal contamination can lead to explosive decomposition. Ignition sources shall not be permitted in the area. Friction, grinding, and other forms of impact shall be avoided. Any questions should be forwarded to the Explosives Support Engineer.

c. Accident Response - In case of a medical emergency exposure dial 911 from any Center telephone or 864-2222 from a cellular telephone. All spills shall be cleaned up immediately. Absorb liquids with vermiculite. Notify the FSH or his/her designee immediately.

d. Transfer and Transport - Small quantities of peroxides shall be handled so as to avoid ignition sources, shock and extreme temperature changes.

e. Storage - Peroxide formers shall be stored in airtight containers in a cool, dry, dark place. Glass containers that have glass stoppers shall not be used. Polyethylene shall be used, if possible. To minimize the rate of decomposition peroxides shall be stored at the lowest temperature consistent with their solubility or freezing point but not lower because they become more sensitive to shock and heat. They shall be properly labeled with the receiving date, the opening date, and the date recommended for disposal. These chemicals shall not be stored for long periods of time, but returned to the Chemical Manager after a given period if not used. Metal containers with screw lids shall be avoided. If old bottles of these materials are discovered, especially if they are in poor condition, contact the FSH, his/her designee or alternate immediately.

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3. Pyrophorics

a. General Information and Storage Requirements - These are liquids or solids which will spontaneously ignite in air at temperatures less than 130°F. This includes oily rags, dust accumulations, organics mixed with strong oxidizers, alkali metals such as sodium, potassium, lithium and phosphorus, butyl lithium and tetraethyl aluminum solutions. These substances shall be treated with the same respect accorded all chemicals. Their storage requirements, however, require noting. These substances shall be stored in inert atmospheres or under kerosene.

D. COMPRESSED GASES

Compressed gases present the potential for exposure to both chemical and mechanical hazards depending on the particular gas. Compressed gases fit into one of six classifications:

1) Flammable– < 13% of gas mixed with air will ignite
2) Asphyxiant– can displace oxygen
3) Oxidizer
4) Corrosive
5) Toxic
6) Highly Toxic

If the gas in question is flammable, flash points lower than room temperature, compounded by high rates of diffusion, present fire and explosion hazards. There are also reactivity and oxygen displacement considerations. The large amount of potential energy present in the pressure used to compress gas makes for a potential rocket or fragmentation bomb. This creates the need for special handling procedures for compressed gases, the cylinders used to contain them, and the regulators and piping used to control and direct the flow.

1. General Information - The Department of Transportation defines a compressed gas as "any material or mixture in the container with an absolute pressure greater than 276 kPa (40 lbf/in^2) at 21°C or an absolute pressure greater than 717 kPa (104 lbf/in^2) at 54°C or both, or any liquid flammable material having a Reid vapor pressure greater than 276 kPa (40 lbf/in^2) at 38°C."

2. Safety Precautions - The contents of any compressed gas shall be clearly identified on the cylinder. All gas lines shall also be clearly labeled so as to identify the gas being transported. The labels shall be color coded to distinguish hazardous gases. Signs identifying flammable compressed gases shall be clearly posted.

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Cylinders shall be firmly secured at all times using a clamp and belt or chain. Pressure release equipment for protecting devices attached to cylinders containing potentially hazardous gases shall be vented to a safe place.

Cylinders shall be placed in such a way that the cylinder valve is readily accessible at all times. The main cylinder valve shall be closed whenever the gas is not in use. This is not only necessary for safety reasons but also to prevent contamination and corrosion in empty cylinders from the diffusion of air and moisture into the cylinder.

The proper tools shall be used on cylinder hardware. Pliers shall not be used. Valves shall be opened slowly and it is never necessary to open the main valve all the way. When opening a cylinder containing toxic gas, stand upwind and to the side or use proper ventilation equipment. Be aware of the location of fellow workers in case a leak exists.

Do not use common brass pressure regulators with corrosive gases such as ammonia, boron trifluoride, chlorine, hydrogen chloride, hydrogen sulfide, and sulfur dioxide; special corrosion resistant regulators shall be used. Regulators used with carbon dioxide shall have special internal designs and special materials in order to prevent freeze-up and corrosion problems.

All pressure regulators shall be equipped with spring-loaded pressure relief valves. When used for hazardous gases of any type these valves shall be properly vented. Do not use internal bleed type regulators.

Sparks and flames shall be kept from the area of flammable gas cylinders. All piping, regulators, appliances, and hoses shall be kept tightly sealed and in good condition. Equipment used for flammables shall not be interchanged with similar equipment used for other gases.

Cylinders shall not be emptied less than 172 kPa (25 lbf/in^2) because the residuals may become contaminated if the valve is left open. Empty cylinders shall not be refilled, the regulator shall be removed and the valve cap replaced. Labels for cylinders, which designate whether they are full, in use or empty shall be used.

All pressure equipment shall be inspected periodically, more often where corrosive or hazardous gases are used.

3. Storage - Cylinders containing flammables and other hazardous gases shall be stored in a well-ventilated area. Cylinders of oxygen shall never be stored with cylinders containing flammables. Do not store empty and

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full cylinders in the same location and do not lay empty cylinders on the ground.

E. WATER REACTIVE CHEMICALS

1. General Information and Storage Requirements - Examples include aluminum and magnesium powder, and calcium and lithium hydride. These chemicals can lead to the formation of flammable toxic gases or release of an extreme amount of energy following contact with water. This property shall be considered when handling. Areas where these compounds are present shall be posted in such a way that fire-fighting personnel are aware of their presence. They shall be stored in waterproof, polyethylene bags, in tightly sealed containers.

V. PROCEDURES, ACTIVITIES OR OTHER OPERATIONS WHICH WARRANT PRIOR APPROVAL BEFORE IMPLEMENTATION

A. GENERAL

In the interest of integrating safe laboratory practices, whenever a particular procedure, operation or activity is to involve the use of carcinogens, reproductive toxins and/or substances with a high degree of acute or chronic toxicity, the FSH and the SFAB at 864-7233 shall be informed during the planning stages. It shall be the responsibility of the Project Planner to investigate the toxicity of materials of interest and to inform the FSH in writing of the plans. In accordance with OSHA 29 CFR 1910.1450 prior approval shall be given before beginning work with hazardous materials.

Examples of activities and operations requiring prior review and approval before implementation are given below:

- Use of OSHA regulated carcinogens and gases with IDLHs < 5000 ppm.
- Any new or radically modified experiment, including scale-ups where greater than 4 liters of highly toxic substances are to be used.
- Any new activity, which will involve the use of high temperature and/or pressure.
- Any activity, which will utilize a toxic substance for an extended period of time. This includes storage as well as handling times.
- Any activity utilizing a substance requiring special disposal or storage requirements for itself or its derivatives.
- Any activity involving the use or synthesis of organometallic materials.

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VI. DESIGNATED WORK AREAS

Designated work areas shall be established for work involving the use of carcinogens, reproductive toxins, and or substances with a high degree of acute toxicity. Laboratory hoods shall be identified throughout the area of such work. Signs can be obtained through the FSH or SFAB IH staff.

VII. LABORATORY HOOD PROGRAM

A. INTRODUCTION

This section establishes specifications and minimum requirements for the inspection of laboratory hoods. The section provides a quantitative procedure for testing hood performance and criteria for judging the acceptability of hoods.

The recommended practices for the safe use of laboratory hoods and basic information on hood function and performance are addressed. These practices are as important as good hood design and inspection procedures in achieving maximum protection of personnel.

B. VENTILATION SPECIFICATIONS

All new, existing or upgraded laboratory hoods intended for use with any material shall attain an average linear face velocity of 100 feet per minute (fpm), with the sash fully opened or lowered to a minimum, allowable working sash height of 12”.

If the hood face opening has to be reduced to achieve 100 fpm or a high velocity for a particular hood use, then visible markings shall clearly indicate the working sash height. (Directional arrow stickers shall be used on all hoods to designate the proper working sash height).

All hoods shall be designed and operated to maintain relatively uniform air velocity over the entire face. As a general rule, the velocity measured at any single point shall not vary more than 20 percent from the overall average.

C. LABORATORY HOOD GUIDELINES

The SFAB IH staff shall inspect existing laboratory hoods for proper use, air turbulence and adequate face velocity at least annually and after any adjustment, modification or maintenance service. New hoods shall be inspected at the time of installation and before use. Required laboratory hood inspections for both new and existing hoods are given below:

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1. Hood Baffle Adjustment

Utilize the baffle adjustment controls to attain uniform face velocity. Most hoods have at least two adjustable baffle slots at the rear to assist in achieving an even distribution of airflow over the entire hood face.

Start baffle adjustment by positioning the bottom slot fully open, the top slot one-half open and the middle slot, where provided, in a slightly open position. These slots can also be adjusted to accommodate special hood use conditions such as high heat loads and heavier-than-air vapors.

a. High Heat Loads - High heat loads are best controlled by fully opening the top slot.

b. Heavier-than-Air Vapors - Heavier-than-air vapors are best controlled by increasing the bottom slot opening and decreasing the top slot opening.

Avoid shutting off an exhaust slot completely. All parts of the hood cavity require some air circulation to control vapor release. Closing off the top slot may cause a dead space in the upper section of the hood. As a result, contaminated air from the hood may escape along the upper edge of the sash.

Do not attempt to adjust the balancing dampers in the air ducts above a hood. System balance is critical and should be left to qualified personnel.

2. General Requirements

Large bulky objects and hood clutter are detrimental to hood performance. Too much equipment and bulky objects in the hood are common causes of poor air performance, i.e., air turbulence and dead space.

Place work well inside the hood. The forward six inches of the hood are most subject to draft and turbulence. Pour, transfer and weigh materials as far back as possible. Avoid placing your head inside the hood.

Maintain the hood sash at the smallest practical open area.

Keep the hood clean. Clean-up spills immediately to avoid build-up of contaminants within the hood.

A visual indicator is a desirable feature for laboratory hoods to warn if ventilation fails or is inadvertently turned off, or falls below a predetermined unacceptable value for the work being performed.

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A hood suspected of not performing properly shall be promptly brought to the attention of the FSH, his/her designee or contact SFAB IH staff at 864-7233.

3. Evaluation of Hood Performance

Uniformity of airflow in the hood can best be determined with velometer measurements and smoke tube tests. The velometer shall be used for quantitative evaluations, whereas the smoke tubes are useful in detecting reverse flow and other undesirable flow conditions. The SFAB IH staff shall be responsible for these measurements on a periodic basis. These measurements shall be recorded on stickers and placed on the outside of the laboratory hoods.

a. Quantitative Evaluations

Make sure the hood fan is on, that all other hoods on the same system are in normal operation and that the system as a whole is balanced.

Open the sliding sashes to their maximum operating position.

Remove bulky items and obstructions that are not normally present when the hood is in use.

Determine the average linear face velocity of the hood using an instrument such as a velometer. Evaluate the uniformity of airflow at the hood face by comparison of individual velocity readings with the overall average. Non-uniformity is indicated by individual variations of greater than 20 percent relative to the average.

Velocity is defined in the laboratory hood as face velocity, which is the inward velocity of air at the open face of the hood, usually expressed in feet per minute (fpm). Face velocity is a function of total airflow rate expressed in cubic feet per minute (cfm) and open face area of the hood. The relationship between face velocity, airflow rate, and hood face area is shown by the following equation:

$$Q = AV$$

Q = air flow rate (cfm)
A = hood face area (square feet)
V = hood face velocity (fpm)

b. Qualitative Evaluation

Inspect hoods for excessive turbulence, reverse flow or dead space. This inspection shall be accomplished by use of smoke tubes. When

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using smoke tubes, make a complete traverse of the hood face and along interior walls and work surfaces parallel to the plane of the hood face at a distance of six inches inside the hood. A visual indicator is located inside each fume hood and it shall be the individual's responsibility using the hood to notify the FSH or his/her designee if the ventilation fails.

VIII. MATERIAL SAFETY DATA SHEET (MSDS) PROGRAM

A. INTRODUCTION

OSHA requires that all employers maintain a complete and accurate MSDS for each hazardous chemical that is used on site. Manufacturers/suppliers shall supply this information when a material is purchased. These MSDSs shall be updated whenever new and significant information becomes available concerning a product's hazards or ways to protect against these hazards.

B. OBJECTIVE

These MSDSs provide an excellent source of specific information on the chemicals, which employees must handle. The MSDS will inform you so that you can protect yourself and respond to emergency situations.

C. LOCATION

MSDSs shall be readily available in each facility and MSDSs can also be found on the web at the following web sites:

http://osemant1.larc.nasa.gov/cmts/
http://www.fisher1.com/
http://www.ilpi.com/msds/index.chtml

It is important that these sites be bookmarked in your computer for easy and quick access. The SFAB IH staff can assist in updating the MSDS library, maintain an up-to-date computer list of MSDSs, and producing a hard copy when requested. MSDSs for new chemicals shall be obtained from the manufacturer when the chemicals are ordered.

D. READING AN MSDS

Each MSDS shall be on a fully completed OSHA Form 174, "Material Safety Data Sheet," or its equivalent. The OSHA Form 174 shall be included with an explanation of its components to help in the interpretation of MSDSs.

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1. Section I. Chemical Identity

   The chemical name and common names/synonyms shall be provided for single component substances. The name shall be cross-referenced to the name on the product label.

2. Section II. Hazardous Ingredients

   If the product is a mixture that contains hazardous ingredients and has been tested as a whole, the chemicals and common names associated with the hazards shall be listed. If the mixture has not been tested as a whole, the chemical and common names of all ingredients determined to be health hazards and compromising 1 percent or more of the total composition shall be listed.

   The chemical and common names of all carcinogens shall be listed if they are present in the mixture at levels of 0.1 percent or more.

   All components that may present physical hazards shall be listed.

   Chemical and common names of all components which present health hazards and are present in quantities less than 1 percent or 0.1 percent for carcinogens shall also be listed if they can exceed Permissible Exposure Limits (PELs) or Threshold Limit Values (TLVs) or present a health risk to employees exposed to these concentrations.

3. Section III. Physical and Chemical Characteristics

   The boiling and freezing points, density, vapor pressure, specific gravity, solubility, volatility, and general appearance and odor of all hazardous ingredients are listed here. These characteristics help in the design of safe and healthful work practices.

4. Section IV. Fire and Explosion Hazard Data

   The compound's potential for ignition and explosion are characterized as well as the conditions under which this may occur. Fire extinguishing media and fire fighting methods are also described here.

5. Section V. Reactivity Data

   Chemical incompatibilities and any hazardous decomposition products are included here.

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6. Section VI. Health Hazards

The acute and chronic health hazards of the chemical, together with signs and symptoms of exposure, shall be listed. In addition, any medical conditions aggravated by exposure, shall be listed. Specific hazard types include carcinogens, corrosives, toxins, irritants, sensitizers, mutagens, teratogens, and effects on target organs. Carcinogens are designated by OSHA, the National Toxicology Program, or the International Agency for Research on Cancer (IARC). If the health affects of this chemical have not been completely determined, then this shall be stated in this section.

The primary means of entry into the body are given in the route of entry section. These will be inhalation, dermal, and ingestion.

OSHA Permissible Exposure Levels (PELs) and ACGIH Threshold Limit Value (TLVs) and other exposure indices are given in this section.

7. Section VII. Precautions for Safe Handling and Use

Precautions for safe handling and use include industrial hygiene practices, precautions to be taken while repairing and conducting maintenance on equipment, and procedures for cleaning up spills and leaks. Environmental Protection Agency waste disposal methods as well as state and local requirements are often given in this section.

8. Section VIII. Control Measures

This section gives engineering controls, safe handling procedures, personal protective equipment, and the use of gloves, body suits, respirators, and face shields.

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LABORATORY SPECIFIC CHP INFORMATION for **Bldg _____, Room _____**

The following required information shall be documented and maintained in each facility requiring a CHP. For additional information regarding compiling this information contact the SFAB IH staff at 864-7233.

The Laboratory Supervisor/Telephone No. is _____/_____

Emergency Information:

Emergency eyewashes/showers are located in _____

Material Safety Data Sheets (MSDS):

MSDSs are readily available in the notebook in Room _____
And MSDSs are also available online at http://osemant1.larc.nasa.gov.

Spill kits are available in _____

Waste disposal:

Chemical/biological wastes shall be properly labeled and deposited in the appropriate containers. Waste labels shall be available in _____ or from the Environmental Management Team.

Personal Protective Equipment:

Hearing protection - The following processes require hearing protection:

Process	Plugs	Muffs
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Hearing protection is available in Room _____

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Glove Protection - The following processes require protective gloves:

Process	Chem	Heat	Cryo	Kevlar
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

Gloves are available from _____

Eye/Face Protection - The following processes require eye/face protection:

Process	Safety Glasses	Chemical Goggles	Face shield
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Eye/Face protection are available from_____

Torso Protection - The following processes require torso protection:

Process	Lab Coats	Rubber Aprons	Tyvek Coveralls
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Torso protection is available from _____

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Respiratory Protection - The following processes require respiratory protection:

Process	Full Face	Half Face	Dust Mask
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Respiratory protection is available from_____

Other Protective Devices:

Laboratory hoods are located in _____

Weighted Bench-top Safety Shields are available from _____

NOTE: A facility diagram shall be included detailing the laboratory locations.

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Appendix D

OSHA REGULATED SUSPECT AND POTENTIAL CARCINOGENS

The chemical listed herein are considered to be particularly hazardous substances as defined in 29 CFR 1910.1450, and they are considered regulated chemicals for the purpose of this handbook.

10.1 CHEMICAL-SPECIFIC OSHA REGULATIONS

The following chemical-specific OSHA regulations are found in 29 CFR 1910.

OSHA Regulation	Material CAS	Number
1910.1001	Asbestos	
	Tremolite	77536-68-6
	Anthophyllite	77536-67-5
	Actinolite	77536-66-4
	Amosite	12172-73-5
	Chrysolite	12001-29-5
	Crocidolite	12001-28-4
1910.1002	Coal Tar Pitch Volatiles (except Asphalt)	65996-93-2
1910.1003	4-Nitrobiphenyl	92-93-3
1910.1004	Alpha-Naphthylamine	134-32-7
1910.1006	Methyl Chloromethyl Ether	107-30-2
1910.1007	3,3'-Dichlorobenzidine (and salts)	91-94-1
1910.1008	bis-Chloromethyl Ether	542-88-1
1910.1009	beta-Naphthylamine	91-59-8
1910.1010	Benzidine	92-87-5
1910.1011	4-Aminobiphenyl	92-67-1
1910.1012	Ethyleneimine	151-56-4
1910.1013	beta-Propiolactone	57-57-8
1910.1014	2-Acetylaminofluorene	53-96-3
1910.1015	4-Dimethylaminoazobenzene	60-11-7
1910.1016	N-Nitrosodimethylamine	62-75-9
1910.1017	Vinyl Chloride	75-01-4
1910.1018	Inorganic Arsenic	7440-38-2
1910.1025	Lead	7439-92-1
1910.1027	Cadmium (MDA)	7440-43-9
1910.1028	Benzene	71-43-2
1910.1029	Coke oven emission	None
1910.1043	Cotton dust	None
1910.1044	1,2-dibromo-3-chloropropane (DBCP)	96-12-8
1910.1045	Acrylonitrile	107-13-1
1910.1047	Ethylene Oxide	75-21-8
1910.1048	Formaldehyde	50-00-0
1910.1050	Methylenedianiline (MDA)	101-77-9
1910.1051	1.3-Butadiene	106-99-0
1910.1052	Methylene Chloride	75-09-2

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APPENDIX E

DEFINITIONS AND TERMINOLOGY

Acute Exposure	Short duration contact, typically minutes or hours.
Asphxiatory	Capable of causing injury by depriving the body of oxygen. Substances producing this effect by dilution of atmospheric oxygen are referred to as simple asphyxiants.
Autoignition Temperature	The temperature at which a material will self-ignite and sustain combustion in absence of a spark or flame.
CAM	Capital Assessment Management
Carcinogenic	Capable of causing cancer. (NOTE: MSDSs are required to list any carcinogens present.)
CHP	Chemical Hygiene Plan
Chronic Exposure	Long duration contact, typically days, months, or years.
Class I Spill	A Class I Spill is relatively small in volume and presents low hazard potential to personnel or the environment. It can be contained and cleaned up with only minor difficulty by the user/custodian. Outside support is not necessary. A Class I Spill results in: • No discharge of oil or hazardous materials to adjacent waters at LaRC and no violation of applicable water quality standards. • No sheen upon or discoloration of surface waters at LaRC. • A release of material that is *below* the Hazardous Substance Reportable Quantity.

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Class II Spill

A Class II Spill involves a large volume of material and ma present significant hazard to personnel or the environment. Any spill reportable under EPA Regulations, 40 CFR 302, 355, or 372 shall be considered a Class II Spill. A Class II Spill results in:

- Discharge of oil or hazardous materials to adjacent waters at LaRC and/or is a violation of applicable water quality standards.
- Discoloration of or sheen upon surface waters at LaRC.
- Amount of released material is above the Hazardous Substance Reportable Quantity.

Cryogenic

Maintained at extremely low temperatures.

Explosive Range

Range of concentration of a gas or vapor in air above and below which the mixture will not burn. Usually described as Lower and Upper Explosive Limits (LEL and UEL) and expressed in percentage.

Flash Point

Lowest temperature at which a liquid will give off enough flammable vapor at or near its surface so that it will ignite upon introduction at an ignition source.

IDLH

Immediately Dangerous to Life or Health Concentration. Concentration at which serious health impairments, or irreversible biological effects possibly leading to death in a period of seconds or several days later, could occur.

Narcotic

Capable of causing depression of the central nervous system; drowsiness, stupor, loss of coordination, unconsciousness.

PEL (Permissible Exposure Level)

Airborne concentration exposure standards are specified by Federal Regulation (OSHA, 29 CFR). Concentrations may be for 8-hour workdays, or shorter periods (usually 15 minutes). (See also Threshold Limit Values.)

RCRA

The Resource Conservation and Recovery Act (RCRA) of 1976 gave the U.S. Environmental Protection Agency (EPA) the authority to control hazardous waste from “cradle-to-grave.” This includes the generation, transportation, treatment, storage, and disposal of hazardous waste. RCRA also set forth a framework for the management of non-hazardous wastes.

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TLV (Threshold Limit Value)	Airborne concentration at or below which it is believed nearly all workers may be repeatedly exposed day after day with no adverse effect. Usually expressed in parts per million (ppm) for gases or vapors and milligrams per cubic meter (mg/m3) for dusts, fumes, and mists. Threshold Limit Values are specified by the American Conference of Governmental Industrial Hygienists and several have been adopted for use by OSHA.
Vapor Density	Ratio of the specific gravity of a vapor to that of air. Materials having a vapor density greater than one are heavier than air.
Vapor Pressure	The measure of tendency for a liquid to go into a gaseous state. Usually expressed in millimeters of mercury (mm Hg). More volatile materials have higher vapor pressures.

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PERSONNEL PROTECTION - CLOTHING AND EQUIPMENT

National Aeronautics and Space Administration

Responsible Office: Safety and Mission Assurance Office

PREFACE

P.1 PURPOSE

This Langley Research Center Procedural Requirements (LPR) is published to establish the standards for the management of protective clothing and equipment for civil servant and contractor employees on Langley Research Center (LaRC). The management of the protective clothing and equipment process includes the responsibilities for the acquisition, issuance, control, and maintenance of these items.

P.2 APPLICABILITY

These requirements apply to all persons performing work at Langley Research Center (LaRC), including civil servants, contractors, research associates, and others. Non-compliance with this LPR will result in appropriate disciplinary action that may include termination for a civil servant employee or exclusion from the Center for a contractor employee, research associate or others.

P.3 AUTHORITY

a. NPD 8710.2, “NASA Safety and Health Program Policy.”
b. Occupational Safety and Health Administration (OSHA), U.S. Department of Labor, Regulation 29 CFR 1910, "Standards for General Industry."
c. Occupational Safety and Health Administration (OSHA), U.S. Department of Labor, Regulation 29 CFR 1926, "Safety and Health Regulations for Construction."
d. American National Standards Institute (ANSI)
e. National Institute for Occupational Safety and Health

P.4 REFERENCES

a. NPR 8715.3, "NASA Safety Manual."
b. LAPD 1700.2, “Safety Assignments.”
c. LPR 1710.5, "Ionizing Radiation."
d. LPR 1710.8, "Nonionizing Radiation."
e. LPR 2710.1, “LaRC Noise Control and Hearing Conservation Program.”
f. LPR 1710.12, "Potentially Hazardous Materials."
g. LPR 1710.6, "Electrical Safety."
h. Langley Form 59, "Certification for Industrial Grade Safety Glasses."
i. Langley Form 73, "Self-Contained Breathing Apparatus (SCBA) Inspection & Maintenance Report (Weekly/Monthly Log on Back)."
j. Mine Safety Appliances (MSA) Bulletin No. 0105-51.

k. ANSI Z87.1-1989, "American National Standard Practice for Occupational and Educational Eye and Face Protection."
l. ANSI Z41-1991, "American Standard for Personal Protection-Protective Footwear."
m. ANSI Z89.1-1986, "American Standard for Personal Protection-Protective Headwear."
n. OSHA 29 CFR 1910.134, "Personal Protective Equipment."

P.5 CANCELLATION

LPR 1710.4 dated October 3, 2004.

Original signed by

Lesa B. Roe
Director

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Chapter 1

1. INTRODUCTION

1.1 GENERAL

Protective clothing and equipment shall be issued to civil service employees at Government expense and to contracting employees at the contracting company's expense in those situations where engineering controls, management controls, or other corrective actions have not reduced a hazard to an acceptable level or where use of engineering controls, management controls, or other techniques are not feasible.

Personal Protective Equipment (PPE) shall be provided and used or worn whenever employees encounter the following hazards in the work environment:

(a) Chemical hazards
(b) Radiological hazards,
(c) Mechanical-particulate or toxic irritants encountered in a manner capable of causing injury or impairment in the function of any part of body through absorption, inhalation or physical contact.

1.1.1 Procurement

The purchase of protective clothing and equipment for civil service employees shall require the approval of the Safety and Facility Assurance Branch (SFAB), Safety and Mission Assurance Office (SMAO), prior to purchase to ensure the proper protective clothing and equipment is obtained for the task being performed. The purchase of protective clothing and equipment for contractor employees shall require the approval of the contracting company safety representative, prior to purchase to ensure the proper protective clothing and equipment is obtained for the task being performed.

1.1.2 Issuance of Proper Clothing and Equipment

Protective clothing and equipment shall be provided, used, stored, and maintained in a serviceable condition at all times. Protective clothing and equipment turned in by an employee or that has been worn by an employee shall be cleaned and sanitized prior to being reused or reissued to another employee. Employees shall be trained in the proper use of provided protective clothing and equipment, in accordance with Federal and Agency regulations. Items, which may be purchased and issued by LaRC or a contracting company include, but are not limited to, the following:

(a) Safety goggles and safety spectacles (prescription and non-prescription).

(b) Welding helmets and shields.

(c) Safety shoes and/or boots.

(d) Aprons, suits, and gloves (e.g., fire resistant materials, leather, rubber, cotton, and synthetics).

(e) Protective headgear (e.g., hard hats and caps, liners, helmets, and hoods).

(f) Face shields.

(g) Fall protection.

(h) Health-related protective clothing and equipment, such as respirators.

(i) Hearing protection

NOTE: Requirements concerning shock and arc flash personal protective clothing and equipment are indicated in LPR 1710.6, "Electrical Safety."

1.1.3 Safety Planning for New Operations

Civil service and contractor research and engineering personnel shall coordinate in advance with Facility Coordinators (FC's), Facility Safety Heads (FSH's), and the LaRC Safety Manager or contracting company manager when planning new operations or tests. Safety planning ensures a review of the operation or test is conducted and the appropriate protective clothing and equipment is identified and its required use explained in the operation or test procedures, to ensure the safety and health of personnel.. The planning process also ensures that personnel have received training in the use, limitations, and maintenance of required safety items.

1.2 DEFINITIONS

The following definitions apply to this LPR:

- **Protective Clothing** - An article of clothing furnished to an employee at Government or contracting company expense, that when worn properly will protect part or all of the body from foreseeable risks of injury or disease in the workplace. Protective clothing shall be worn when performing work assignments in a potentially hazardous work environment or performing work under hazardous conditions. Typical items of protective clothing are protective footwear, headwear, or gloves.

- **Protective Equipment** - A device or item provided to an employee at Government or contracting company expense, that when used correctly will protect part or all of the body from foreseeable risks of injury or disease in the workplace. Protective equipment shall be utilized when entering or performing work assignments in hazardous work environments or during hazardous

conditions. Protective equipment includes hearing protection, eye protection respirators, barricades, warning cones, lights, alarms, full body harnesses and lanyards.

- **Normal Clothing** - An item of clothing furnished by employees at their own expense as a condition of employment. Typical items of normal clothing are: dress or street shoes, boots, raincoats, standard work gloves, winter clothing for outdoor jobs, and wide brim hats or tinted sunglasses for sun protection. Certain items of normal clothing may be unacceptable in industrial work places and thus restricted from use. These items include sandals, tennis shoes, shorts, and extremely loose clothing.

- **Appropriate Hair Length** - Exposed hair in excess of 2 inches may constitute a hazard in LaRC industrial work places.

1.3 RESPONSIBILITIES

The following paragraphs summarize responsibilities assigned to specific individuals on LaRC, ensuring the proper management and administration of personnel protection clothing and equipment.

1.3.1 LaRC Safety Manager

The LaRC Safety Manager is responsible of the issuance of protective clothing and equipment in accordance with LAPD 1700.2, "Safety Assignments," and LaRC procurement procedures. In addition, the LaRC Safety Manager shall be responsible for the following activities:

- Providing advice to Research Project Engineers, FSHs, FCs or supervisors concerning the determination and designation of hazardous areas and/or occupations where protective clothing and equipment are required,
- Determining the appropriate protective clothing and equipment authorized for use by civil service employees while working around hazards,
- Providing advice concerning the selection of protective clothing and equipment for civil service employees,
- Approving purchase requests for NASA LaRC-furnished protective clothing and equipment,
- Consulting with the proper medical authority, when professional medical advice is necessary, to determine specific requirements of protective clothing and equipment,
- Coordinating with radiation safety personnel to determine protective clothing and equipment requirements for items worn around ionizing and nonionizing radiation (see LPR 1710.5, "Ionizing Radiation," and LPR 1710.8, "Nonionizing Radiation"),
- Ensuring all applications for respiratory protective devices are specified,
- Ensuring civil service employees issued respiratory protection equipment are fitted for use,

- Ensuring civil service employees requiring respiratory protection equipment receive instruction from the SFAB Industrial Hygienist concerning the use of and limitations of respiratory protection, and
- Ensuring that other required protective devices, such as gloves, hearing protection, and eye protection are issued to civil service employees and instruction provided concerning fitting and maintenance requirements.

1.3.2 Contract Manager

The Contract Manager or his/her designee shall be responsible for the issuance of protection clothing and equipment in accordance with the terms and conditions of their contract or agreement. In addition, the Contract Manager or his/her designee shall be responsible for the following activities:

- Providing advice to contractor Research Project Engineers, FSHs, FCs or supervisors concerning the determination and designation of hazardous areas and/or occupations where protective clothing and equipment are required,
- Determining the appropriate protective clothing and equipment authorized for use by contractor employees while working around hazards,
- Providing advice concerning the selection of protective clothing and equipment for contractor employees,
- Approving the purchase of contractor provided protective clothing and equipment,
- Consulting with the proper medical authority, when professional medical advice is necessary, to determine specific requirements of protective clothing and equipment,
- Coordinating with radiation safety personnel to determine protective clothing and equipment requirements for items worn around ionizing and nonionizing radiation (see LPR 1710.5, "Ionizing Radiation," and LPR 1710.8, "Nonionizing Radiation"),
- Ensuring all applications for respiratory protective devices are specified,
- Ensuring contractor employees issued respiratory protection equipment are fitted for use,
- Ensuring contractor employees requiring respiratory protection equipment receive instruction from the contracting company's qualified individual concerning the use of and limitations of respiratory protection,
- Ensuring that other required protective devices, such as gloves, hearing protection, and eye protection are issued and instruction provided concerning fitting and maintenance requirements.

1.3.3 Cognizant Line Supervisor (Civil Service and Contractor)

Line supervisors shall have the following responsibilities concerning the issuance of protective clothing and equipment:

- Surveying and identifying, for review by the LaRC Safety Manager/Contract Manager, all actual and potentially hazardous work areas, job operations and

working conditions where protective clothing or equipment may be essential for the safety and personal protection of employees,

- Initiating and approving stores stock requisitions for required protective clothing and equipment available in the Center's/contracting company's stores stock inventory. The approval of the requisition is subject to the verification of the need for and appropriateness of the items requisitioned, and
- Ensuring that each employee under their jurisdiction is aware of the specific protective clothing and equipment requirements for work assignments and is trained in the use and safety limitations of those items.

1.3.4 Office of Human Capital Management (OHCM)

The LaRC Office of Human Capital Management and the contracting company's equivalent office shall provide new employees with information concerning job specific requirements for apparel or clothing. Specifically, new employees shall be informed when items must be furnished at the employee's expense. These items shall be required for employees to perform their assigned job functions and are a condition of employment.

1.4 ACCOUNTABILITY AND CONTROL

Protective clothing and equipment issued by LaRC or the contracting company shall be accounted for and controlled by applicable Agency, Center, or contracting company property control procedures.

1.5 FAIR WEAR AND TEAR, LOST, DAMAGED, OR DESTROYED ITEMS

Items, which have served their purpose through normal wear and tear, shall be turned in by the user to the cognizant supervisor for disposal. Items, which become lost, misplaced, damaged, or destroyed, shall be reported to the cognizant supervisor prior to issuance of replacement. The supervisor shall account for such items in accordance with applicable Agency, Center, or contracting company property control procedures.

1.6 CLEANING OF PROTECTIVE CLOTHING

Protective clothing, as defined in this LPR, shall be laundered, cleaned, and decontaminated at Government or contracting company expense. An annual purchase requisition is submitted through the Logistics Management Team, Center Operations Directorate, to cover laundry and/or dry cleaning services for civil service organizations. Laundry and/or dry cleaning services are available for coveralls, towels, lab coats, pants, shirts, night suits, and jackets to all civil service employees. The initiator, or designee of the purchase request for laundry or dry cleaning service shall ensure accountability of items cleaned and sign appropriate delivery tickets certifying quantities received. Contracting companies shall have an equivalent process to provide for the laundry and/or dry cleaning services of protective clothing for contractor employees.

1.7 LOAN OF PROTECTIVE CLOTHING AND EQUIPMENT

Protective clothing and equipment is not normally issued to contractor personnel by the Government, however, the contract technical monitor or on-site supervisor shall contact the LaRC Safety Manager to obtain authorization for the issuance or loan of appropriate protective devices in an emergency or when such issuance is beneficial to the Government.

Chapter 2

2. RESPIRATORY PROTECTION DEVICES

2.1 PURPOSE

This chapter provides instruction governing the issuance, maintenance and use of respiratory protection devices on LaRC for civil service and contractor employees.

2.2 OSHA REQUIREMENTS

Under OSHA regulation 29 CFR 1910.134, LaRC/contracting company shall be responsible for:

- Providing respirators when such equipment is necessary to protect an employee's health,
- Providing respirators that are applicable and suitable for the purpose intended, and
- Establishing and maintaining a respirator protection program.

2.3 LaRC RESPIRATORY PROTECTION PLAN

The LaRC Respiratory Protection Plan identifies the situations where it is not possible, through the use of engineering techniques, to control human exposure to toxic chemical agents in the workplace or during emergency situations. The plan:

- Provides specific operating procedures, which govern the selection and use of respirators, ensuring that all respirators are approved and certified,
- Establishes respirator selection criteria based on the hazards to which workers are exposed,
- Documents employee instruction and training in the proper use and limitations of respirators,
- Specifies the method that respirators are individually assigned to workers for their exclusive use,
- Specifies the methods used to clean and disinfect the equipment,
- Outlines the required inspection and maintenance process, and establishes a timetable for these required events,
- Provides industrial hygiene surveillance of work area conditions where respirators are subject to be used, and
- Establishes the required medical surveillance and physical ability of individuals to wear the provided respiratory equipment.

Contracting companies shall have a respiratory protection plan equivalent to LaRC's.

2.4 GENERAL REQUIREMENTS FOR RESPIRATORS

Use of respiratory protection devices shall be required whenever engineering controls are insufficient to assure personnel will not become exposed to hazardous levels of air contaminants or an oxygen deficient atmosphere.

Only respirators certified by the National Institute for Occupational Safety and Health shall be used on LaRC. The selection of respirators for use on the Center shall be based upon the requirements of each specific facility. Specifically, the concentration of materials and airborne contaminants, which could be encountered, shall be the primary consideration when making respirator selection. Air-purifying respirators shall never be used in atmospheres immediately dangerous to life and health or when the contaminant has poor warning properties.

Respirator users shall be instructed in the limitations of the respirator and the proper procedures for their use, maintenance and storage.

Where practical, respirators shall be issued to individual users for their exclusive use, and a record of respirator users shall be maintained. A suitable entry shall be made in the medical records of each user, and the user's medical status with regard to use of the respirator shall be reviewed by the appropriate medical personnel.

Line supervision shall have the day-to-day responsibility of insuring respiratory protection devices are replaced when necessary.

2.4.1 Specific Procedures For Air-Purifying Respirators

Air-purifying respirators shall be issued through the SFAB or contracting company Industrial Hygienist. LaRC/contracting company shall provide such respiratory protection in the interests of employee safety, morale and concern. Consequently, respirators shall be issued to employees even though the concentrations of airborne contaminants would not be great enough to otherwise warrant such action.

2.4.2 Specific Procedures For Atmospheric-Supplying Respirators

All atmospheric-supplying respirators shall be of the pressure-demand, open circuit type. This ensures positive pressure relative to ambient so that any leakage is outward rather than into the face piece.

Atmospheric-supplying respirators shall be selected by the LaRC/ contracting company to assure compatibility with LaRC/contracting company repair and maintenance capabilities.

2.5 MEDICAL AND TRAINING REQUIREMENTS

Civil service employees who are authorized to use respirators on LaRC shall be listed on an authorization list. Contractor employees who are authorized to use respirators

shall be listed on a contractor company authorization list. The following paragraphs contain requirements for individuals to be on the authorization list.

2.5.1 Medical Surveillance

Respirator users shall be required to undergo an annual physical examination. The Workforce Planning, Management, and Analysis Branch (WFMAB), OHCM, shall conduct a medical review of each proposed civil service respirator user and the results of the medical reviews shall be reported to the LaRC Safety Manager. Additionally, the WFMAB shall maintain all documentation concerning the examination process. Contractor companies shall conduct a medical review of each proposed contractor respirator user and the results of the medical reviews shall be reported to the Contract Manager or his/her designee. Additionally, the contractor company shall maintain all documentation concerning the examination process.
Each employee who is issued a respirator for use in the workplace shall be required to obtain an annual medical examination in compliance with LaRC Occupational Medical Examination Protocol (OMEP). The physician conducting the examination shall:

- Complete a medical history and physical examination,
- Complete the medical qualification examination respirator form,
- Direct the patient to the SFAB or contractor company Industrial Hygienist for respirator training, and
- Notify the SFAB or contracting company Industrial Hygienist if the patient is disapproved for respirator use.

2.5.2 Changes in Medical Status

If the employee's medical status changes or if the employee fails to report for the examination:

- The WFMAB or contractor company shall notify the SFAB or contracting company Industrial Hygienist, in writing.
- If an individual is no longer authorized to use a respirator, the SFAB or contracting company Industrial Hygienist shall immediately notify the FSH.
- The FSH shall provide the SFAB or contracting company Industrial Hygienist with written notification of the individual's change in duty status.
- The SFAB or contracting company Industrial Hygienist shall provide the WFMAB or equivalent contractor company organization a copy of the individual's change in duty status and the individual shall be removed from medical surveillance.

2.5.3 Management of Authorized Respirator Users List

The SFAB or contracting company Industrial Hygienist shall provide the list of personnel who have fulfilled the training and medical review requirements to the appropriate line supervisor and to the WFMAB or equivalent contractor company organization. This list shall be the official list of authorized respirator users. Supervisors shall ensure that the respirator users, while using their respirators, only perform tasks for which they are trained. The FSH shall immediately provide written notification to the SFAB or contracting company Industrial Hygienist of any proposed additions to or deletions from

the official list of authorized respirator users. The SFAB or contracting company Industrial Hygienist shall provide WFMAB or equivalent contractor company organization any change to the respirator user list.

2.5.4 Authorization for Use

The FSH of each facility or research apparatus shall develop and maintain a list of personnel (civil service and contractor) who have been trained and certified as respirator users in accordance with LPR 1740.6, "Personnel Certifications."

The SFAB or contracting company Industrial Hygienist shall ensure that basic respirator training is provided to users and forward to the WFMAB or equivalent contractor company organization a copy of the list of individuals who receive this training.

The FSH shall be responsible to ensure that personnel (civil service and contractor) are trained to perform the specific tasks for which-the respirator is required. Written documentation of this training shall be provided to the SFAB or contracting company Industrial Hygienist once it is completed.

2.6 TYPES OF RESPIRATORS

The following paragraphs describe the types of respirators permitted for use on LaRC, as well as the repair, maintenance and inspection requirements for this equipment.

2.6.1 Air-Purify ing Respirators

Air-purifying respirators (APR) function by passing ambient air, which is moved by the user's breathing action or by a blower, through an air-purifying element that removes the contaminates. The element uses filters to remove solid or liquid aerosols for the air the user breathes. Air-purifying respirators may be divided into two subclasses:

- Particulate-removing purifiers that intercept particles before they enter the face piece, and
- Vapor and gas-removing purifiers that entrap gas or vapor molecules.

Powered Air-Purifying Respirators (PAPR's) are another class. They use a blower to force ambient air through air-purifying elements. Similar to non-powered air-purifying devices, PAPR's may be used with a variety of filter types, depending on the type of air contaminants present.

The PAPR is significantly heavier than the APR, and is more costly. However, it offers a higher level of protection against airborne contaminants and is generally more efficient in situations involving a high work rate.

2.6.2 Supplied-Air Respirators

Supplied Air Respirators, also known as Atmosphere Supplying Respirator and Airline Respirators, are referred to by various authorities by these different names. Regardless of their names, the function of these respirators is the same, i.e., to carry respirable air

to the user through an airline from a remote source. The air supply provided by an airline respirator may be either:

- Continuous-Flow - providing a continuous rate of air, regardless of the users breathing pattern, or
- Pressure-Demand Device **-** introduces more air into the face piece as a result of a pressure drop when the wearer takes a breath.

The American National Standards Institute (ANSI) has divided atmospheric supplying respirators into two subclasses:

- Self-Contained Breathing Apparatus (SCBA), and
- Airline Respirators, which use a stationary source of compressed air delivered to the respirator user through a high-pressure hose.

2.6.2.1 Advantages of Supplied Air Respirators

A supplied-air respirator can be used for a longer duration than a SCBA. It also provides significantly greater protection than an APR and the user need not overcome the breathing resistance encountered when using a non-powered APR. Airline respirators can be used in atmospheres where other respiratory protective devices cannot be operated, including oxygen-deficient environments. These respirators can also be used in an environment that is immediately dangerous to life and health, provided it has an auxiliary, self-contained air supply.

2.6.2.2 Disadvantages of Supplied Air Respirators

Supplied-air respirators have disadvantages that should be considered before they are authorized for use in a facility. They restrict the movement of the user to the length of the airline hose, and a hazard exists because the trailing airline hose has the potential to come into contact with machinery or vehicles that could sever the line or restrict the flow of air.

2.6.3 SCBA MAINTENANCE, REPAIR AND INSPECTION

SCBA respirators shall be inspected weekly and sanitized monthly or after each use as required by the manufacturer's recommendation and ANSI Z88.2 and Z88.5. The inspections shall be performed by the respirator users in order to assure continuing familiarity with the respirator. Check-sheets documenting the inspections shall be maintained at the facility using Langley Form 73, " Self-Contained Breathing Apparatus (SCBA) Inspection & Maintenance Report (Weekly/Monthly Log on Back)."

2.6.3.1 SCBA Inspections

SCBA's shall be inspected weekly, monthly and after every use. Additionally, the air cylinder shall be hydrostatically tested every 5 years. The procedures for these inspections are found in MSA Bulletin No. 0105-51. A copy of this Bulletin shall be issued to every air pack operator.

2.6.3.2 Recharging Cylinders

The LaRC Safety Manager/Contract Manager shall have responsibility to ensure that compressed air cylinders of SCBA respirators are recharged upon request. A permanent record of the cylinder recharging shall be maintained. Air, which is supplied to compressed air cylinders, shall meet the requirements of the specification for Grade D breathing air as described in ANSI Z86.1

2.6.3.3 Repair to SCBA Respirators

Also, the LaRC Safety Manager/Contract Manager shall ensure that a repair capability to the extent recommended by respirator manufacturers, is available for these systems. All repairs shall be authorized and shall be performed by personnel trained by the manufacturer of the equipment. A detailed record of all repairs conducted on these systems shall be maintained.

2.6.3.4 Maintenance

When a Government-issued respirator has less than a full air cylinder, the unit shall be returned to the LaRC Fire Station, Facility 1248, to be recharged. The tank shall be charged until the gauge on the bottle reads - FULL.

If defects are found during an inspection, they shall be brought to the attention of the unit supervisor and the FSH. The defective SCBA shall be marked **"Danger - Defective Air Pack - Do Not Use"** and returned to the LaRC Fire Station for immediate repair.

Adjustments to SCBA equipment shall only be performed by certified personnel.

Contractor companies shall have an equivalent maintenance process in place.

NOTE: Grade D breathing air supplied for SCBA equipment, as well as to facilities requiring breathing grade air is done so through the Facility 1247E Compressor Station. This breathing air shall be tested quarterly to meet the requirements of the specification for Grade D breathing air as described in ANSI Z86.1. The quarterly testing shall be performed by the SFAB Industrial Hygienist.

2.6.3.5 Program Audit

Elements of the atmospheric-supplying respiratory program shall be audited at the discretion of the LaRC Safety Manager/Contract Manager. At a minimum there shall be a complete audit of the program on an annual basis.

Chapter 3

3. EYE AND FACE PROTECTION

3.1 PURPOSE

This chapter contains specific instructions for the authorization, issuance, and use of eye and face protective devices, including goggles, spectacles, face shields, and welding helmets.

3.2 PROTECTIVE EYEGLASSES (SAFETY GLASSES)

Non-prescription and prescription safety glasses (lens and frames) shall be manufactured to meet the requirements of ANSI Z87.1-1989, "American National Standard Practice for Occupational and Educational Eye and Face Protection." For safety purposes, there shall be no deviation from prescribed manufacturing standards when providing eye protection.

Photo chromic lenses (lens that darken when exposed to sunlight, and which fade when removed from sunlight) are unacceptable in LaRC hazardous work environments. Wearers of contact lenses shall be required to wear the appropriate eye protection in LaRC hazardous work environments.

3.2.1 Non-prescription Safety Glasses

Non-prescription protective eyeglasses (safety glasses) shall be provided to civil service employees by the Government and to contractor employees by their contracting company, when they are engaged in work operations or in work environments, when there is inherent danger to workers' eyes or the probability of incurring an eye injury is high. When the danger is high, protective eyeglasses shall be provided to workers in the following manner:

Employees engaged in operations where they are exposed to hazards from flying particles, molten metal, liquid chemicals, acids or caustic liquids, chemical gases or vapors, or potentially injurious light radiation such as cutting, grinding, machining, soldering, filing, fabricating and major maintenance work, and employees performing frequent survey, audit, inspection, or overview functions in eye hazardous areas, or employees performing in other work environments deemed by the LaRC Safety Manager/Contract Manager to present eye hazard elements, shall be furnished protective eyeglasses at no cost to the employee. This requirement also includes employees who are required to wear prescription eyeglasses in the normal course of these duties. However, the cost of the eye examination to obtain the prescription for the glasses will be borne by the employee.

3.2.1 Prescription Safety Glasses

Civil service employees who are eligible for prescription safety glasses shall obtain them by requesting authorization from the SFAB. This will require the employee to submit a

current prescription when initiating their request (prescriptions shall not be accepted if they are more than 2 years old). Upon SFAB verification of eligibility and need, the SFAB shall issue NASA Langley Form 59, "Certification for Industrial Grade Safety Glasses," authorizing the employee to obtain prescription safety glasses through the WFMAB contracted optical services company. Upon receipt of the authorization from the SFAB and prescription from the employee, the WFMAB contracted optical services company shall arrange for the prescription safety glasses.

The repair or replacement of civil service supplied prescription safety glasses will be borne by the Government, provided such repair or replacement is a result of normal wear and usage, or accidental damage while performing work functions. Civil service employees desiring a second pair of safety glasses may elect to procure them through the WFMAB contracted optical services company. However, the cost of the second pair of safety glasses shall be borne by the employee.

Contractor employees shall be provided prescription safety glasses through an equivalent process by their contracted company.

3.3 PROTECTIVE EQUIPMENT

The Selection Chart (Figure 3.1) illustrates and identifies the protective equipment, which is available for use on LaRC. The chart also contains recommended applications of the equipment to optimize eye and face protection while performing hazardous work. This protective equipment shall be required in work operations and work environments having the capacity to produce an injury to an employee’s eyes or face. It also serves as a guide to employees and supervisors in selecting eye and face protectors consistent with prevalent working conditions.

3.3.1 Requisitioning Protective Equipment

Face and eye protective equipment and devices required by civil service employees for normal operations shall be obtained through the employee's supervisor/organization with approval by SFAB. When work efforts require special devices, such as, laser goggles, foundry devices, or newly developed devices, the required equipment shall be requisitioned through a Government Purchase Request, processed through the LaRC Safety Manager for approval.

Contractor companies shall have an equivalent process to provide the required equipment for contractor employees.

3.3.2 Maintaining an Adequate Supply of Protective Equipment

Supervisors and/or FSH’s shall ensure that their respective facilities maintain an adequate supply of protective equipment and devices, including appropriate protective devices for personnel who visit their facilities. They shall also ensure that employees and visiting personnel wear required protective equipment and devices while working in or visiting hazardous areas.

3.3.3 Identifying Hazardous Areas

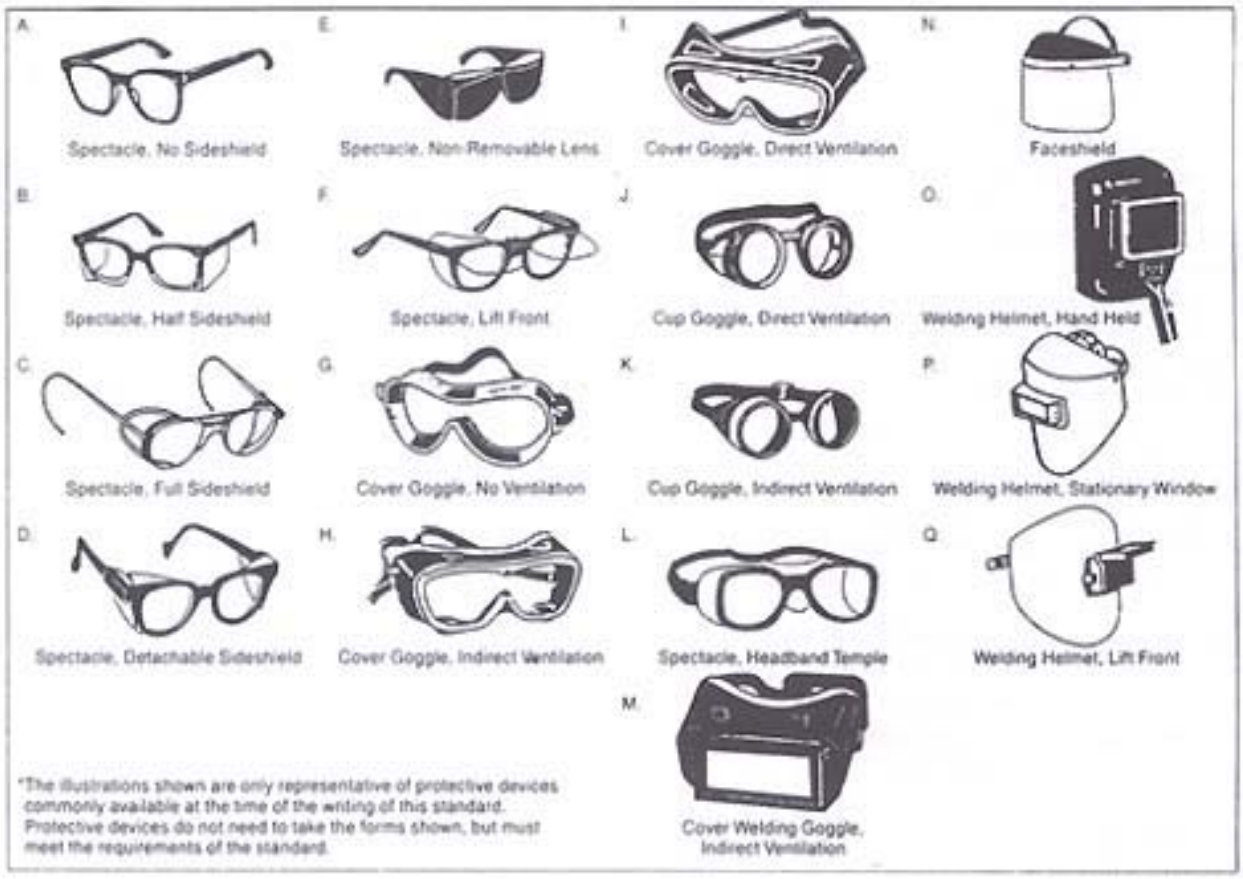
Hazardous areas shall be designated and shall be prominently identified by special signs and designators. Where necessary, the SFAB/contractor company shall inspect and verify the locations of areas that present hazards to employees' eyes and faces. This inspection shall ensure that hazardous areas are properly designated and that protective devices and equipment are being used while performing work functions. Additionally, the SFAB/contract company shall make recommendations concerning the type of devices including goggles, spectacles, and face shields that are most suitable to the working conditions in that work area.

AMERICAN NATIONAL STANDARD Z87.1-1989		SELECTION CHART				PROTECTORS
		ASSESSMENT SEE NOTE (1)	PROTECTOR TYPE	PROTECTORS	LIMITATIONS	NOT RECOMMENDED
IMPACT	Chipping, grinding machining, masonry work, riveting and sanding	Flying fragments, objects, large chips, particles, sand, dirt etc.	B,C,D, E,F,G, H,I,J, K,L,N	Spectacles, goggles. face shields SEE NOTES (1) (3) (5) (6) (10) For severe exposure add N	Protective devices do not provide unlimited protection. SEE NOTE (7)	Protectors that do not provide protection from side exposure. SEE NOTE (10) Filter or tinted lenses that restrict light transmittance, unless it Is determined that a glare hazard exists. Refer to OPTICAL RADIATION.
HEAT	Furnace operations, pouring, casting, hot dipping, gas cutting, and welding.	Hot sparks	B,C,D, E,F,G, H,I,J, K,L,N	Face shields, goggles spectacles *For severe exposure add N SEE NOTES (2) (3)	Spectacles, cup and cover type goggles do not provide unlimited facial protection. SEE NOTE (2)	Protectors that do not provide protection from side exposure.
		Splash from molten metals	N	*Face shields worn over goggles H, K		
		High temperature exposure	N	SEE NOTES (2) (3) Screen face shields, Reflective face shields SEE NOTES (2) (3)	SEE NOTE (3)	
CHEMICAL	Acid and chemicals handling, degreasing plating	Splash	G,H,K N	Goggles, eyecup and cover types *For severe exposure, add N	Ventilation should be adequate but well protected from splash entry	Spectacles, welding helmets, hand shields
		Irritating mists	G	Special purpose goggles	SEE NOTE (3)	
DUST	Woodworking, buffing, general dusty conditions	Nuisance dust	G,H,K	Goggles, eyecup and cover types	Atmospheric conditions and the restricted ven-tilation of the protector can cause lenses to fog. Frequent cleaning may be required.	
OPTICAL RADIATION	WELDING: Electric Arc		O,P,Q	TYPICAL FILTER LENS SHADE / PRO TECTORS SEE NOTE (9) 10-14 Welding Helmets or Welding Shields	Protection from optical radiation Is directly related to filter lens density. SEE NOTE (4). Select the darkest shade that allows adequate task performance.	Protectors that do not provide protection from optical radiation. SEE NOTE (4)
	WELDING: Gas CUTTING		J,K,L, M,N,O, P,Q	SEE NOTE (9) 4-6 Welding Goggles or Welding Faceshield 3-6		
	TORCH BRAZING			3-4	SEE NOTE (3)	
	TORCH SOLDERING		B,C,D, E,F,N	1.5-3 Spectacles or Welding Faceshield		
	GLARE		A,B	Spectacle SEE NOTES (9) (10)	Shaded or Special Purpose lenses, as suitable. SEE NOTE (8)	

Selection Chart

Figure 3.1, American National Standard Z87.1-1989, Selection Chart

ANSI (Z87.1 – 1989) Recommended Eye and Face Protectors for Use in Industry, Schools and Colleges



NOTES:

(1) Care shall be taken to recognize the possibility of multiple and simultaneous exposure to a variety of hazards. Adequate protection against the highest level of each of the hazards must be provided.
(2) Operations involving heat may also involve optical radiation. Protection from both hazards shall be provided.
(3) Face shields shall only be worn over primary eye protection.
(4) Filter lenses shall meet the requirements for shade designates in Table 1 of ANSI Standard Z87.1.
(5) Persons whose vision requires the use of prescription lenses shall wear either protective devices fitted with prescription lenses or protective devices designed to be worn over regular prescription eyewear.
(6) Wearers of contact lenses shall also be required to wear appropriate covering eye and face protection devices in a hazardous environment. It should be recognized that dusty and/or chemical environments may represent an additional hazard to contact lens wearers.
(7) Caution should be exercised in the use of metal frame protective devices in electrical hazard areas.
(8) Refer to Section 6.5, Special Purpose Lens, of ANSI Standard Z87.1.
(9) Welding helmets or hand shields shall be used only over primary eye protection.
(10) Non-side shield spectacles are available for frontal protection only.

Figure 3.2, American National Standard Z87.1 - 1989, Protective Devices

Chapter 4

4. PROTECTIVE FOOTWEAR

4.1 POLICY

Protective footwear shall be provided to employees engaged in work operations where there is a danger of foot injuries due to falling or rolling objects, or objects piercing the sole, and where such employee's feet are exposed to electrical hazards. Civil service employees engaged in continuous work situations where foot hazards are present shall be furnished appropriate protective footwear at no cost to the employee by the Government and to contractor employees by the contractor company. The cost to repair/replace required protective footwear for civil service employees shall be borne by the Government and for contractor employees by the contractor company.

All protective footwear shall meet the requirements of ANSI Standard Z41-1991, "American Standard for Personal Protection-Protective Footwear."

4.2 RESPONSIBILITIES

Responsibilities concerning the use of protective footwear are discussed in the following paragraphs.

4.2.1 Safety and Facility Assurance Branch

The Safety and Facility Assurance Branch shall be responsible for:

- Implementing and maintaining a protective footwear program, including authorizing the procurement of and issuance of protective footwear to designated civil service employees, and
- Determining the areas of operation and work environments where the use of protective footwear is required.

4.2.2 Contractor Company

Contractor companies shall be responsible for:

- Implementing and maintaining a protective footwear program, including authorizing the procurement of and issuance of protective footwear to designated contractor employees, and
- Determining the areas of operation and work environments where the use of protective footwear is required.

4.2.3 Line Supervisors

Civil servant line supervisors shall be responsible for:

- Initiating requests to purchase protective footwear for civil service employees, through their organization.

- Obtaining approval for the purchase of protective footwear from the SFAB for civil service employees.
- Assuring that the furnished protective footwear is worn by employees in designated foot hazard areas.

Contractor companies shall have an equivalent process to provide the required equipment for contractor employees.

4.2.4 Employ ees

Employees shall be responsible for the normal care and appropriate use of protective footwear. They shall return used footwear for replacement, or repair when required. Employees shall be restricted from wearing defective or worn-out protective footwear, which could contribute to a foot injury.

Chapter 5

5. HEARING PROTECTION DEVICES

5.1 PURPOSE

This chapter provides instructions for the issuance and use of hearing protection devices on LaRC. Issues concerning the LaRC Noise Control and Hearing Conservation Program are referred to in LPR 2710.1, "LaRC Noise Control and Hearing Conservation Program."

Uncontrolled, noise can cause numerous hazards in the work place. Employees shall protect themselves from excessive noise levels in order to prevent:

- Being annoyed by noise in the workplace,
- Having their concentration disrupted when working on assigned tasks,
- Suffering from ear pain,
- Suffering from nausea,
- Incurring a permanent noise-induced hearing loss, and
- In extreme cases, incurring other health complications.

5.2 GENERAL REQUIREMENTS

Generally, whenever noise levels exceed an eight-hour time-weighted average (TWA) of 90 decibels, OSHA requires that administrative and engineering controls be utilized to limit employees' exposure to noise. When administrative and engineering controls cannot reduce the noise to an acceptable level, personal protective equipment (PPE) shall be required.

The use of hearing protection devices is required on LaRC whenever personnel are exposed to sound pressure levels in excess of:

- 85 dBA for steady sound pressure and/or intermittent noise, or
- 140 dB peak sound pressure or greater for impact/impulse noise.

5.3 PROTECTION AGAINST NOISE HAZARDS

Hearing protection devices such as earplugs and/or earmuffs are the primary methods used to protect the hearing of employees who work in noise hazardous areas. These protective devices are designed to reduce hazardous noise while allowing passage of sounds, which fall in the speech frequency range. This allows workers to safely communicate with each other while working.

Earplugs and/or earmuffs allow employees to work in a high noise area without developing a hearing loss. In most situations, one or the other device will provide adequate protection, however, there are some noise conditions requiring both earplugs and muffs to be worn at the same time.

5.4 TYPES OF PERSONAL PROTECTIVE EQUIPMENT (PPE)

Hearing protection devices provided to workers on LaRC shall be either earplugs or earmuffs. Earplugs shall be individually available at hazardous noise areas while earmuffs shall be issued on an individual basis through the SFAB Industrial Hygienist for civil service employees and through the contractor company Industrial Hygienist for contractor employees.

Hearing protection devices shall possess a Noise Reduction Rating of at least 20 dB as defined by the Environmental Protection Agency. Communications headsets may be worn in noise hazardous areas as a hearing protection device if they provide the required amount of hearing protection.

Both earplugs and earmuffs shall be worn when personnel are exposed to steady and/or intermittent sound pressure levels of 110 dBA or above.

5.4.1 Disposable Earplugs

Disposable earplugs shall be provided to employees to be used one time and then thrown away. They are made of an expandable foam material designed to be inserted into the ear canal to block out noise hazards. Personnel shall wash their hands before using these earplugs and should keep them free from grease and dirt.

5.4.2 Earmuffs

Earmuffs cover the external ear to provide a barrier against hazardous noise. They shall be equipped with soft plastic cushions, which are filled with either foam or liquid. They must form a perfect seal around the ear to be effective. Glasses, long sideburns, long hair, and facial movements, such as chewing, can reduce their protective qualities.

Earmuffs shall be kept clean by regularly wiping them with a damp cloth, and the cushions shall be replaced when they become worn, stiff or torn.

5.5 EXAMPLES OF NOISE LEVELS:

The basic unit of level in acoustics is the "Decibel" (dB). In acoustics, the term "level" is used to designate that the quantity is referred to some reference value, which is either stated or implied. The letter following dB, i.e. A, B, or C represents frequency characteristics of the average human ear for various sound intensities, these are called "weighting networks." The "A" weighted network is the relative frequency response of the average ear when sound pressure levels of about 20 to 30 dB are heard. Examples of approximate decibel levels for selected situations are as follows:

SITUATION	DECIBEL LEVEL
Soft whisper -	30 decibels
Conversational Speech-	60 decibels
Printing press plant -	90 decibels
Pneumatic drill -	100 decibels
Jackhammer -	125 decibels
Jet plane -	140 decibels

Rocket launching pad - 180 decibels

5.5.1 RESPONSIBILITIES

Line supervisors shall have day-to-day responsibility for ensuring hearing protection devices are worn in noise hazardous areas. Users shall be instructed in the limitations of hearing devices and in proper procedures for their use, maintenance and storage.

A record of employees who use hearing protection devices shall be maintained, and an entry shall be made in the medical records of each user. Additionally, the medical status of employees who work in noise hazard shall be reviewed by the medical staff, in regard to the use of the hearing protection device.

A supply of hearing protection devices, including disposable earplugs, shall be maintained at noise hazardous areas for visitors, transients and personnel who do not have individually issued earmuffs in their possession.

5.6 LaRC NOISE CONTROL AND HEARING CONSERVATION PROGRAM

Government employees, who are exposed to noise levels above the NASA Action level, shall be placed in the LaRC Noise and Control Hearing Conservation Program (NCHCP). The LaRC NCHCP is used to measure any change in employee's hearing from year to year while working in a high noise area. Employees placed in this program shall undergo medical surveillance and receive annual training. Contractor companies shall have an equivalent Noise and Control Hearing Conservation Program.

5.6.1 Medical Surveillance

Individuals in the LaRC NCHCP are required to undergo a pre-certification, annual and termination physical examinations in compliance with LaRC OMEP's. Contractor companies shall provide individuals with an equivalent pre-certification, annual and termination physical examination in compliance with LaRC OMEP's.

5.6.2 Training Requirements.

There shall be an annual training program for employees who are in the LaRC NCHCP. This annual training is the responsibility of the WFMAB for civil service employees and the contracting company for contractor employees.

Chapter 6

6. PROTECTIVE HEADWEAR

6.1 POLICY

Protective headwear shall be provided to employees engaged in work operations where there is a potential for injury to the head from falling objects and when near exposed electrical conductors which could contact the head. Civil service employees engaged in continuous work situations where hazards to the head are present shall be furnished appropriate protective headwear at no cost to the employee by the Government and to contractor employees by the contractor company. The cost to repair/replace required protective headwear for civil service employees shall be borne by the Government and for contractor employees by the contractor company.

6.2 GENERAL REQUIREMENTS

All protective headwear shall meet the requirements of ANSI Standard Z89.1-1986, "American Standard for Personal Protection-Protective Headwear."

Protective helmets are classified according to the specific impact and electrical performance requirements they are designed to meet. All protective helmets in accordance with ANSI Standard Z89.1-1986, shall meet either Type I or Type II impact requirements. In addition, all helmets are further classified as meeting Class G, E, or C electrical requirements (i.e., Type I, Class G or Type II, Class E).

6.2.1 Impact Types

Type 1 - Helmets intended to reduce the force of impact resulting from a blow only to the top of the head.

Type 2 - Helmets intended to reduce the force of impact resulting from a blow, which may be received off center or to the top of the head.

6.2.2 Electrical Classes

Class G (General) - Helmets intended to reduce the danger of contact exposure to low voltage conductors.

Class E (Electrical) - Helmets intended to reduce the danger of exposure to high voltage conductors.

Class C (Conductive) - Helmets intended to provide protection against contact with electrical conductors.

6.2.3 Helmet Accessories

Helmet accessories, as indicated below, are permissible if manufactured and used in accordance with the requirements of ANSI Standard Z89.1-1986.

- Sweatbands of the removable/replaceable type or that are an integral with the headband. They shall cover at the forehead portion of the headband.
- Winter liners that shall be made of suitable materials and shall not affect the protective capabilities of the helmet. There shall be no metal parts in winter liners intended for use with helmets labeled as meeting Class E requirements.

6.3 RESPONSIBILITIES

Responsibilities concerning the use of protective headwear are discussed in the following paragraphs.

6.3.1 Line Supervisors

Line supervisors shall be responsible for:

- Determining the appropriate type of protective headwear (Type and Class) required to perform tasks.
- Obtaining required protective headwear for employees in designated protective headwear hazard areas.
- Assuring that the furnished protective headwear is worn by employees in designated protective headwear hazard areas.

6.3.2 Employ ees

Employees shall be responsible for the normal care and appropriate use of protective headwear. They shall return used headwear for replacement, or repair when required. Employees shall be restricted from wearing defective or worn-out protective headwear, which could contribute to a head injury.

Chapter 7

7. PROTECTIVE HANDWEAR

7.1 POLICY

Protective handwear shall be provided to employees engaged in work operations where the employees' hands are exposed to hazards such as those from skin absorption of harmful substances; severe cuts or lacerations; severe abrasions; punctures; chemical burns; thermal burns; and harmful temperature extremes. The appropriate protective handwear shall be determined by an evaluation of the tasks to be performed by the employee, including the conditions present, duration of the task, and the hazards and potential hazards identified during the evaluation. Civil service employees engaged in continuous work situations where hand hazards are present shall be furnished appropriate protective handwear at no cost to the employee by the Government and to contractor employees by the contractor company. The cost to repair/replace required protective handwear for civil service employees shall be borne by the Government and for contractor employees by the contractor company.

Direct requirements on protective handwear shall be obtained through:

- LPR 1710.12, "Potentially Hazardous Materials."
- LPR 1710.6, "Electrical Safety."
- SFAB Industrial Hygienist for civil service employees or contractor company's qualified individual for contractor employees.

7.2 RESPONSIBILITIES

Responsibilities concerning the use of protective handwear are discussed in the following paragraphs.

7.2.1 Safety and Facility Assurance Branch

The Safety and Facility Assurance Branch shall be responsible for:

- Providing assistance in determining the areas of operation and work environments where the use of protective handwear is required for civil service employees.
- Providing guidance in the selection and issuance of protective handwear to civil service employees.

7.2.2 Contractor Company

Contractor companies shall be responsible for:

- Providing assistance in determining the areas of operation and work environments where the use of protective handwear is required for contractor employees.

- Providing guidance in the selection and issuance of protective handwear to contractor employees.

7.2.3 Line Supervisors

Line supervisors shall be responsible for:

- Evaluating work areas and tasks to determine if protective handwear is required.
- Obtaining required protective handwear for employees in designated protective handwear hazard areas.
- Assuring that the furnished protective handwear is worn by employees in designated protective handwear hazard areas.

7.2.4 Employ ees

Employees shall be responsible for the normal care and appropriate use of protective handwear. They shall return used handwear for replacement, or repair when required. Employees shall be restricted from wearing defective or worn-out protective handwear, which could contribute to a hand injury.

Chapter 8

8. FALL PROTECTION

8.1 PURPOSE

This chapter provides instruction governing the issuance, maintenance and use of fall protection on LaRC for civil service and contractor employees.

8.2 FALL PROTECTION REQUIREMENTS

In accordance with OSHA 29 CFR 1926.501 fall protection shall be provided to all civil service and contractor employees engaged in work operations where the employee is required to work on a walking/working surface (horizontal and vertical surface) with an unprotected side or edge, which is 6 feet or more above a lower level. The fall protection shall be a guardrail system, safety net system, a personal fall arrest system, or a safety monitoring system.

Civil service employees engaged in work situations where fall protection is required shall be furnished the appropriate fall protection at no cost to the employee by the Government and to contractor employees by the contractor company. The cost to repair/replace the required fall protection for civil service employees shall be borne by the Government and for contractor employees by the contractor company.

Guardrail systems shall comply with the provisions outlined in OSHA 29 CFR 1926.502(b), including, but not limited to the following:

- Top edge of rail shall be 42 inches (plus or minus 3 inches) above the walking/working level.
- Midrails shall be placed at a height of at least 21 inches.
- Shall be capable of withstanding, without failure, a force of at least 200 pounds applied within 2 inches of the top edge, in any outward or downward direction, at any point along the top edge and 150 pounds applied in any downward or outward direction at any point along the midrail or other member.
- Top rails and midrails shall be at least one-quarter inch nominal diameter or thickness to prevent cuts and lacerations. If wire rope is used for top rails, it shall be flagged at not more than 6-foot intervals with high-visibility material.
- When used around holes, which are used as points of access, they shall be provided with a gate, or be so offset that a person cannot walk directly into the hole.

Safety net systems shall comply with the provisions outlined in OSHA 29 CFR 1926.502(c), including, but not limited to the following:

- Shall be installed as close as practicable under the walking/working surface on which employees are working, but in no case more than 30 feet below such level.
- Shall be installed with sufficient clearance under them to prevent contact with the surface or structures below when subjected to an impact force equal to the drop test specified in paragraph OSHA 29 CFR 1926.502(c)(4).
- Shall be drop-tested at the worksite after initial installation and before being used as a fall protection system, whenever relocated, after major repair, and at 6-month intervals if left in one place. The drop-test shall consist of a 400 pound bag of sand 30 + or - 2 inches in diameter dropped into the net from the highest walking/working surface at which employees are exposed to fall hazards, but not from less than 42 inches above that level.
- Shall have a border rope for webbing with a minimum breaking strength of 5,000 pounds.
- Shall be inspected at least once a week for wear, damage, and other deterioration and after any occurrence, which could affect the integrity of the safety net system. Defective components shall be removed from service.
- Mesh shall not exceed 36 square inches nor be longer than 6 inches on any side, and the opening, measured center-to-center of mesh ropes or webbing, shall not be longer than 6 inches.
- Connections between safety net panels shall be as strong as integral net components and shall be spaced not more than 6 inches apart.

Personal fall arrest systems shall comply with the provisions outlined in OSHA 29 CFR 1926.502(d), including, but not limited to the following:

- Horizontal lifelines shall be designed, installed, and used, under the supervision of a qualified person, as part of a complete personal fall arrest system, which maintains a safety factor of at least two.
- Lanyards and vertical lifelines shall have a minimum breaking strength of 5,000 pounds.
- Each employee shall be attached to a separate lifeline, except during the construction of elevator shafts.
- Self-retracting lifelines and lanyards which automatically limit free fall distance to 2 feet or less shall be capable of sustaining a minimum tensile load of 3,000 pounds applied to the device with the lifeline or lanyard in the fully extended position.
- Self-retracting lifelines and lanyards which do not limit free fall distance to 2 feet or less, rip stitch lanyards, and tearing and deforming lanyards shall be capable of sustaining a minimum tensile load of 5,000 pounds applied to the device with the lifeline or lanyard in the fully extended position.
- Ropes and straps (webbing) used in lanyards, lifelines, and strength components of body harnesses shall be made from synthetic fibers.
- Anchorages used for attachment of personal fall arrest equipment shall be independent of any anchorage being used to support or suspend platforms and capable of supporting at least 5,000 pounds, per employee attached, or shall be designed, installed, and used as part of a complete personal fall arrest system,

which maintains a safety factor of a least two; and under the supervision of a qualified person.

- Person fall arrest systems, when stopping a fall, shall limit maximum arresting force on an employee to 1,800 pounds when used with a body harness.
- Be rigged such that an employee can neither free fall more than 6 feet nor contact any lower level.
- Bring an employee to a complete stop and limit maximum deceleration distance an employee travels to 3.5 feet and have sufficient strength to withstand twice the potential impact energy of an employee free falling a distance of 6 feet or the free fall distance permitted by the system, whichever is less.
- The attachment point of the body harness shall be located in the center of the wearer's back near shoulder level, or above the wearer's head.
- Personal fall arrest systems and components subjected to impact loading shall be immediately removed from service and shall not be used again for employee protection until inspected and determined by a competent person to be undamaged and suitable for reuse.
- Shall be inspected prior to each use for wear, damage and other deterioration, and defective components shall be removed from service.
- Shall not be attached to guardrail systems, nor shall they be attached to hoists except as specified in other subparts of OSHA 29 CFR 502.

Safety monitoring systems shall be a safety system in which a competent person is responsible for recognizing and warning employees of fall hazards and shall comply with the provisions outlined in OSHA 29 CFR 1926.502, including, but not limited to the following:

- The competent person shall be designated by the employing organization as the safety monitor and shall be an individual who is competent to recognize fall hazards, and who shall monitor the safety of other employees. The safety monitor shall not have any other responsibilities that could deter his/her attention from the monitoring function; shall warn employees when it appears that the employee is unaware of a fall hazard or is acting in an unsafe manner; and shall be close enough to communicate orally with employees.
- Each employee working in a controlled access zone shall be directed to comply promptly with fall hazard warnings from the safety monitor.
- Safety monitoring systems shall be required for roofing work, with warning lines a minimum of 6 feet from the edge of a roof, unless guardrails are erected at the edge of the roof.
- Contractors using safety monitoring system shall have a written fall protection plan in place in accordance with OSHA 29 CFR 1926.502(k), that includes a description of the training conducted and procedures in place to protect employees.

Additional fall protection requirements relating to construction activities shall be adhered to by all civil servants and contractors, as specified in OSHA 29 CFR 1926.502.

8.3 DEFINITIONS

The following definitions apply to this chapter:

- **Anchorage** means a secure point of attachment for lifelines, lanyards or deceleration devices.
- **Body harness** means straps which may be secured about the employee in a manner that will distribute the fall arrest forces over at least the thighs, pelvis, waist, chest and shoulders with means for attaching it to other components of a personal fall arrest system.
- **Deceleration distance** means the additional vertical distance a falling employee travels, excluding lifeline elongation and free fall distance, before stopping, from the point at which the deceleration device begins to operate. It is measured as the distance between the location of an employee's body belt or body harness attachment point at the moment of activation (at the onset of fall arrest forces) of the deceleration device during a fall, and the location of that attachment point after the employee comes to a full stop.
- **Free fall** means the act of falling before a personal fall arrest system begins to apply force to arrest the fall.
- **Free fall distance** means the vertical displacement of the fall arrest attachment point on the employee's body belt or body harness between onset of the fall and just before the system begins to apply force to arrest the fall. This distance excludes deceleration distance, and lifeline/lanyard elongation, but includes any deceleration device slide distance or self-retracting lifeline/lanyard extension before they operate and fall arrest forces occur.
- **Guardrail system** means a barrier erected to prevent employees from falling to lower levels.
- **Hole** means a gap or void 2 inches or more in its least dimension, in a floor, roof, or other walking/working surface.
- **Lanyard** means a flexible line of rope, wire rope, or strap, which generally has a connector at each end for connecting the body belt or body harness to a deceleration device, lifeline, or anchorage.
- **Lifeline** means a component consisting of a flexible line for connection to an anchorage at one end to hang vertically (vertical lifeline), or for connection to anchorages at both ends to stretch horizontally (horizontal lifeline), and which serves as a means for connecting other components of a personal fall arrest system to the anchorage.
- **Lower levels** mean those areas or surfaces to which an employee can fall. Such areas or surfaces include, but are not limited to, ground levels, floors, platforms, ramps, runways, excavations, pits, tanks, material, water, equipment, structures, or portions thereof.
- **Personal fall arrest system** means a system used to arrest an employee in a fall from a working level. It consists of an anchorage, connectors, a body belt or body harness and may include a lanyard, deceleration device, lifeline, or suitable combinations of these. As of January 1, 1998, the use of a body belt for fall arrest is prohibited.

- **Qualified Person** means one who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training, and experience, has successfully demonstrated his/her ability to solve or resolve problems related to the subject matter, the work, or the project.
- **Safety-monitoring system** means a safety system in which a competent person is responsible for recognizing and warning employees of fall hazards.
- **Self-retracting lifeline/lanyard** means a deceleration device containing a drum-wound line, which can be slowly extracted from, or retracted onto, the drum under slight tension during normal employee movement, and which, after onset of a fall, automatically locks the drum and arrests the fall.
- **Walking/working surface** means any surface, whether horizontal or vertical on which an employee walks or works, including, but not limited to, floors, roofs, ramps, bridges, runways, formwork and concrete reinforcing steel but not including ladders, vehicles, or trailers, on which employees must be located in order to perform their job duties.

8.4 TRAINING REQUIREMENTS

All civil servant and contractor employees who might be exposed to fall hazards shall be trained to recognize the hazards of falling and the procedures to be followed in order to minimize these hazards. The training shall be conducted by a qualified person. The training shall include, but not be limited to, the following:

- The nature of fall hazards in the work area.
- The correct procedures for erecting, maintaining, disassembling, and inspecting the fall protection systems to be used.
- The use and operation of guardrail systems, personal fall arrest systems, safety net systems, and other protection to be used.

A written certification record shall be maintained and shall contain the name or other identity of the employee trained, the date(s) of the training, and the signature of the person who conducted the training.

When the Government or contractor company has reason to believe that any affected employee who has already been trained does not have the understanding and skill required to recognize fall hazards, the employer shall retrain such employee. Circumstances where retraining shall be required include, but are not limited to, situations where: changes in the workplace render previous training obsolete; changes in the types of fall protection systems or equipment to be used render previous training obsolete; or Inadequacies in an affected employee's knowledge or use of fall protection systems or equipment indicate that the employee has not retained the requisite understanding or skill.

8.5 RESPONSIBILITIES

Responsibilities concerning the use of fall protection are discussed in the following paragraphs.

8.5.1 Safety and Facility Assurance Branch

The Safety and Facility Assurance Branch, the authority having jurisdiction at LaRC, shall be responsible for:

- Providing assistance in determining the areas of operation and work environments where the use of fall protection is required for civil service and contractor employees, as well as the type of fall protection to be used that will most effectively protect civil service and contractor employees.
- Providing guidance in the selection and issuance of fall protection to civil service employees.
- Providing assistance in the training of civil service employees.

8.5.2 Contractor Company

Contractor companies shall be responsible for:

- Determining the areas of operation and work environments where the use of fall protection is required for contractor employees
- Determining the appropriate fall protection device is selected and issued to contractor employees in required areas.
- Providing training to contractor employees.

8.5.3 Line Supervisors

Line supervisors shall be responsible for:

- Evaluating work areas and tasks to determine if fall protection is required.
- Developing procedures for the use of fall protection in fall hazard areas.
- Obtaining required fall protection for employees in designated fall protection hazard areas.
- Assuring that the furnished fall protection is worn by employees in designated fall protection hazard areas.
- Ensuring employees are trained/retrained as required and the appropriate training certification is maintained.

8.5.4 Employ ees

Employees shall be responsible for adhering to all fall protection procedures and shall maintain all fall protection devices in good condition. Employees shall also be responsible for notifying their line supervisor of any potential fall hazards they encounter while performing their assigned tasks.

Langley Research Center

LPR 1710.40

Effective Date: February 3, 2005
Expiration Date: February 3, 2010

Langley Research Center
Pressure Systems Handbook

National Aeronautics and Space Administration

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Responsible Office: Safety and Mission Assurance Office

PREFACE

PURPOSE

This Langley Procedural Requirement (LPR) implements the requirements of NASA NPD 8710.5, “NASA Safety Policy for Pressure Vessels and Pressurized Systems,” and is part of the Langley Management System. It establishes requirements and standards for pressurized systems within the framework of Langley Research Center safety policies and constraints. It provides a basis for safety and uniformity in the design, procurement, fabrication, and use of pressure vessels, piping, and associated equipment.

APPLICABILITY

This LPR is applicable to all Langley employees.

AUTHORITY

NPD 8710.5, “NASA Safety Policy for Pressure Vessels and Pressurized Systems.”

REFERENCE

NPD 8715.4, “Inservice Inspection of Ground-Based Pressure Vessels and Systems.”

LPR 1710.10, “Safety Clearance Procedures for the Control of Hazardous Energy (Lockout/Tagout).”

LPR 1710.15, "Wind-Tunnel Model Systems Criteria.”

LPR 1710.41, “Langley Research Center Standard for the Evaluation of Socket and Branch Connection Welds.”

LPR 1710.42, “Safety Program for Maintenance of Ground-Based Pressure Vessels and Pressurized Systems.”

LPR 1740.2, "Facility Safety Requirements.”

LPR 1740.4, “Facility System Safety Analysis and Configuration Management.”

LPR 1740.5, "Procedures for Cleaning of Systems and Equipment for Oxygen Service.”

LPR 1740.7, “Process Systems Certification Program.”

LMS-CP-5616, “Computerized Maintenance Management System (CMMS) Change

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Request."

LMS-TD-5569, "Performing Visual Inspections."

LF 121, "LaRC Safety Manual Review for Certified Operators."

LF 122, "Facility Safety Awareness and Procedures Review for Certified Operators."

LF 159, "Appointment for Operator Certification."

CANCELLATION

LPR 1710.40, "Safety Regulations Covering Pressurized Systems," dated October 3, 2004.

original signed on file

Roy D. Bridges, Jr.
Director

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1. INTRODUCTION

1.1 Purpose

This LPR establishes requirements and guidelines regarding the design, procurement, fabrication, modification, repair, operation, and/or recertification of pressure systems owned by Langley Research Center (LaRC), whether located on Center or off Center, or used at Langley Research Center.

1.2 Fundamental Premise

This document is written on the premise that the functions listed in Chapter 13 are essential to provide the checks and balances necessary to ensure pressure system safety and functional integrity.

1.3 Applicability and Exclusions

This LPR is applicable to all pressure systems owned by or used at LaRC, including new, existing, temporary, and permanent systems.

Pressurized systems in wind tunnel models shall comply with LPR 1710.15, "Wind-Tunnel Model Systems Criteria."

The following systems are excluded from the requirements of this document:

(a) AIR-PAK Rescue Equipment or Other Self-Sustaining Breathing Apparatus

These items shall comply with OSHA regulations in 29 CFR Part 1910, Subparts 1910.134 through 1910.140.

(b) Commercial Off-The-Shelf Pressure Systems and Components

Commercial off-the-shelf (COTS) pressure systems and components are exempt from the requirements of this document provided they are:

- Used, maintained, and repaired in accordance with the manufacturer's recommendations.
- Furnished with an ASME Code Stamp, unless determined by the SPE that code stamping is not applicable.

Modifications to COTS systems and components shall be approved by the SPE.

(c) Fire Extinguishers

These items are covered by OSHA regulations in 29 CFR Part 1910, Subpart L, and include:

- Portable extinguishers,
- Stand pipe and hose systems,

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- Automatic sprinkler systems,
- Fixed dry and wet chemical extinguishing systems,
- Carbon dioxide extinguishing systems, and
- Alternative gas (environmentally friendly) extinguishing systems.

(d) Low Energy Systems

The following systems are excluded from the requirements of this document provided they are installed and maintained in accordance with standard practices using code acceptable materials:

- Water vessels or systems operating at pressures less than 125 psig and temperatures less than 130 °F.
- Vessels or systems containing air or inert gases, with a volume less than 40 cubic feet water volume, operating at less than 125 psig and 130 °F (equates to an energy content less than 5000 psi-ft^3).
- Vacuum vessels or systems with volumes not exceeding 100 cubic feet water volume.

(e) Over-the-Road Trailers

Over the road trailers shall comply with the Department of Transportation (DOT) regulations, 49 CFR Parts 171 through 180.

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2. GENERAL REQUIREMENTS

2.1 Codes and Standards

All pressure systems and components owned by or used at Langley Research Center shall be designed, fabricated, modified, repaired, and/or recertified, as a minimum, in accordance with the following codes and standards as applicable:

(a) American Society of Mechanical Engineers (ASME)

- Boiler and Pressure Vessel Code
- B31.1, “Power Piping” (for steam piping)
- B31.3, “Process Piping” (for all piping other than steam systems)
- B31.5, “Refrigeration Piping and Heat Transfer Components”

(b) National Board of Boiler and Pressure Vessel Inspectors (NBBI)

- NB-23, “National Board Inspection Code”

(c) American Institute of Aeronautics and Astronautics (AIAA)

- S-080 “Space Systems – Metallic Pressure Vessels, Pressurized Structures, and Pressure Components”
- S-081 “Space Systems - Composite Overwrapped Pressure Vessels (COPV)”

(d) Langley Research Center (LaRC)

- LPR 1710.41, “Langley Research Center Standard for the Evaluation of Socket and Branch Connection Welds”
- LPR 1710.42, “Safety Program for Maintenance of Ground-Based Pressure Vessels and Pressurized Systems”
- LPR 1710.15, "Wind-Tunnel Model Systems Criteria”

2.2 Approvals

Ground-based pressure systems shall be approved, as a minimum, by the Standard Practice Engineer (SPE) for Pressure Systems. Flight rated pressure systems shall be approved by the Standard Practice Engineer (SPE) for Flight Systems. The SPE's may waive specific requirements of this document on a case-by-case basis. The Pressure Systems Committee must approve deviations from the requirements in the codes and standards listed above.

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3. DEFINITIONS

Change Notification Sheet (CNS) – An electronic form available through the Configuration Management On Line (CMOL) website initiated with the intent to document changes to systems under configuration control.

Code Stamp – A marking applied to a pressure component by a certified manufacturer to indicate compliance with a national consensus code. Available stamps include :

U – ASME B&PV Code Section VIII, Div 1 (Pressure Vessels)

U2 – ASME B&PV Code Section VIII, Div 2 (Pressure Vessels)

R – NBBI Pressure Vessel Repair

VR – NBBI Valve Repair

N – ASME B&PV Code Section III (Nuclear Facility Components)

PP – ASME Power Piping

Cognizant Engineer – a person who understands the design and operation of a pressure system and is responsible for monitoring the progress of pressure systems work.

Commercial Off-The-Shelf Pressure Systems and Components - Commercial off-the-shelf (COTS) pressure systems and components are systems and components routinely produced by a reputable manufacturer. COTS pressure systems and components are typically furnished with a recommended pressure rating, temperature rating, and/or life expectancy.

Configuration Management On Line (CMOL) – A LaRC website for processing CNS's or to obtain copies of Configuration Controlled Documents (CCD's) (http://cmol).

Design pressure – the value of the maximum difference in pressure across the pressure retaining boundary of a pressure component used in its design calculations.

Inert gas – refers to any non-reactive, non-toxic gaseous media, e.g., gaseous nitrogen, helium, and argon.

Maximum Allowable Working Pressure (MAWP) – the maximum allowable working pressure of a system, subsystem, or component as permitted by the applicable code. In general, the MAWP is taken to be equal to the design pressure, unless it is explicitly determined by calculations, testing, or recertification.

Maximum/minimum design temperature – the maximum/minimum metal temperature (averaged through-the-wall) considered in the design calculations.

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Modification – an alteration or change to the original configuration of a pressure system, which may affect its pressure retaining capability. Any operational or physical change to a pressure system other than a direct replacement of a component is a modification. Operational changes may include such things as changing the working pressure, temperature, or relief valve settings of the system. Physical changes may include such things as changing relief valves or adding/removing piping or components.

Owner – as used in this document, the owner of a pressure system refers to the Organizational Unit Manager (OUM), or his/her designated representative, who is responsible for the pressure system.

Piping system – an assembly of structural components, which may include pipes, valves, fittings, and other such piping components, with the primary purpose to convey, distribute, mix, separate, discharge, meter, control, or snub the flow of a fluid. For the purpose of this definition, tubing and piping shall be considered to be interchangeable.

Pressure vessel – an assembly of structural components, which may include pipes, fittings, and piping components, with the primary purpose to hold, contain, or enclose a finite volume of a fluid under pressure.

Pressure system – a collection of piping systems and/or pressure vessels used jointly to convey or contain a pressurized fluid or a vacuum.

Pressure Systems Document (PSD) – a configuration controlled document describing the current system configuration, including isometric sketches of the system and a database of components. PSDs are available through the CMOL web site.

Relief device setting – the value of increasing inlet static pressure at which the relief device begins venting fluid. For different relief device types, this value may be called opening pressure, popping pressure, start-to-leak pressure, burst pressure, or breaking pressure.

Repair – the work necessary to restore a pressure system to a safe and satisfactory operating condition, provided that no deviation from the original design is made.

Standard Practice Engineer (SPE) for Pressure Systems – An agent of the Pressure Systems Committee responsible for ensuring ground based pressure systems comply with this document.

Standard Practice Engineer (SPE) for Flight Systems – An agent of the Pressure Systems Committee responsible for ensuring pressure components on flight rated systems comply with this document.

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Working pressure – the pressure at which a pressurized system operates under normal conditions.

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4. DESIGN OF NEW PRESSURE SYSTEMS

4.1 General

All new pressure systems owned by or used at LaRC shall be designed in accordance with the applicable codes and standards, as outlined in Chapter 2, and shall include documentation to verify that they are in accordance with these codes. Documentation examples include drawings or sketches, calculations, catalog cuts, and manufacturer certifications.

All drawings/sketches shall include the following information:

(a) Date

(b) Facility name

(c) Building number

(d) Drawing or sketch title

(e) Drawing or sketch number

(f) Salient engineering data, as applicable, such as

- Fluid Service
- Design pressure
- Design temperature
- Material specification
- Nondestructive examination (NDE) and inspection requirements
- Testing requirements
- Set pressure of relief valves
- Set points of all interlocks and protection devices

(g) Applicable design code(s) and/or standard(s)

4.2 Review and Acceptance

All designs of pressure systems owned by or used at LaRC shall be reviewed and accepted (signed off) by the following (in order):

(a) The Facility Coordinator

(b) The Standard Practice Engineer

(c) The Facility Safety Head

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5. FABRICATION OF NEW PRESSURE SYSTEMS

5.1 General

New pressure systems owned by or used at LaRC shall be fabricated in accordance with an approved design as defined in Chapter 4.

5.2 Pressure Vessels

Pressure vessels shall be stamped by the fabricator in accordance with the ASME Pressure Vessel Code, Section VIII, Divisions 1 or 2.

5.3 Welded or Brazed Piping Systems

Welded or brazed piping systems shall be fabricated by organizations that are holders of an ASME (or National Board) Certificate of Authorization for the application of a code stamp, such as the “U”, “U2”, “N”, “R”, or “PP” stamps, as appropriate. The Certificate of Authorization ensures that the fabricator is familiar with and uses the quality control measures required by the ASME codes for pressure vessels and piping.

Whenever a pressure system is fabricated by welding or brazing, the fabricator shall submit the following documents for approval by the SPE or his/her designated representative prior to the start of any welding:

(a) Welding or brazing procedure specification (WPS/BPS)

(b) Procedure Qualification Records (PQR)

(c) Welder or brazer Performance Qualifications (WPQ/BPQ)

(Note: these documents are not submitted for Government approval with ASME code stamped pressure vessels)

5.4 Non-welded or Non-Brazed Piping Systems

Non-welded or non-brazed piping systems shall be fabricated by persons experienced in the fabrication method being utilized.

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6. MODIFICATIONS AND REPAIRS TO PRESSURE SYSTEMS

6.1 General

Pressure systems owned by or used at LaRC shall be modified or repaired in accordance with an approved design as defined in Chapter 4.

6.2 Pressure Vessels

Modifications and repairs to pressure vessels shall be performed by organizations that are holders of an applicable National Board Certificate of Authorization such as the “R”, “VR”, or “NR” stamps. Deviations from this requirement must be approved by the LaRC Pressure Systems Committee (see Chapter 14, “Deviations”).

6.3 Welded or Brazed Piping Systems

Modifications and repairs to welded or brazed piping systems shall be performed by organizations that are holders of one of the following ASME or National Board stamps: “U”, “U2”, “R”, “N”, or “PP”.

Whenever a piping system is modified or repaired by welding or brazing, the fabricator shall submit the following documents for approval by the SPE or his/her designated representative prior to the start of any welding:

(a) Welding procedure specification (WPS)

(b) Procedure Qualification Records (PQR)

(c) Welder Performance Qualifications (WPQ)

6.4 Non-Welded or Non-Brazed Piping Systems

Modifications and repairs to non-welded or non-brazed piping systems may be performed by organizations that are not holders of an ASME or National Board stamp but that are experienced in the fabrication method used.

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7. PROCUREMENT OF PRESSURE SYSTEMS

7.1 General

All pressure systems and components procured for use in systems owned by or used at LaRC shall comply with the requirements of this document and shall be reviewed by the Standard Practice Engineer.

7.2 New Pressure Vessels

All contracts or orders requiring the purchase of new pressure vessels shall require the vessel to be ASME code stamped and shall contain the following note:

> “This solicitation includes fabrication of pressure vessels. A current ASME Certificate of Authorization for use of a “U” or “U2” code stamp shall be held by the organization performing the fabrication and stamping of the pressure vessels. The contract award process will be greatly facilitated by submittal of the Certificate of Authorization with the offeror's bid; however, early certification submittal is not required to ensure bid responsiveness. An offeror's ability to confirm that deliverable pressure vessels will be code stamped as required is a matter relating to the offeror's responsibility and will be determined prior to award.”

7.3 Welded or Brazed Piping Systems and Existing Pressure Vessels

All contracts requiring fabrication, modification, or repair of welded or brazed piping systems and existing pressure vessels shall require the fabricator to be a holder of an ASME code stamp and shall contain the following note:

> “This solicitation requires fabrication, modification, and/or repairs to pressure systems. A current National Board or ASME Certificate of Authorization for use of any of the following stamps: "R”, “U”, “U2”, “N”, or “PP” is required. This certificate shall be held by the organization performing the work and shall be maintained valid and current throughout the contract performance period. The contract award process will be greatly facilitated by submittal of the applicable Certificate of Authorization with the offeror's bid; however, early certification submittal is not required to ensure bid responsiveness. An offeror's ability to confirm that the organization performing the work is a holder of any of the above stamps is a matter relating to the offeror's responsibility and will be determined prior to award.”

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8. INSPECTION AND TESTING OF PRESSURE SYSTEMS

8.1 General

Inspection and testing of pressure systems to be owned by or used at LaRC shall meet, as a minimum, the requirements of the applicable design code listed in Chapter 2 of this document.

8.2 Supplemental Inspection Requirements

In addition to the minimum code requirements, the Cognizant Engineer shall ensure that the following supplemental requirements are met:

(a) Non-destructive evaluation (NDE) shall be done in accordance with Table 8-1 (LaRC Supplemental NDE Requirements).

(b) All NDE shall be performed by inspectors certified to the American Society for Nondestructive Testing (ASNT) Level II or Level III requirements.

(c) When heat treatment or stress relieving of a pressure retaining component is required, a magnetic particle examination (MT) or a dye penetrant examination (PT) of the heat-affected-zone shall be conducted after all other required examinations are complete.

(d) Inspection and acceptance criteria for socket welds and branch connection welds shall be in accordance with LPR 1710.41, “Langley Research Center Standard for the Evaluation of Socket and Branch Connection Welds.”

(e) Acceptance criteria for butt welds in pressure systems shall be in accordance with ASME B31.3 “Process Piping” for severe cyclic conditions.

(f) Radiographic inspection of piping girth butt welds shall utilize tangential techniques wherever possible (elliptical techniques should be avoided).

(g) Final interpretation and acceptance of radiographs of pressure systems will be by the SPE or his/her designated representative.

(h) All radiographic film of pressure systems shall be submitted by the Cognizant Engineer to the LaRC recertification contractor’s COTR or his/her designated representative for final filing and storage. The LaRC recertification contractor shall retain the radiographic film in a controlled environment repository for a minimum of 5 years.

(i) All hydrostatic and pneumatic tests conducted on site at Langley Research Center shall be performed using written and approved test plans and operating procedures. Test plans shall be approved by the cognizant engineer and the SPE. When hydrostatic testing is conducted at the Component Verification Facility (Building 1284B), the development of test plans is not required.

(j) Hydrostatic or pneumatic testing is used to establish the ability of new, modified, or repaired pressure systems to withstand the design pressure of the system.

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Both methods of testing are potentially hazardous. Adequate safety precautions shall be taken to ensure the safety of personnel and equipment. Pneumatic testing should be conducted only when hydrostatic testing is not feasible. A gas complying with cleanliness requirements of the pressure vessel and system shall be used. A hazard zone shall be established by engineering analysis and all personnel must be excluded from the hazard zone. The pneumatic test procedure must be approved by the SPE; the Chairperson of the Pressure Systems Committee; the Director of the Safety and Mission Assurance Office (SMAO); and the cognizant Facility Safety Head (FSH).

(k) Hydrostatic or pneumatic testing of pressure systems shall be witnessed by the Standard Practice Engineer or his/her designated representative. The fabricator shall provide a hydrostatic or pneumatic test certificate, signed and dated by the fabricator's testing personnel. The fabricator's certificate shall include a description of the tested system, the test pressure, holding time, and any other pertinent test parameters.

(l) As a minimum, acceptance criteria for the evaluation of visual inspections on pressure components shall be in accordance with LMS-TD-5569, "Performing Visual Inspections."

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Table 8 - 1, LaRC Supplemental NDE Requirements

		Joint Type				
		Butt Weld	**Socket Weld**	**Branch Weld**	**Fillet Weld**	**Threaded / Tubing**
Pressure Vessels	**Code Stamped** (all pressures, all volumes)	Per ASME Boiler and Pressure Vessel Code				
	Not Code Stamped (P > 15 psig, all volumes)	100% VT 100% RT	100% VT 100% RT	100% VT 100% RT	100% VT 100% MT or PT	100% VT
	Not Code Stamped (P ≤ 15 psig, V > 340 ft^3)	100% VT 100% MT or PT	100% VT 100% MT or PT	100% VT 100% MT or PT	100% VT 100% MT or PT	100% VT
	Not Code Stamped (P ≤ 15 psig, V ≤ 340 ft^3)	100% VT	100% VT	100% VT	100% VT	100% VT
Process Piping (except steam piping)	**Air, Water, or Inert Gas** (P ≤ 125 psi, T > 130 °F)	100% VT 5% RT	100% VT 5% RT	100% VT 5% RT	100% VT 5% MT or PT	100% VT
	Air, Water, or Inert Gas (P > 125 psi, T > 130 °F)	100% VT 100% RT	100% VT 100% RT	100% VT 100% RT	100% VT 100% MT or PT	100% VT
	Other Media (all pressures and temperatures)	100% VT 100% RT	100% VT 100% RT	100% VT 100% RT	100% VT 100% MT or PT	100% VT
Steam Piping	**P ≤ 125 psig**	100% VT 10% RT	100% VT 10% RT	100% VT 10% RT	100% VT 10% MT or PT	100% VT
	P > 125 psig	100% VT 100% RT	100% VT 100% RT	100% VT 100% RT	100% VT 100% MT or PT	100% VT

VT – Visual Inspection, MT – Magnetic Particle Inspection, PT – Liquid Penetrant Inspection, RT – Radiographic Inspection

The SPE has the authority to waive inspection or test requirements on a case-by-case basis. The Pressure Systems Committee shall approve deviations from the minimum requirements in the design code.

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9. VERIFICATION AND SHAKEDOWN OF PRESSURE SYSTEMS

9.1 General

All new, modified, or repaired pressure systems owned by or used at LaRC shall undergo verification and shakedown prior to being placed in operational service.

9.2 Verification

The cognizant engineer shall verify that the system has been constructed, repaired, or modified in accordance with the approved design documentation (as described in Chapter 4) and shall verify that:

(a) All nondestructive examinations have been completed and accepted.

(b) All hydrostatic tests, leak tests, and any other testing required by the design, repair, or modification documents have been completed and accepted.

(c) All safety and interlock devices have current calibrations, have been installed, and are operating properly.

(d) All other system devices (e.g., valves, actuators, gages, traps) have been properly installed and are operable (without pressure).

(e) A shakedown plan has been developed.

Once verified, the cognizant engineer shall document the verification in a letter (or e-mail) to the Owner, or his/her designated representative, for concurrence, certifying that:

(a) All work has been completed and complies with LPR 1710.40, “Pressure Systems Handbook.” Deviations from ASME and ANSI codes and standards, if any, were approved by the Pressure Systems Committee.

(b) The installation was completed in accordance with the engineering design, specifications, and drawings.

(c) Any changes to the original design were approved by the Standard Practice Engineer.

(d) The Pressure Systems Committee, a formal design review committee, or the Standard Practice Engineer has reviewed the plans for shakedown.

(e) The system is ready to be pressurized.

For systems under configuration control, the letter shall identify the appropriate CNS number for the change.

9.3 Shakedown

Shakedown may be performed after the system has been verified, and shall validate

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system performance and operator training. The Cognizant Engineer shall oversee shakedown. During shakedown:

(a) The operators shall be properly trained and certified.

(b) The operating procedures shall be completed and signed off in accordance with the configuration management process.

(c) The system performance shall be demonstrated with system fluids (systems containing toxic, combustible, flammable, or otherwise hazardous fluids may use an inert fluid first).

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10. OPERATIONS AND MAINTENANCE OF PRESSURE SYSTEMS

10.1 General

Pressure systems under configuration control shall be operated in accordance with Standard Operating Procedures developed and approved in accordance with LPR 1740.4, “Systems Safety Analysis and Configuration Management.”

Facility Coordinators shall ensure that all pressure-retaining equipment (e.g., relief valves, control valves, gages, transmitters) in pressure systems within their facility shall be included in the Computerized Maintenance Management System (CMMS) in accordance with LMS-CP-5616, “Computerized Maintenance Management System (CMMS) Change Request.”

10.2 Operator Certification

All pressure systems used at LaRC shall be operated by personnel who have received training in the operational characteristics of the system and understand the operational procedures, checklists, and inherent hazards associated with the system. The operator of a pressure system owned by LaRC shall be certified in accordance with LPR 1740.7, “Process System Certification Program.” The Facility Safety Head shall ensure that Langley Form (LF) 121, “LaRC Safety Manual Review for Certified Operators,” and LF 122, “Facility Safety Awareness and Procedures Review for Certified Operators,” include the appropriate documents to ensure the operator has read and understands the operational procedures, checklists, and inherent hazards associated with the system. The certification of the operator shall be documented on LF 159, “Appointment for Operator Certification.”

10.3 Personnel Protection

When any maintenance operation could result in injury to personnel or serious damage to equipment, the system shall be locked/tagged out in accordance with LPR 1710.10, “Safety Clearance Procedures for the Control of Hazardous Energy (Lockout/Tagout).”

Any system containing toxic fuel or other potentially dangerous media shall be purged with an appropriate agent such as fresh air, water, inert gas, or a neutralizing agent prior to disassembly of components or opening up the system. The purge shall be performed in accordance with written procedures approved by the Facility Safety Head.

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11. DOCUMENTATION

11.1 General

The cognizant engineer shall provide records to the Facility Safety Head that document the as-built configuration of the system. Documentation shall include:

(a) As-built drawings or sketches for incorporation into the Configuration Control System.

(b) NDE records.

(c) Test reports.

(d) Shakedown records.

The owner of a pressure system shall maintain a file copy of:

(a) Current certifications of calibrated devices

(b) Test reports

(c) Non-destructive examination reports

(d) Inspection records

(e) Shakedown records

(f) Process and instrumentation diagram (PID)

11.2 Process and Instrumentation Diagrams

The owner of a pressure system shall maintain a file copy of a current process and instrumentation diagram (P&ID) for each pressure system at his/her facility. These P&ID drawings shall be made available to the system operators. The P&ID drawing shall identify all safety devices and their set points. For pressure systems under configuration management, the P&ID shall be a configuration controlled document.

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12. RECERTIFICATION

12.1 General

Pressure systems owned by or used at LaRC shall be periodically inspected and recertified in accordance with the guidelines in NPR 8715.4 "*Inservice Inspection of Ground-Based Pressure Vessels and Systems*" and LPR 1710.42, "Safety Program for Maintenance of Ground-Based Pressure Vessels and Pressurized Systems."

Pressure systems at LaRC shall be documented in a Pressure System Document (PSD) including a description of the system, an overall system schematic, detailed system sketches, a listing of all the components, a listing of components recommended for replacement (if any), references to the system's inspection plans, and information on the status of the pressure system. PSD's are available electronically through the CMOL website.

12.2 Active and Inactive Pressure Systems

The owner is responsible for establishing the operational status of a pressure system. A pressure system designated as "ACTIVE" will be subject to the periodic inspections required by the LaRC Recertification Program and by the guidelines in NPR 8715.4 and LPR 1710.42. An "INACTIVE" pressure system will not be subject to periodic inspection and shall not be operated. In order to change a pressure system's operational status from "INACTIVE" back to "ACTIVE", the pressure system shall be thoroughly inspected and/or tested as required by the Standard Practice Engineer prior to re-pressurization.

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13. RESPONSIBILITIES

The functions listed below are essential to provide the checks and balances necessary to ensure pressure system safety and functional integrity.

13.1 Cognizant Engineer

The Cognizant Engineer shall:

(a) Monitor the progress of pressure systems work.

(b) Ensure that all performance and safety requirements for pressure systems are documented.

(c) Ensure that all fabrication, modifications, repairs, and inspections are in compliance with the approved design.

(d) Ensure that completed pressure systems meet documented project requirements.

(e) Provide written notification to the Facility Safety Head that the system has met the requirements of this document and is ready to be placed in operation.

(f) Ensure that all radiographs and weld maps are submitted to the Recertification contractor's COTR or his/her designated representative.

(g) Oversee pressure system shakedown activities.

13.2 Facility Coordinator (FC)

Facility Coordinators shall:

(a) Ensure that all pressure-retaining equipment (e.g., relief valves, control valves, gages, transmitters) in pressure systems within their facility shall be included in the Computerized Maintenance Management System (CMMS) in accordance with LMS-CP-5616.

(b) Review and accept pressure system designs for their facility.

(c) Maintain records of valve numbers in their facility pressure systems.

13.3 Facility Safety Head (FSH)

Facility Safety Heads shall:

(a) Ensure that all new pressure vessels, piping, associated equipment, and all modifications thereto are approved by the Standard Practice Engineer and/or the LaRC Formal Design Review process before commencing site work.

(b) Ensure that each employee is familiar with and complies with the provisions of this handbook and other related LaRC safety regulations.

(c) Possess written verification that a pressure system is ready to be re-energized as described in Chapter 9.

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(d) Ensure that new operational procedures and/or revision of existing operational procedures for changes, additions, or alterations are completed.

(e) Ensure that a complete set(s) of final drawings, design specifications, design analysis manuals, and schematic drawings required for safe and proper operation is available.

(f) Ensure safeguarding, inspection, and testing of flex hoses that are not permanently installed.

(g) Approve pneumatic test procedures.

(h) Review and accept pressure systems designs for their facility.

13.4 Owner

The owner of a pressure system shall:

(a) Maintain a file copy of a current process and instrumentation diagram (P&ID) for each pressure system at his/her facility.

(b) Maintain a file copy of all relevant pressure system documentation.

(c) Establish operational status of pressure systems.

13.5 Pressure Systems Operator

The Pressure Systems Operator shall:

(a) Be knowledgeable of the operational procedures, checklists, and inherent hazards of the system.

(b) Be certified in accordance with LPR 1740.7, “Process Systems Certification Program.”

13.6 Standard Practice Engineer (SPE) For Pressure Systems

The Standard Practice Engineer for Pressure Systems (ground-based) shall:

(a) Review and approve all new designs, modifications, and repairs to pressure systems and shall certify their compliance with existing codes and standards.

(b) Evaluate requests for deviations from the requirements of this document.

(c) Interpret and accept, or designate a representative to interpret and accept, radiographs of pressure systems.

(d) Approve all designs of glass windows to be installed in pressure systems.

(e) Witness, or designate a representative to witness, hydrostatic or pneumatic tests.

13.7 Standard Practice Engineer (SPE) For Flight Systems

The Standard Practice Engineer for Pressurized Flight Systems shall

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(a) Review and approve drawings, test plans, operational procedures, checkout procedures, purchase requests, specifications, and statements of work.

(b) Evaluate requests for deviations from the requirements of this document.

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14. DEVIATIONS

14.1 General

Deviations from the requirements of the codes and standards listed in Chapter 2 must be approved by the LaRC Pressure Systems Committee (PSC).

A request for deviation to the PSC shall include full justification for the deviation and the supporting data and analyses to demonstrate that safe operation can be achieved. The PSC will review the request and forward its recommendation to the LaRC Executive Safety Board for final approval.

Deviations from other requirements of this document require approval by the Standard Practice Engineer.

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Appendix A - Additional Requirements and Best Practices

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Appendix A – Additional Requirements and Best Practices

This Appendix contains additional requirements and best practices associated with pressure systems. Whenever the word “shall “ is used in this Appendix, the text is understood to be mandatory. Whenever the word “should “ is used, the text is interpreted as being a recommended practice.

A-1 Anchoring

(a) All vessels and major components of a system shall be anchored to a stable foundation designed to withstand all static and dynamic loads acting on the pressure system.

(b) Pipe, tubing, and flexible hoses should be firmly secured to a stable structure at or near joints and bends to prevent violent displacement in case of joint failure.

A-2 Bladder Accumulators

(a) Bladder accumulators should be pre-charged with nitrogen gas rather than air or other gases to prevent adverse reaction or combustion.

A-3 Bushings

(a) Single-step bushings conforming to ANSI/ASME B16.11 shall not be used in systems with pressures above 125 psig. All transitions of this type should be made using concentric reducer sections or reducing couplings.

A-4 Cleaning

(a) Pressurized components shall be cleaned internally before use to the extent necessary to be compatible with their intended use. For example, use of oxygen gas, liquid oxygen, or high pressure air (high concentration of oxygen) in a system containing oil or other hydrocarbon-rich residues will form a flammable or explosive mixture, which may result in an explosion.

(b) Systems requiring cleanliness to 10 parts per million or less of hydrocarbons shall be cleaned in accordance with LPR 1740.5, "Procedures for Cleaning of Systems and Equipment for Oxygen Service.”

(c) Hydrostatically tested pressure systems should be dried using air or nitrogen gas.

A-5 Color Coding and Marking

(a) All pressure systems shall have identification of media type, flow direction, and use the color coding scheme specified in LPR 1740.2, "Facility Safety Requirements."

A-6 CPV-Type Union Nuts

(a) CPV type union nuts subject to pressures above 3000 psi shall have vent holes and be torqued to the values listed in the figure below. CPV type unions 1 1/4" and larger

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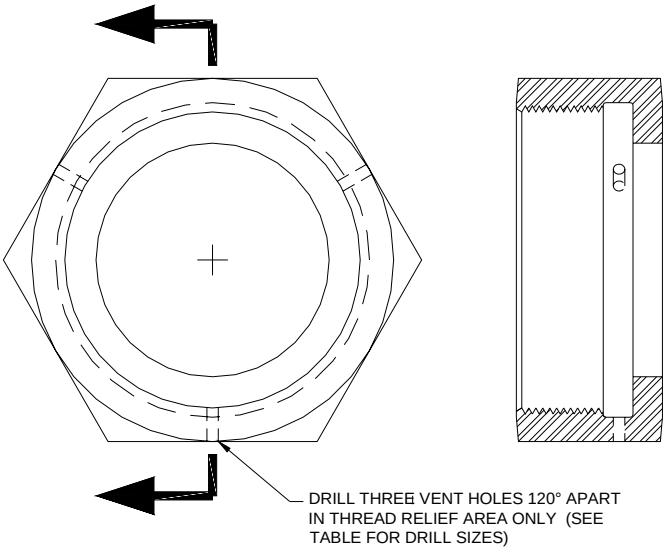
in size shall not be used in compressed gas systems above 2400 psi.

SIZE	TORQUE (FT-LB)	VENT HOLE DIAMETER
1/8"	10 - 25	1/16"
1/4"	10 - 25	1/16"
3/8"	12 - 30	1/16"
1/2"	15 - 40	3/32"
3/4"	20 - 50	3/32"
1"	25 - 60	3/32"
1 1/4"	30 - 75	1/8"
1 1/2"	35 - 90	1/8"
2"	45 - 120	1/8"



A-7 Filter Regulators

(a) Filter regulators with glass bulbs shall not be used in pressure systems unless the glass bulb is made of impact-resistant glass.

A-8 Flexible Hoses

(a) Flex hoses shall not be used in a system in lieu of rigid piping or tubing unless the use of rigid piping or tubing has been determined to be impractical, or where vibration isolation, motion allowance, or component flexibility requires their use.

(b) Fabrication and testing of flex hoses for use in LaRC ground-based facilities shall be performed by certified personnel at the Component Verification Facility (Building 1284B) or by flex hose manufacturers/providers.

(c) Flex hoses in pneumatic systems with working pressure above 125 psig shall be secured at both ends and at intermediate connections using Kellems or similar type restraints. Hose restraints in liquid systems shall be evaluated by the SPE.

(d) Procurements of flex hose assemblies shall require the following:

- the maximum allowable working pressure (MAWP) of the flex hose shall be marked on the outside surface
- the manufacturer shall provide a signed pressure test certificate
- the manufacturer shall provide a tag affixed to the flex hose indicating the date and pressure of the pressure test

(e) All flex hoses shall be tested prior to initial use to 150% of the hose material's MAWP if hydrostatically tested or 110% of the MAWP if pneumatically tested.

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(f) Flex hoses shall be periodically retested if (a) the flex hose is subject to periodic disconnection and reconnection, (b) the flex hose is subject to constant flexing, twisting, or stretching (c) the flex hose contains a pressurized liquid that is known to be corrosive or damaging to the hose material, or (d) the hose is exposed to external agents or conditions that deteriorate its outer layer. Under these conditions, flex hoses shall be retested hydrostatically or pneumatically to 100% of the hose MAWP every 2 years.

(g) A pressure test tag or band shall be placed on all flex hoses indicating the date and pressure of the last test. Flex hoses with missing test tags shall be retested or replaced.

(h) Flex hoses that are permanently installed in a pressure system shall be periodically inspected using a visual external inspection technique by a certified ASNT Level II or Level III inspector. Inspection intervals shall be as required by the LaRC pressure systems recertification program.

(i) It is the responsibility of the Facility Safety Head to ensure that any flex hoses which are not a part of a permanent installation, or hoses which are used for multiple purposes are appropriately labeled and safeguarded. The FSH shall ensure that these flex hoses are entered in the Computerized Maintenance Management System (CMMS), and that they are visually inspected and pressure tested at least every two years.

(j) A flex hose with leaks, or has flat areas, kinks, blisters, sharp ends, twists, damaged end fittings, cracks in the inner liner, severe corrosion (including the hose restraints), or has other signs of deterioration shall not be used.

(k) Flex hoses shall not be subjected to normal (or sustained) operating pressures greater than the manufacturer's recommended MAWP. Additionally, due to the probability of plastic yielding, any flex hose that experiences momentary pressures in excess of 2 times its MAWP shall be immediately removed from service and destroyed.

A-9 Glass Windows in Pressure Systems

(a) The use of glass windows exposed to pressure differentials should be avoided. If used, glass surfaces should be shielded or protected by quick-acting closures whenever possible. Indirect viewing using electronic cameras and monitors rather than direct viewing should be employed to the greatest extent possible.

(b) All windows in pressure and vacuum vessels must be approved by the SPE.

(c) A minimum safety factor of 10 shall be used for all glass window designs. Window frames shall be designed in accordance with the applicable code.

(d) Special consideration should be given to vacuum systems and implosion effects whereby viewing windows present potential hazards to personnel.

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Appendix A – Additional Requirements and Best Practices

A-10 Heat Sources

(a) Care should be taken to ensure that pressure systems are not subject to extraneous heat sources since heat raises gas pressure and reduces metal strength.

(b) Glass windows in pressure systems should not be subjected to extraneous heat sources such as ultraviolet lamps, infrared lamps, or other lighting/heat sources, which could cause cracking and/or breakage due to thermal expansion of glass and/or frame.

A-11 Isolation and Depressurization

(a) Isolation of pressure systems, or sections of pressure systems, should be accomplished utilizing a double-block and bleed configuration.

(b) Depressurization of systems shall be verified by the opening of vent valves or by other positive means.

(c) Isolation valves shall not be placed upstream of relief valves.

A-12 Materials

(a) Pressure retaining components made of cast iron or ductile iron shall not be used at pressures above 125 psig or where they will be subject to vibration or shock loading.

(b) Non-metallic piping shall not be used in compressed gas service.

A-13 Pressure Gages

(a) Gages used in pressure systems shall meet the requirements shown in Table A-13.

(b) All gages referenced in a system's standard operating procedures (SOP) shall be calibrated at least once every 5 years to ensure accurate measurement.

(c) All pressure gages shall be mounted so that safety features, such as blowout backs, will function properly.

(d) Gages shall be installed on both sides of pressure regulators to ensure proper monitoring of pressures.

Table A-13 – Requirements for Pressure Gages

Requirements	Service Above 125 Psig		Service 125 psig and lower (1)	Instrument gages, 0-30 psig, and vacuum gages
	Type A	Type B	Type C	
Max. Operating Pressure	No Limit	No Limit	125 psig	30 psig
Allow. Working Pressure (% of full scale)	80	60	60	100
Safety Case (2) (5)	Required	Not required	Not required	Not required
Proof Test Pressure	100	100	100	100

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(% of full scale)				
Type of Test [3]	Dead Weight	Dead Weight	Dead Weight or N_2	Dead Weight or N_2
Retest Period	5 year	5 year	Not required	Not required
Test Label [4] [6]	Required	Required	Required if tested	Required if tested

Notes:

(1) Gage shall be bourdon-tube type for non-flight applications.

(2) Gages shall have a solid front, glass or plastic pane, with blow out of entire back area. Blowout plugs are not allowed.

(3) Dead weight test media shall be water or oil. Oil shall not be used for gages used with oxygen or other oxidizing agents.

(4) Test label shall include maximum pressure, test date, and initials of testing personnel. Label shall be made of aluminum foil, with pressure sensitive adhesive back, and shall be a different color each year.

(5) An adequate free area shall be provided for discharge of blowout back gages.

(6) A “No certification/calibration required” sticker should be applied to devices used in general service.

A-14 Pressure Relieving and Venting Systems

(a) Relief valves on pressure systems shall be ASME code stamped.

(b) Exhaust piping downstream of relief valves and vent valves shall be equal to or larger than the valve outlet size.

(c) Piping downstream of relief valves and vent valves shall be designed for the maximum system working pressure unless engineering calculations are made to justify a lower design pressure. For example, calculations may be performed in accordance with the American Petroleum Institute (API) RP-521 “Guide for Pressure Relieving and Depressuring Systems”.

(d) Piping downstream of relief valves and vent valves should be routed separately to the point of discharge. A properly designed common header may be used when approved by the SPE.

(e) Exhaust piping downstream of relief valves and vent valves should utilize equalization tees and bird screens.

(f) Exhaust piping shall be routed to minimize exposure of personnel to vented media and/or noise.

(g) New relief valves shall be tested and certified by the valve manufacturer or by the LaRC Component Verification Facility prior to initial use to ensure proper relief setting.

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(h) A relief valve shall be used in conjunction with a rupture disk in cryogenic systems where liquid cryogen entrapment could occur.

(i) When a single relief device is used, the set pressure shall not exceed the MAWP of the system, subsystem, or component being protected.

A-15 Pressure Testing of Tubing

(a) The required pressure for testing of tubing shall be 1.5 times the system design pressure for hydrostatic tests, and 1.1 times the system design pressure for pneumatic tests. Engraving or marking of test pressure on the tubing fittings is not required, but a test report is required.

A-16 Reclaimed Materials

(a) Reclaimed piping or tubing may be reused provided the reclaimed materials are (1) examined to determine if the minimum wall thickness is greater than that required by the applicable code, (2) hydrostatically tested to 1.5 times the design pressure of the system, (3) inspected for imperfections which would be unacceptable for the new intended use, and (4) cleaned in sufficient measure to ensure compatibility with their intended use (see A-4).

A-17 Seam-Welded Pipe and Fittings

(a) Seam-welded pipe and fittings shall not be used in pressure systems with working pressure above 125 psig unless:

(b) The seam welds are 100% radiographed and accepted, or

(c) An appropriate “joint quality factor”, as defined by the applicable piping design code, is utilized in the design calculations to determine the minimum required wall thickness of the pipe or fitting.

Either alternative shall be approved by the Standard Practice Engineer.

A-18 Torque Values

(a) Torque values for bolted connections in pressure systems shall be designated on the system’s drawings.

A-19 Valve bodies

(a) Valve bodies should be forged for valve sizes 6” or larger or where the flange rating is 600 pound class or above.

A-20 Valve Numbering

(a) System valves shall be numbered in accordance with LPR 1740.2, "Facility Safety Requirements."

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(b) The Facility Coordinators shall be responsible for maintaining records of valve numbers in pressure systems at their facility.

A-21 Working Pressure

(a) The *maximum* working pressure should be 5 to 10% below the MAWP of the system or relief device setting.

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Appendix B – Pressure Rating of Metallic Seamless Piping

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Pressure Rating of Metallic Seamless Piping Notes 1,5,6,8

Butt Welding, Socket Welding, and Threaded

Sample Materials: A-53 Gr. B, A-106 Gr. B, A-516 Gr. 60, SE = 20,000 PSIG
A-312 Grades TP304, TP316, and TP347 Max. Temp. = 100 °F

					WELDED(Note 2)		THREADED(Note 2)	
Nominal Pipe Size	**Wall Schedule**	**Outside Diameter**	**Nominal Wall Thickness**	**Max. Thread Depth**	**Allowable Pressure (PSIG)**	**SW Fitting Pound Class**	**Allowable Pressure (PSIG)**	**Thr. Fitting Pound Class**
1/8	10	0.405	0.049	(Note 7)	4641	3000#		
	30	0.405	0.057	0.02963	5479	3000#	2057	2000#
	40	0.405	0.068	0.02963	6723	3000#	3150	2000#
	STD	0.405	0.068	0.02963	6723	3000#	3150	2000#
	80	0.405	0.095	0.02963	7525	3000#	5295	2000#
	XS	0.405	0.095	0.02963	7525	3000#	5295	2000#
1/4	10	0.540	0.065	(Note 7)	4612	3000#		
	30	0.540	0.073	0.04444	5237	3000#	1448	2000#
	40	0.540	0.088	0.04444	6438	3000#	2570	2000#
	STD	0.540	0.088	0.04444	6438	3000#	2570	2000#
	80	0.540	0.119	0.04444	7182	3000#	4561	2000#
	XS	0.540	0.119	0.04444	7182	3000#	4561	2000#
3/8	10	0.675	0.065	(Note 7)	3622	3000#		
	30	0.675	0.073	0.04444	4104	3000#	1152	2000#
	40	0.675	0.091	0.04444	5237	3000#	2164	2000#
	STD	0.675	0.091	0.04444	5237	3000#	2164	2000#
	80	0.675	0.126	0.04444	7496	3000#	4243	2000#
	XS	0.675	0.126	0.04444	7496	3000#	4243	2000#
1/2	5	0.840	0.065	(Note 7)	2870	3000#		
	10	0.840	0.083	(Note 7)	3736	3000#		
	30	0.840	0.095	0.05714	4292	3000#	1270	2000#
	40	0.840	0.109	0.05714	4974	3000#	1877	2000#
	STD	0.840	0.109	0.05714	4974	3000#	1877	2000#
	80	0.840	0.147	0.05714	7003	3000#	3626	2000#
	XS	0.840	0.147	0.05714	7003	3000#	3626	2000#
	160	0.840	0.188	0.05714	7240	6000#	5113	3000#
	XXS	0.840	0.294	0.05714	9808	9000#	8378	6000#
3/4	5	1.050	0.065	(Note 7)	2270	3000#		
	10	1.050	0.083	(Note 7)	2945	3000#		
	30	1.050	0.095	0.05714	3375	3000#	1010	2000#
	40	1.050	0.113	0.05714	4079	3000#	1653	2000#
	STD	1.050	0.113	0.05714	4079	3000#	1653	2000#
	80	1.050	0.154	0.05714	5732	3000#	3159	2000#

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A-312 Grades TP304, TP316, and TP347 Max. Temp. = 100 °F

					WELDED(Note 2)		THREADED(Note 2)	
Nominal Pipe Size	**Wall Schedule**	**Outside Diameter**	**Nominal Wall Thickness**	**Max. Thread Depth**	**Allowable Pressure (PSIG)**	**SW Fitting Pound Class**	**Allowable Pressure (PSIG)**	**Thr. Fitting Pound Class**
3/4	XS	1.050	0.154	0.05714	5732	3000#	3159	2000#
	160	1.050	0.219	0.05714	6887	6000#	5158	3000#
	XXS	1.050	0.308	0.05714	8812	9000#	7455	6000#
1	5	1.315	0.065	(Note 7)	1796	3000#		
	10	1.315	0.109	(Note 7)	3067	3000#		
	30	1.315	0.114	0.06957	3239	3000#	930	2000#
	40	1.315	0.133	0.06957	3796	3000#	1472	2000#
	STD	1.315	0.133	0.06957	3796	3000#	1472	2000#
	80	1.315	0.179	0.06957	5280	3000#	2794	2000#
	XS	1.315	0.179	0.06957	5280	3000#	2794	2000#
	160	1.315	0.250	0.06957	7686	6000#	4984	3000#
	XXS	1.315	0.358	0.06957	8377	9000#	6969	6000#
1-1/4	5	1.660	0.065	(Note 7)	1412	3000#		
	10	1.660	0.109	(Note 7)	2399	3000#		
	30	1.660	0.117	0.06927	2585	3000#	808	2000#
	40	1.660	0.140	0.06927	3151	3000#	1311	2000#
	STD	1.660	0.140	0.06927	3151	3000#	1311	2000#
	80	1.660	0.191	0.06927	4376	3000#	2479	2000#
	XS	1.660	0.191	0.06927	4376	3000#	2479	2000#
	160	1.660	0.250	0.06957	5900	6000#	3868	3000#
	XXS	1.660	0.382	0.06957	7423	9000#	6186	6000#
1-1/2	5	1.900	0.065	(Note 7)	1230	3000#		
	10	1.900	0.109	(Note 7)	2083	3000#		
	30	1.900	0.125	0.06957	2405	3000#	857	2000#
	40	1.900	0.145	0.06957	2825	3000#	1230	2000#
	STD	1.900	0.145	0.06957	2825	3000#	1230	2000#
	80	1.900	0.200	0.06957	3977	3000#	2313	2000#
	XS	1.900	0.200	0.06957	3977	3000#	2313	2000#
	160	1.900	0.281	0.06957	5777	6000#	4002	3000#
	XXS	1.900	0.400	0.06957	6941	9000#	5812	6000#
2	5	2.375	0.065	(Note 7)	979	3000#		
	10	2.375	0.109	(Note 7)	1653	3000#		
	30	2.375	0.125	0.06957	1906	3000#	683	2000#

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Sample Materials: A-53 Gr. B, A-106 Gr. B, A-516 Gr. 60, SE = 20,000 PSIG
A-312 Grades TP304, TP316, and TP347 Max. Temp. = 100 °F

					WELDED(Note 2)		THREADED(Note 2)	
Nominal Pipe Size	**Wall Schedule**	**Outside Diameter**	**Nominal Wall Thickness**	**Max. Thread Depth**	**Allowable Pressure (PSIG)**	**SW Fitting Pound Class**	**Allowable Pressure (PSIG)**	**Thr. Fitting Pound Class**
2	40	2.375	0.154	0.06957	2382	3000#	1119	2000#
	STD	2.375	0.154	0.06957	2382	3000#	1119	2000#
	80	2.375	0.218	0.06957	3438	3000#	2124	2000#
	XS	2.375	0.218	0.06957	3438	3000#	2124	2000#
	160	2.375	0.344	0.06957	5641	6000#	4219	3000#
	XXS	2.375	0.436	0.06957	7384	9000#	5872	6000#
2-1/2	5	2.875	0.083	(Note 7)	1037	3000#		
	10	2.875	0.120	(Note 7)	1505	3000#		
	30	2.875	0.188	0.1	2406	3000#	921	2000#
	40	2.875	0.203	0.1	2606	3000#	1109	2000#
	STD	2.875	0.203	0.1	2606	3000#	1109	2000#
	80	2.875	0.276	0.1	3610	3000#	2057	2000#
	XS	2.875	0.276	0.1	3610	3000#	2057	2000#
	160	2.875	0.375	0.1	5022	(Note 3)	3387	3000#
	XXS	2.875	0.552	0.1	6456	(Note 3)	5333	6000#
3	5	3.500	0.083	(Note 7)	848	3000#		
	10	3.500	0.120	(Note 7)	1230	3000#		
	30	3.500	0.188	0.1	1960	3000#	754	2000#
	40	3.500	0.216	0.1	2258	3000#	1038	2000#
	STD	3.500	0.216	0.1	2258	3000#	1038	2000#
	80	3.500	0.300	0.1	3198	3000#	1923	2000#
	XS	3.500	0.300	0.1	3198	3000#	1923	2000#
	160	3.500	0.438	0.1	4797	(Note 3)	3458	3000#
	XXS	3.500	0.600	0.1	6818	(Note 3)	5380	6000#
3-1/2	5	4.000	0.083	(Note 7)	741	3000#		
	10	4.000	0.120	(Note 7)	1073	3000#		
	30	4.000	0.188	0.1	1706	3000#	659	2000#
	40	4.000	0.226	0.1	2062	3000#	1000	2000#
	STD	4.000	0.226	0.1	2062	3000#	1000	2000#
	80	4.000	0.318	0.1	2944	3000#	1846	2000#
	XS	4.000	0.318	0.1	2944	3000#	1846	2000#
	XXS	4.000	0.636	0.1	6256	(Note 3)	5030	6000#

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Pressure Rating of Metallic Seamless Piping Notes 1,5,6,8

Butt Welding, Socket Welding, and Threaded

Sample Materials: A-53 Gr. B, A-106 Gr. B, A-516 Gr. 60, SE = 20,000 PSIG
A-312 Grades TP304, TP316, and TP347 Max. Temp. = 100 °F

					WELDED(Note 2)		THREADED(Note 2)	
Nominal Pipe Size	**Wall Schedule**	**Outside Diameter**	**Nominal Wall Thickness**	**Max. Thread Depth**	**Allowable Pressure (PSIG)**	**SW Fitting Pound Class**	**Allowable Pressure (PSIG)**	**Thr. Fitting Pound Class**
4	5	4.500	0.083	(Note 7)	657	3000#		
	10	4.500	0.120	(Note 7)	951	3000#		
	30	4.500	0.188	0.1	1511	3000#	585	2000#
	40	4.500	0.237	0.1	1910	3000#	970	2000#
	STD	4.500	0.237	0.1	1910	3000#	970	2000#
	80	4.500	0.337	0.1	2767	3000#	1796	2000#
	XS	4.500	0.337	0.1	2767	3000#	1796	2000#
	120	4.500	0.438	0.1	3653	(Note 3)	2649	2000#
	160	4.500	0.531	0.1	4506	(Note 3)	3470	3000#
	XXS	4.500	0.674	0.1	5859	(Note 3)	4771	6000#
5	5	5.563	0.109		693	(Note 3)		(Note 4)
	10	5.563	0.134		856	(Note 3)		(Note 4)
	40	5.563	0.258		1680	(Note 3)		(Note 4)
	STD	5.563	0.258		1680	(Note 3)		(Note 4)
	80	5.563	0.375		2475	(Note 3)		(Note 4)
	XS	5.563	0.375		2475	(Note 3)		(Note 4)
	120	5.563	0.500		3361	(Note 3)		(Note 4)
	160	5.563	0.625		4269	(Note 3)		(Note 4)
	XXS	5.563	0.750		5208	(Note 3)		(Note 4)
6	5	6.625	0.109		580	(Note 3)		(Note 4)
	10	6.625	0.134		717	(Note 3)		(Note 4)
	40	6.625	0.280		1524	(Note 3)		(Note 4)
	STD	6.625	0.280		1524	(Note 3)		(Note 4)
	80	6.625	0.432		2391	(Note 3)		(Note 4)
	XS	6.625	0.432		2391	(Note 3)		(Note 4)
	120	6.625	0.562		3158	(Note 3)		(Note 4)
	160	6.625	0.719		4110	(Note 3)		(Note 4)
	XXS	6.625	0.864		5023	(Note 3)		(Note 4)
8	5	8.625	0.109		444	(Note 3)		(Note 4)
	10	8.625	0.148		610	(Note 3)		(Note 4)
	20	8.625	0.250		1037	(Note 3)		(Note 4)
	30	8.625	0.277		1148	(Note 3)		(Note 4)
	40	8.625	0.322		1343	(Note 3)		(Note 4)

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Pressure Rating of Metallic Seamless Piping Notes 1,5,6,8

Butt Welding, Socket Welding, and Threaded

Sample Materials: A-53 Gr. B, A-106 Gr. B, A-516 Gr. 60, SE = 20,000 PSIG
A-312 Grades TP304, TP316, and TP347 Max. Temp. = 100 °F

					WELDED(Note 2)		THREADED(Note 2)	
Nominal Pipe Size	**Wall Schedule**	**Outside Diameter**	**Nominal Wall Thickness**	**Max. Thread Depth**	**Allowable Pressure (PSIG)**	**SW Fitting Pound Class**	**Allowable Pressure (PSIG)**	**Thr. Fitting Pound Class**
8	STD	8.625	0.322		1343	(Note 3)		(Note 4)
	60	8.625	0.406		1702	(Note 3)		(Note 4)
	80	8.625	0.50		2117	(Note 3)		(Note 4)
	XS	8.625	0.50		2117	(Note 3)		(Note 4)
	100	8.625	0.594		2534	(Note 3)		(Note 4)
	120	8.625	0.719		3098	(Note 3)		(Note 4)
	140	8.625	0.812		3530	(Note 3)		(Note 4)
	XXS	8.625	0.875		3824	(Note 3)		(Note 4)
	160	8.625	0.906		3970	(Note 3)		(Note 4)
10	5	10.750	0.134		439	(Note 3)		(Note 4)
	10	10.750	0.165		542	(Note 3)		(Note 4)
	20	10.750	0.250		828	(Note 3)		(Note 4)
	30	10.750	0.307		1021	(Note 3)		(Note 4)
	40	10.750	0.365		1216	(Note 3)		(Note 4)
	STD	10.750	0.365		1216	(Note 3)		(Note 4)
	60	10.750	0.50		1685	(Note 3)		(Note 4)
	XS	10.75	0.50		1685	(Note 3)		(Note 4)
	80	10.75	0.594		2013	(Note 3)		(Note 4)
	100	10.75	0.719		2455	(Note 3)		(Note 4)
	120	10.75	0.844		2906	(Note 3)		(Note 4)
	140	10.75	1.000		3483	(Note 3)		(Note 4)
	160	10.75	1.125		3951	(Note 3)		(Note 4)
12	5	12.75	0.156		434	(Note 3)		(Note 4)
	10	12.75	0.180		501	(Note 3)		(Note 4)
	20	12.75	0.250		697	(Note 3)		(Note 4)
	30	12.75	0.330		923	(Note 3)		(Note 4)
	STD	12.75	0.375		1051	(Note 3)		(Note 4)
	40	12.75	0.406		1139	(Note 3)		(Note 4)
	XS	12.75	0.500		1413	(Note 3)		(Note 4)
	60	12.75	0.562		1593	(Note 3)		(Note 4)
	80	12.75	0.688		1963	(Note 3)		(Note 4)
	100	12.75	0.844		2428	(Note 3)		(Note 4)
	120	12.75	1.000		2905	(Note 3)		(Note 4)

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Pressure Rating of Metallic Seamless Piping Notes 1,5,6,8

Butt Welding, Socket Welding, and Threaded

Sample Materials: A-53 Gr. B, A-106 Gr. B, A-516 Gr. 60, SE = 20,000 PSIG
A-312 Grades TP304, TP316, and TP347 Max. Temp. = 100 °F

					WELDED(Note 2)		THREADED(Note 2)	
Nominal Pipe Size	**Wall Schedule**	**Outside Diameter**	**Nominal Wall Thickness**	**Max. Thread Depth**	**Allowable Pressure (PSIG)**	**SW Fitting Pound Class**	**Allowable Pressure (PSIG)**	**Thr. Fitting Pound Class**
12	XXS	12.75	1.000		2905	(Note 3)		(Note 4)
	140	12.75	1.125		3290	(Note 3)		(Note 4)
	160	12.75	1.312		3881	(Note 3)		(Note 4)
14	5	14	0.156		395	(Note 3)		(Note 4)
	10	14	0.250		634	(Note 3)		(Note 4)
	20	14	0.312		792	(Note 3)		(Note 4)
	30	14	0.375		955	(Note 3)		(Note 4)
	STD	14	0.375		955	(Note 3)		(Note 4)
	40	14	0.438		1119	(Note 3)		(Note 4)
	XS	14	0.500		1284	(Note 3)		(Note 4)
	60	14	0.594		1531	(Note 3)		(Note 4)
	80	14	0.750		1947	(Note 3)		(Note 4)
	100	14	0.938		2461	(Note 3)		(Note 4)
	120	14	1.094		2892	(Note 3)		(Note 4)
	140	14	1.250		3334	(Note 3)		(Note 4)
	160	14	1.406		3780	(Note 3)		(Note 4)
16	5	16	0.165		363	(Note 3)		(Note 4)
	10	16	0.250		554	(Note 3)		(Note 4)
	20	16	0.312		692	(Note 3)		(Note 4)
	30	16	0.375		834	(Note 3)		(Note 4)
	STD	16	0.375		834	(Note 3)		(Note 4)
	40	16	0.500		1120	(Note 3)		(Note 4)
	XS	16	0.500		1120	(Note 3)		(Note 4)
	60	16	0.656		1477	(Note 3)		(Note 4)
	80	16	0.844		1916	(Note 3)		(Note 4)
	100	16	1.031		2362	(Note 3)		(Note 4)
	120	16	1.219		2818	(Note 3)		(Note 4)
	140	16	1.438		3356	(Note 3)		(Note 4)
	160	16	1.594		3749	(Note 3)		(Note 4)
18	5	18	0.165		322	(Note 3)		(Note 4)
	10	18	0.250		491	(Note 3)		(Note 4)
	20	18	0.312		614	(Note 3)		(Note 4)
	STD	18	0.375		740	(Note 3)		(Note 4)

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Pressure Rating of Metallic Seamless Piping Notes 1,5,6,8

Butt Welding, Socket Welding, and Threaded

Sample Materials: A-53 Gr. B, A-106 Gr. B, A-516 Gr. 60, SE = 20,000 PSIG
A-312 Grades TP304, TP316, and TP347 Max. Temp. = 100 °F

					WELDED(Note 2)		THREADED(Note 2)	
Nominal Pipe Size	**Wall Schedule**	**Outside Diameter**	**Nominal Wall Thickness**	**Max. Thread Depth**	**Allowable Pressure (PSIG)**	**SW Fitting Pound Class**	**Allowable Pressure (PSIG)**	**Thr. Fitting Pound Class**
18	30	18	0.438	[redacted]	866	(Note 3)	[redacted]	(Note 4)
	XS	18	0.500		993	(Note 3)		(Note 4)
	40	18	0.562		1118	(Note 3)		(Note 4)
	60	18	0.750		1502	(Note 3)		(Note 4)
	80	18	0.938		1894	(Note 3)		(Note 4)
	100	18	1.156		2352	(Note 3)		(Note 4)
	120	18	1.375		2824	(Note 3)		(Note 4)
	160	18	1.781		3720	(Note 3)		(Note 4)
20	5	20	0.188		332	(Note 3)		(Note 4)
	10	20	0.250		442	(Note 3)		(Note 4)
	20	20	0.375		665	(Note 3)		(Note 4)
	STD	20	0.375		665	(Note 3)		(Note 4)
	30	20	0.500		892	(Note 3)		(Note 4)
	XS	20	0.500		892	(Note 3)		(Note 4)
	40	20	0.594		1062	(Note 3)		(Note 4)
	60	20	0.812		1464	(Note 3)		(Note 4)
	80	20	1.031		1872	(Note 3)		(Note 4)
	100	20	1.281		2347	(Note 3)		(Note 4)
	120	20	1.500		2772	(Note 3)		(Note 4)
	140	20	1.750		3262	(Note 3)		(Note 4)
	160	20	1.969		3701	(Note 3)		(Note 4)
22	5	22	0.188		302	(Note 3)		(Note 4)
	10	22	0.250		401	(Note 3)		(Note 4)
	20	22	0.375		604	(Note 3)		(Note 4)
	STD	22	0.375		604	(Note 3)		(Note 4)
	30	22	0.500		809	(Note 3)		(Note 4)
	XS	22	0.500		809	(Note 3)		(Note 4)
	60	22	0.875		1433	(Note 3)		(Note 4)
	80	22	1.125		1855	(Note 3)		(Note 4)
	100	22	1.375		2287	(Note 3)		(Note 4)
	120	22	1.625		2726	(Note 3)		(Note 4)
	140	22	1.875		3173	(Note 3)		(Note 4)
	160	22	2.125		3625	(Note 3)		(Note 4)

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Pressure Rating of Metallic Seamless Piping Notes 1,5,6,8

Butt Welding, Socket Welding, and Threaded

Sample Materials: A-53 Gr. B, A-106 Gr. B, A-516 Gr. 60, SE = 20,000 PSIG
A-312 Grades TP304, TP316, and TP347 Max. Temp. = 100 °F

					WELDED(Note 2)		THREADED(Note 2)	
Nominal Pipe Size	**Wall Schedule**	**Outside Diameter**	**Nominal Wall Thickness**	**Max. Thread Depth**	**Allowable Pressure (PSIG)**	**SW Fitting Pound Class**	**Allowable Pressure (PSIG)**	**Thr. Fitting Pound Class**
24	5	24	0.218		320	(Note 3)		(Note 4)
	10	24	0.250		368	(Note 3)		(Note 4)
	20	24	0.375		553	(Note 3)		(Note 4)
	STD	24	0.375		553	(Note 3)		(Note 4)
	XS	24	0.500		741	(Note 3)		(Note 4)
	30	24	0.562		834	(Note 3)		(Note 4)
	40	24	0.688		1024	(Note 3)		(Note 4)
	60	24	0.969		1454	(Note 3)		(Note 4)
	80	24	1.219		1844	(Note 3)		(Note 4)
	100	24	1.531		2338	(Note 3)		(Note 4)
	120	24	1.812		2791	(Note 3)		(Note 4)
	140	24	2.062		3199	(Note 3)		(Note 4)
	160	24	2.344		3669	(Note 3)		(Note 4)

Notes for Piping Pressure Rating Table:

(1) Pressure ratings are based on ASME B31.3 “Process Piping” Code, 2002 edition.
(2) Pressure rating is shaded for thick walled pipe (t > OD / 6). The allowable pressure is based on the Mises-Hencky failure criterion instead of the standard ASME code equation. See paragraph 304.1.2(b) in ASME B31.3 for additional requirements.
(3) ANSI B16.11 socket welding fittings not available in sizes over NPS 2, except for 3000# class which is available up to size NPS 4.
(4) ANSI B16.11 threaded fittings not available in sizes over NPS 4.
(5) For sizes NPS 2 and above, the use of ANSI B16.9 butt welding fittings is recommended.
(6) Corrosion allowance used in calculating pressure ratings in this table is C_A = 0.000 inch.
(7) Pipe schedules 5 and 10 do not allow threading per ASME B1.20.1.
(8) Pressure rating for piping made of materials with an allowable stress S_b different from the one used in the table above (S_a = 20,000 psi) can be calculated by multiplying the pressure rating listed in the table by the ratio of allowable stresses, S_b/S_a.

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Appendix C – Pressure Rating of Metallic Seamless Tubing

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A.S.M.E. B31.3, Process Piping Code – 2002 Edition Notes 1, 3

Pressure Rating of Metallic Seamless Tubing

Sample Materials: A-312 Grades 304, 316, 347 Max. Temp. = 100 °F SE = 20,000 psig

Tubing Size	Outside Diameter	Nominal Wall Thickness	Minimum Wall Thickness	Maximum Wall Thickness	Minimum Inside Diameter	Maximum Inside Diameter	Allowable Working Pressure (psig) (Notes 2, 4, 5, 6)
1/8	0.125	0.010	0.009	0.011	0.103	0.107	3,056
		0.020	0.018	0.022	0.081	0.089	6,510
		0.028	0.025	0.031	0.063	0.075	7,345
		0.035	0.032	0.039	0.047	0.061	8,751
3/16	0.188	0.020	0.018	0.022	0.144	0.152	4,147
		0.028	0.025	0.031	0.126	0.138	5,952
		0.035	0.032	0.039	0.110	0.124	6,523
1/4	0.250	0.020	0.018	0.022	0.206	0.214	3,056
		0.028	0.025	0.031	0.188	0.200	4,348
		0.035	0.032	0.039	0.172	0.186	5,704
		0.049	0.044	0.054	0.142	0.162	6,698
		0.065	0.059	0.072	0.106	0.132	8,327
5/16	0.313	0.020	0.018	0.022	0.269	0.277	2,411
		0.028	0.025	0.031	0.251	0.263	3,413
		0.035	0.032	0.039	0.235	0.249	4,454
		0.049	0.044	0.054	0.205	0.225	6,335
		0.065	0.059	0.072	0.169	0.195	7,047
3/8	0.375	0.020	0.018	0.022	0.331	0.339	1,997
		0.028	0.025	0.031	0.313	0.325	2,817
		0.035	0.032	0.039	0.297	0.311	3,663
		0.049	0.044	0.054	0.267	0.287	5,180
		0.065	0.059	0.072	0.231	0.257	7,200
1/2	0.500	0.028	0.025	0.031	0.438	0.450	2,083
		0.035	0.032	0.039	0.422	0.436	2,698
		0.049	0.044	0.054	0.392	0.412	3,787
		0.065	0.059	0.072	0.356	0.382	5,212
		0.083	0.075	0.091	0.318	0.350	6,818

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A.S.M.E. B31.3, Process Piping Code – 2002 Edition Notes 1, 3

Pressure Rating of Metallic Seamless Tubing

Sample Materials: A-312 Grades 304, 316, 347 Max. Temp. = 100 °F SE = 20,000 psig

Tubing Size	Outside Diameter	Nominal Wall Thickness	Minimum Wall Thickness	Maximum Wall Thickness	Minimum Inside Diameter	Maximum Inside Diameter	Allowable Working Pressure (psig) (Notes 2, 4, 5, 6)
5/8	0.625	0.035	0.032	0.039	0.547	0.561	2,135
		0.049	0.044	0.054	0.517	0.537	2,984
		0.065	0.059	0.072	0.481	0.507	4,084
		0.083	0.075	0.091	0.443	0.475	5,310
3/4	0.750	0.035	0.032	0.039	0.672	0.686	1,767
		0.049	0.044	0.054	0.642	0.662	2,462
		0.065	0.059	0.072	0.606	0.632	3,358
		0.083	0.075	0.091	0.568	0.600	4,348
		0.095	0.086	0.105	0.540	0.578	5,050
		0.109	0.098	0.120	0.510	0.554	5,837
7/8	0.875	0.035	0.032	0.039	0.797	0.811	1,507
		0.049	0.044	0.054	0.767	0.787	2,096
		0.065	0.059	0.072	0.731	0.757	2,851
		0.083	0.075	0.091	0.693	0.725	3,681
		0.095	0.086	0.105	0.665	0.703	4,267
		0.109	0.098	0.120	0.635	0.679	4,921
1	1.000	0.035	0.032	0.039	0.922	0.936	1,314
		0.049	0.044	0.054	0.892	0.912	1,824
		0.065	0.059	0.072	0.856	0.882	2,477
		0.083	0.075	0.091	0.818	0.850	3,191
		0.095	0.086	0.105	0.790	0.828	3,694
		0.109	0.098	0.120	0.760	0.804	4,253
		0.120	0.108	0.132	0.736	0.784	4,729
1 1/4	1.250	0.049	0.044	0.054	1.142	1.162	1,449
		0.065	0.059	0.072	1.106	1.132	1,962
		0.083	0.075	0.091	1.068	1.100	2,521
		0.095	0.086	0.105	1.040	1.078	2,912
		0.109	0.098	0.120	1.010	1.054	3,346
		0.120	0.108	0.132	0.986	1.034	3,713

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A.S.M.E. B31.3, Process Piping Code – 2002 Edition Notes 1, 3

Pressure Rating of Metallic Seamless Tubing

Sample Materials: A-312 Grades 304, 316, 347 Max. Temp. = 100 °F SE = 20,000 psig

Tubing Size	Outside Diameter	Nominal Wall Thickness	Minimum Wall Thickness	Maximum Wall Thickness	Minimum Inside Diameter	Maximum Inside Diameter	Allowable Working Pressure (psig) (Notes 2, 4, 5, 6)
1 1/2	1.500	0.049	0.044	0.054	1.392	1.412	1,202
		0.065	0.059	0.072	1.356	1.382	1,624
		0.083	0.075	0.091	1.318	1.350	2,083
		0.095	0.086	0.105	1.290	1.328	2,404
		0.109	0.098	0.120	1.260	1.304	2,757
		0.120	0.108	0.132	1.236	1.284	3,056
2	2.000	0.065	0.059	0.072	1.856	1.882	1,209
		0.083	0.075	0.091	1.818	1.850	1,546
		0.095	0.086	0.105	1.790	1.828	1,781
		0.109	0.098	0.120	1.760	1.804	2,040
		0.120	0.108	0.132	1.736	1.784	2,258
		0.134	0.121	0.147	1.706	1.758	2,543

Notes for Tubing Pressure Rating Table:

(1) Pressure ratings are based on ASME B31.3 Process Piping Code, 2002 Edition.

(2) Pressure rating is shaded for thick walled tubing (t > OD / 6). The allowable pressure is based on the Mises-Hencky failure criterion instead of the standard ASME code equation. See paragraph 304.1.2(b) in ASME B31.3 for additional requirements.

(3) Corrosion allowance used in calculating pressure ratings in this table is C_A = 0.000 inch.

(4) Pressure rating for soft copper tubing conforming to ASTM B-280 (060 temper) or ASTM B-88 (050 and 060 tempers) is 30% of the corresponding allowable working pressures listed in the table above.

(5) Pressure rating for non-brazed hard copper tubing conforming to ASTM B-88 (H temper) is 60% of the corresponding allowable working pressures listed in the table above. Pressure rating for brazed hard copper tubing conforming to ASTM B-88 is 30% of the corresponding allowable working pressures listed in the table above.

(6) Pressure rating for carbon steel tubing conforming to SAE 1025 (AMS 5075) is 84% of the corresponding allowable working pressures listed in the table above.

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Langley Research Center

LPR 1710.42

Effective Date: March 23, 2007

Expiration Date: April 23, 2012

SAFETY PROGRAM FOR THE MAINTENANCE OF GROUND-BASED PRESSURE VESSELS AND PRESSURIZED SYSTEMS

National Aeronautics and Space Administration

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Responsible Office: Safety and Mission Assurance Office

P.1 PURPOSE

This Langley Procedural Requirement (LPR) implements NPD 8710.5, "NASA Safety Policy for Pressure Vessels and Pressurized Systems," in conjunction with LPR 1710.40, "Langley Research Center Pressure Systems Handbook." This LPR provides details for maintaining pressure system safety through the use of documentation, inservice inspection, maintenance, operation procedures, and training.

P.2 APPLICABILITY

This procedural requirement applies to all persons performing work at Langley Research Center (LaRC), including civil servants, contractors, research associates, and others. Non-compliance with this LPR will result in appropriate disciplinary action that may include termination for a civil servant employee or exclusion from the Center for a contractor employee, research associate or others.

P.3 AUTHORITY

a. NPD 8710.5, "NASA Safety Policy for Pressure Vessels and Pressurized Systems."

P.4 REFERENCE

a. LPR 1710.40, "Langley Research Center Pressure Systems Handbook"

b. LPR 1710.41, "Langley Research Center Standard for the Evaluation of Socket and Branch Connection Welds."

c. LPR 1740.4, "Facility System Safety Analysis and Configuration Management."

d. LPR 1740.7, "Process Systems Certification Program."

e. LMS-TD-5569, "Performing Visual Inspections."

f. OSHA 29 CFR Part 1910, Subparts 1910.134 through 1910.140.

g. OSHA 29 CFR Part 1910, Subpart L.

h. Department of Transportation (DOT) regulations, 49 CFR Parts 171 through 180.

i. ASME Boiler and Pressure Code, Sections VI, VII and VIII.

j. CID 1150.2, "Councils, Boards, Panels, Committees, Teams, and Groups."

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P.5 CANCELLATION

LPR 1710.42, “Safety Program for Maintenance of Ground Based Pressure Vessels and Pressurized Systems,” dated July 22, 2004.

Original signed on file

Lesa B. Roe
Director

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Chapter 1

1. INTRODUCTION

1.1. PURPOSE

The purpose of this LPR is to establish the procedural requirements to document LaRC's approach to ensuring the safety of ground-based pressure vessels and systems. This pressure system safety program consists of five elements: documentation, inservice inspection, maintenance, operation, and training, as depicted in Figure 1-1. The first three of these elements, documentation, inservice inspection, and maintenance, make up the LaRC Pressure Systems Recertification Program (RECERT).

1.2. APPLICABILITY

a. This LPR is applicable to all pressurized systems at LaRC.

b. The following systems are excluded from the documentation and inservice inspection requirements described in this LPR because they do not present sufficient risk to warrant other than normal maintenance, operation, and training practices:

(1) **Low Energy Systems –** The following categories of systems are excluded provided they are installed and maintained in accordance with standard practices using code acceptable materials:

(a) Water vessels or systems operating at pressures less than 125 psig and temperatures less than 130°F.

(b) Vessels or systems containing air or inert gases, with a volume less than 40 cubic feet water volume, operating at less than 125 psig and 130°F (equates to an energy content less than 5000 psi-ft^3).

(c) Vacuum vessels with volumes not exceeding 100 cubic feet water volume and vacuum piping systems with nominal diameter less than 20 inches.

(2) **AIR-PAK Rescue Equipment or Other Self-Sustaining Breathing Apparatus –** These items shall comply with OSHA regulations in 29 CFR Part 1910, Subparts 1910.134 through 1910.140.

(3) **Fire Extinguishers –** These items are covered by OSHA regulations in 29 CFR Part 1910, Subpart L, and include (1) portable extinguishers, (2) stand pipe and hose systems, (3) automatic sprinkler systems, (4) fixed dry and wet chemical extinguishing systems, (5) carbon dioxide extinguishing systems, and (6) alternative gas (environmentally friendly) extinguishing systems.

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(4) **Over-the-Road Trailers –** Over the road trailers shall comply with the Department of Transportation (DOT) regulations, 49 CFR Parts 171 through 180.

(5) **Heating and Power Boilers –** Heating boilers shall comply with the ASME Boiler and Pressure Code, Section VI. Power boilers shall comply with the ASME Boiler and Pressure Code, Section VII.

(6) **Refrigeration Systems –** Refrigeration systems with energy content[1] less than 500 psi-in[2] are excluded. Maintenance and operation shall follow the practices recommended by the manufacturer.

[1] The energy content of a refrigeration system is defined as the product of the maximum operating pressure, in pounds per square inch gage, times the square of the pipe diameter, in inches squared.

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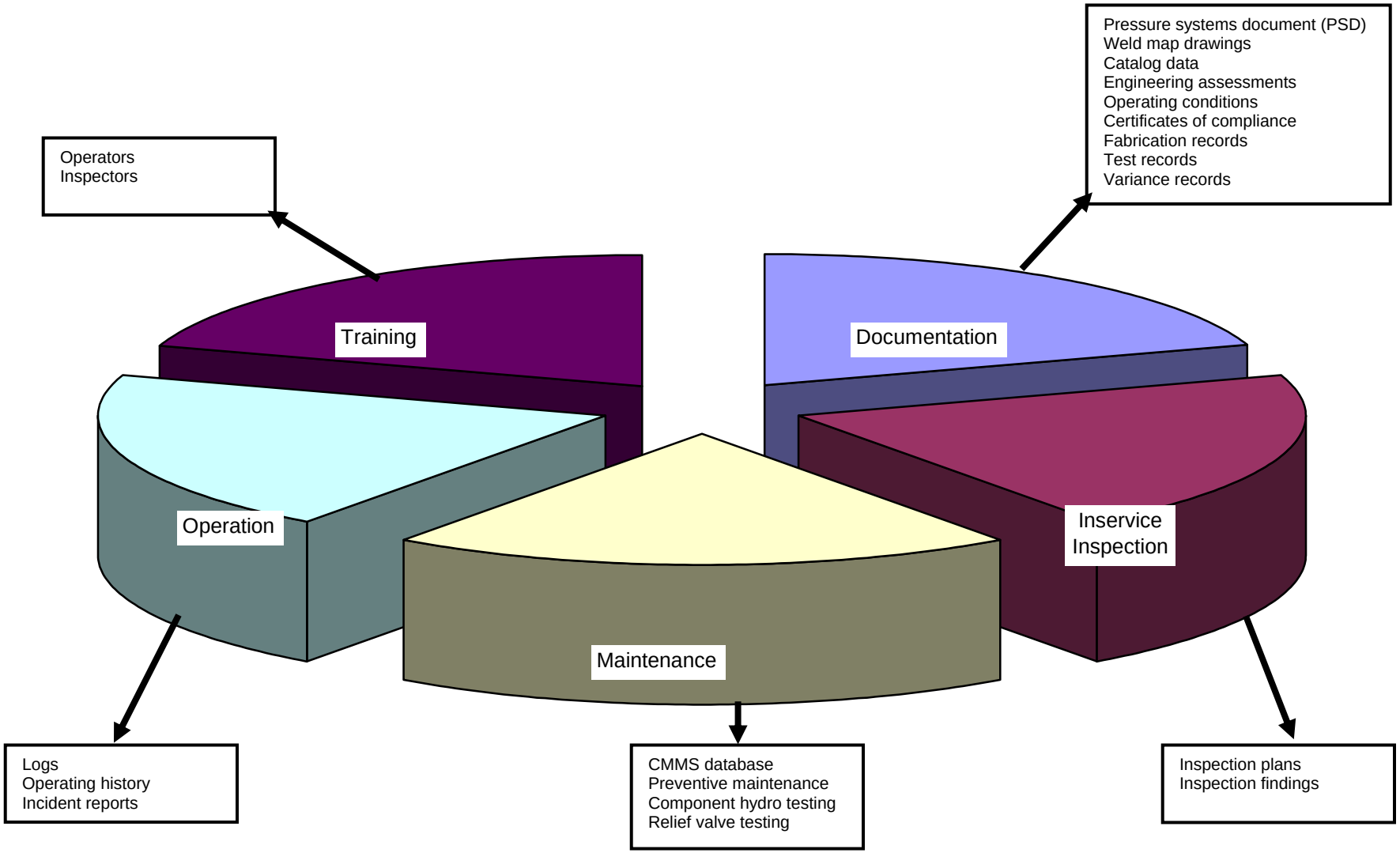

Figure 1-1 The Five Elements of LaRC's Pressure Systems Safety Program

1.3. RESPONSIBILITIES

1.3.1. Executive Safety Council (ESC)

a. The Executive Safety Council (ESC) reviews and approves/disapproves written requests for variances or deviations from established NASA policy on pressure systems that have been recommended for approval by the Pressure Systems Committee (PSC).

1.3.2. Pressure Systems Committee (PSC)

The membership of the PSC is documented in CID 1150.2, "Councils, Boards, Panels, Committees, Teams, and Groups." Among its members, the committee shall include the Pressure Systems Manager and a representative from the Safety and Facility Assurance Branch (SFAB), Safety and Mission Assurance Office (SMAO). The PSC:

a. Reviews and recommends for approval or disapproval requests for deviation from the requirements of NPD 8710.5, "NASA Safety Policy for Pressure Vessels and Pressurized Systems," LPR 1710.40, "LaRC Pressure Systems Handbook," and this LPR.
b. Identifies specific pressure systems or categories of pressure systems that need not be subject to the requirements of NPD 8710.5 and documents the rationale for the exclusion.
c. In concert with the SFAB, SMAO, provides oversight of the LaRC Pressure Systems Recertification Program and conducts quarterly progress reviews of the scheduled in-service inspections. Delinquent inspections shall be highlighted to the PSM and plans for completing the delinquent inspections and/or removing the lapsed system(s) from service shall be developed. The PSC Chair shall provide a summary status of the quarterly reviews to the ESC on a semi-annual basis.

1.3.3. Pressure Systems Manager (PSM)

The Pressure Systems Manager (PSM) is designated by the LaRC Center Director as required by NPD 8710.5. The PSM:

a. Serves as a member of the PSC, acting as the committee's primary advisor on matters relating to the applicability of National Consensus Codes to LaRC pressure systems.
b. Ensures referral to the PSC when a pressure system does not comply with the code requirements in LPR 1710.40.
c. Evaluates requests for variances and forwards them to the PSC for action. See Appendix B for details on variances.
d. Ensures that all LaRC pressure vessels/systems are certified in compliance with applicable codes, standards, and guidelines.
e. Evaluates and approves new designs and modifications to pressure systems.
f. Manages and oversees the implementation of the LaRC RECERT program.

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g. Maintains an inventory of all pressure systems at LaRC. The inventory, among other things, keeps track of the current RECERT program phase (1, 2, or 3) of all pressure systems as well as their current operational status (Active, Inactive, or Standby).
h. Ensures that necessary documentation to support the recertification program is available for all pressure systems.
i. Ensures that a Pressure Systems Document (PSD) is prepared for each pressure systems in the LaRC RECERT program.
j. Controls the retention of all pressure system certification/recertification documents as part of a recertification file for each system.
k. Assigns priorities to pressure systems for the purpose of field surveys and non-destructive examination (NDE).
l. Approves disposition (e.g., derate, repair, scrap) of all pressure systems which do not meet the requirements of this LPR.
m. Submits proposed deviations to the PSC when appropriate.
n. Prepares and forwards a RECERT Program Status Report annually to the ESC. The status report shall indicate the anticipated inspection/repair time frames for all PHASE 1 or 2 systems.
o. Reviews/approves all Inspection Plans (IP) for all pressure systems.
p. Provides guidance to Project Managers (PM's) in the requirements for initial certification of pressure systems.
q. In the event that a pressure system is transferred from LaRC to another installation, either by physical movement or through transfer of responsibility to an outside agent, the PSM ensures that an appropriate recertification file is forwarded with it.

1.3.4. Contracting Officer's Technical Representative (COTR) for the Research, Operations, Maintenance, and Engineering (ROME) Contract

In support of the LaRC pressure systems safety program, the ROME COTR shall ensure the ROME Contractor:

a. Formulates a 3-year pressure systems recertification plan.
b. Develops a Pressure Systems Document (PSD) for each pressure system covered by this LPR and maintains them under configuration control in the LaRC Configuration Management On-Line (CMOL) system.
c. Maintains additional supporting documentation for pressure systems, e.g., NDE results, manufacturer's catalog data, analyses, and approved variances.
d. Performs engineering assessments and provides the PSM with recommendations regarding the disposition of pressure system components.
e. Prepares an Inspection Plan (IP) to ensure continued system integrity through periodic inspections based on the guidance provided by this LPR.
f. Performs non-destructive evaluation (NDE) of existing pressure systems to assess their structural integrity.
g. Performs inspections as required by the IP.
h. Performs preventive maintenance on pressure systems in accordance with the Computerized Maintenance Management System (CMMS).
i. When directed, repairs major deficiencies discovered during non-destructive

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examinations and analyses.

j. Enters information into the CMMS from maintenance input data sheets completed by either the FC or by ROME contractor personnel.
k. Tests, tags, and maintains logs of relief valves. The logs keep track of the date tested, valve number, pressure set-point, and any adjustments or repairs made to the relief valves.
l. Reports to the PSM at the beginning of the last quarter of the calendar year whenever the annual requirements of the RECERT program will not be met.

1.3.5. Facility Safety Head (FSH)

Every facility at LaRC has a Facility Safety Head (FSH) who is nominated by the line organization and approved by the Vice-Chairperson of the ESC. The FSH shall:

a. Review inservice inspection plans (IP).
b. Ensure that personnel training and facility operational knowledge of procedures for working with pressure vessels and systems are current. Qualified operators shall be certified in writing per LPR 1740.7, “Process System Certification Program.”
c. Coordinate pressure systems training as required. General pressure system safety training shall be conducted after system modifications and after any extended “down” period.
d. Maintain pressure system training records for personnel assigned to the facility.
e. Review operational procedures and ensure that changes, modifications, or alterations are appropriately reflected.
f. Maintain current log of operations.
g. Review results of periodic inspections performed by the ROME Contractor and, if necessary, establish a contingency plan for correcting rejectable deficiencies noted in the inspection report.

1.3.6. Facility Coordinator (FC)

Every facility at LaRC has a Facility Coordinator (FC) who is appointed by the line organization and the FSH. The FC shall:

a. Initiate maintenance requests for repairs and/or facility modifications.
b. Submit new work requests as required.
c. Review all applicable computerized maintenance sheets for accuracy and submit changes to the Maintenance Manager.
d. Coordinate with the PSM and the ROME Contractor for walk-through of pressure systems to verify/update Pressure Systems Documents (PSD's).

1.3.7. Project Managers (PM)

Project Managers (PM) shall:

a. Initiate a Change Notification Sheet (CNS) to document changes to pressure systems affected by their project.
b. Ensure that an inspector is assigned to inspect all new pressure system installations, alterations, repairs, and modifications.
c. Ensure their projects comply with applicable pressure system standards, codes, and regulations or ensure that deviations have been approved by the PSM or the PSC,

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as applicable.

d. Provide written certification to the FSH that a pressure system installation was performed in accordance with LPR 1710.40, “LaRC Pressure Systems Handbook” prior to re-energizing a pressure system.
e. Ensure that documentation (see Chapter 2 for types of documentation) regarding the components used in the modification, alteration, or construction of pressure systems is obtained during the course of the project. The PM shall turn over this documentation to the PSM after the completion of Operational Readiness Review (ORR) or the final Systems Operations Committee (SOC) review.
f. Obtain guidance from the PSM regarding the requirements for pressure system documentation.

1.3.8. Center Operations Directorate (COD)

The Center Operations Directorate (COD) shall designate persons with the following responsibilities:

a. Managing and overseeing the LaRC Maintenance Program.
b. Managing and overseeing the LaRC RECERT Program.
c. Ensuring the information in the CMMS database is accurate.
d. Maintaining historical maintenance information.

1.3.9. Construction Inspection Contractor

The COTR for the Quality Assurance and Inspection (QAI) contract shall ensure the Construction Inspector.

a. Ensures that all new installations, alterations, repairs, and modifications of pressure systems meet the requirements of the specifications.
b. Witnesses all tests (hydrostatic, pneumatic, or operational) as required by the specifications.
c. Coordinates with the PM to resolve any problems with the interpretation of the specifications.
d. Verifies that the calibration of a Contractor’s test apparatus is current before use.

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Chapter 2

2. RECERT PROGRAM

2.1. GENERAL

The RECERT program is an Agency-wide program mandated by NPD 8710.5, "NASA Safety Policy for Pressure Vessels and Pressurized Systems." The main purpose of this NASA safety program is to manage the risk to people, facilities, and the environment posed by pressurized systems. This risk management is accomplished via compliance with national consensus codes, documentation, non-destructive examination (NDE), engineering assessments, repairs, and periodic inspections.

2.2. METHODOLOGY

The RECERT program is subdivided into three phases of work. A brief description of what is accomplished in each phase and the risk assessment associated with the pressure system within each phase is provided in Table 2-1.

Table 2-1, Brief Description of RECERT Phases and Associated Risk Codes.

Phase	Existing System	Typically Associated RAC(*)
1	Available documentation is gathered and a field survey of all components is performed. An engineering assessment of system integrity is conducted, which may include the nondestructive examination of a 10 percent sampling of welds and high stress areas. A PSD and a weld map are developed.	RAC 1 (I-B) for systems not built to a national consensus code RAC 3 (I-D) for systems built to a national consensus code
2	Up to 100 percent NDE is performed, depending on the results of the Phase 1 engineering assessment. Any necessary repairs are conducted. An inspection plan is developed.	RAC 1 (I-C) for systems not built to a national consensus code if no emergency repairs required. RAC 1 (I-A) if emergency repairs are required. RAC 3 (I-D) for systems built to a national consensus code
3	Periodic inspections are performed in accordance with the developed inspection plan.	RAC 3 (I-D) for all systems

(*) Particular conditions of a system may alter the risk assessment codes shown here

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2.3. SYSTEM PRIORITIZATION

The PSM determines the order of priority for the recertification of pressure systems based on criteria such as stored energy (pressure times volume), cyclic duty, environmental considerations (susceptibility to erosion/corrosion), number and proximity of personnel, cost of replacement, schedule impact, and age.

2.4. RECERT PHASE 1

a. The primary products of Phase 1 shall be (a) a pressure system component database, (b) a pressure system document (PSD), (c) weld maps, (d) a weld database, and (e) a recertification file. During this Phase, the ROME Contractor shall develop recommendations of actions for each specific system component, such as performing repairs, conducting additional tests, removal from service, de-rating, or recertification.

b. Specific responsibilities for the activities that are performed during Phase 1 depend on whether the system is an existing system or a new/modified system, as follows:

2.4.1. Systems Built to a National Consensus Code

For pressure systems built to a national consensus code, after the Operational Readiness Review (ORR) or final Systems Operations Committee (SOC) review, the Project Manager (PM) shall send to the PSM all documentation required for the establishment of the Pressure System Document and any other pertinent information to be stored in a recertification file. See section 2.4.8 for a detailed description of the data/documentation required. It shall be the responsibility of each PM to gather the required documentation for the development of the RECERT documentation for new systems. For those cases where original manufacturer's documentation is not available, the PM shall be required to conduct all necessary field surveys, NDE, and/or pressure system analyses to develop equivalent documentation. After the documentation is gathered, it shall be forwarded to the ROME Contractor for inclusion in the system's recertification file. The ROME Contractor shall conduct field surveys as needed to validate the completeness of the provided documentation.

2.4.2. Systems with Uncertain National Consensus Code Compliance

For existing systems where compliance with national consensus codes is uncertain, the ROME Contractor shall gather any available documentation and evaluate it for completeness. For those cases where original documentation is not available, the ROME Contractor shall additionally conduct field surveys to identify all system components and perform any required analyses to develop equivalent documentation. The ROME Contractor shall then perform a 10 percent-sampling nondestructive examination of welds and high stress areas.

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2.4.3. Field Surveys for the Development of the Pressure Systems Document

a. Detailed field surveys shall generally be accomplished to collect data on pressure system components, such as pipe sizes, wall schedules, flange and valve class ratings, manufacturer's nameplate data, relief valve set point and capacity, and the location of all welds and support structures.

b. The component information gathered during the field surveys shall be entered into a pressure system component database. After conducting the field surveys, the ROME Contractor shall produce isometric sketches showing each component in the system. Figure 2-2 shows a sample of a component database sheet from a typical PSD. Details of the information that shall be included in each column of a component database sheet are listed in Figure 2-3. The component database and the sketches shall be used to create a Pressure Systems Document (PSD) for each pressure system. In addition to gathering the information in the component database and the isometric drawings, field surveys shall be used to create weld identification drawings for the system, also known as weld maps.

c. The ROME Contractor shall be responsible for the inclusion of the PSD and the weld maps in the Configuration Management On-Line (CMOL) system.

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FACILITY: BLDG. 1247E, WAA 01-6000A-PSCM
SYSTEM: 6000 PSI AIR SAMPLE APR 1, 1997
REFERENCE SKETCH: 60-A-1

NO.	Component	END	Manufacturer/Description	Material	Installation	Inspection	Rated Pressure	Working Pressure	Code	Analysis	NDE	Foot Notes	Reference	Rec
1	PIPE ELL	SW	VOGT 2”, 6000 CWP	STEEL	12/64	12/92	6000	6000	B11	MC	V	3	D1,D4,E3,S1	RC
2	PIPE ELL	SW	BONNY FORGE 2’, 6000#	A105	12/64	12/92	6599	6000	B11	MC	V	62	D1,D4,E3,S1	RC
3	PRE FILTER	BW	DOLLINGER 2’, S/N 30781 6500 PSI, “U’ STAMP	STEEL	06/76	12/92	6500	6000	81	ES	V		D1,D4,E3	RC
4	BUSHING	TH	UNKNOWN 1/2 X 1/4”	STEEL	06/76	12/92	12250	6000	B11	CE/PS	V	3	D1	RC
4A	MALE ELL	TH	CRAWFORD 1/4”, 1/8” SS TUBE	STAINLESS	06/76	12/92	9352	6000	N/A	MC/TC	V	40	D1	RC
5	MALE CONNECTOR	TH	UNKNOWN 1/4”, 1/8” SS TUBE	STAINLESS	06/76	12/92	6500	6000	SA5	CE	V	8	D1	RC
6	DIFFERENTIAL PRESSURE GAUGE	TH	ORANGE RESEARCH, INC. 1/4”, M/N 1202 PG-1-2 0-100 PSID RANGE	STEEL	06/76	12/92	9352	6000	N/A	TC	V	58	D1	RC
7	MALE CONNECTOR	TH	UNKNOWN 1/4”, 1/8” SS TUBE	STAINLESS	06/76	12/92	9352	6000	SA5	CE	V	8	D1	RC
8	BUSHING	TH	UNKNOWN 1/2 X 1/4”	STEEL	06/76	12/92	12250	6000	B11	CE/PS	V	3	D1	RC
8A	MALE ELL	TH	CRAWFORD 1/4”, 1/8” SS TUBE	STAINLESS	06/76	12/92	9352	6000	N/A	MC/TC	V	40	D1	RC
8T	TUBE		UNKNOWN 1/8”, T=.028”	STAINLESS	06/76	12/92	7482	6000	B3	PS	UT	4	D1,E2	RC
9	COUPLING	SW	BONNY FORGE 3/4’, 6000#	A105	06/76	12/92	8466	6000	B11	MC/PS	V		D1,D4	RC
10	PIPE ELL	SW	BONNY FORGE 3/4’, 6000#	A105	06/76	12/92	8466	6000	B11	MC/PS	V		D1,D4	RC

Figure 2-2, Sample Component Database Sheet in a Pressure System Document (PSD)

Figure 2-3, Key To Component Database Sheets.

UPPER LEFT: Facility Name and Building Number. System Name. Reference Sketch for Recertification Status Sheet. Date of latest computer printout. Page Number.
UPPER RIGHT: System Designation.

Fifteen Columns - Read Left to Right

(1) NO: Component number which can be found on the sketch referred to in the upper right of the recertification status sheet. (Example: REF SK. 60-A-1)

(2) COMPONENT: Component name. The names are derived from ANSI and SAE.

(3) END: End connection. It is listed by abbreviation: TH = threaded; SW = socket weld; BW = butt weld; FL = flanged; CW = connection weld; SO = slip on (flange only; WN = weld neck (flange only).

(4) MANUFACTURER/DESCRIPTION: Consists of the information which shall be gathered in the field. The first line gives the manufacturer (if known). The second line lists the line size of the component and also any information such as model number, class or type. The last line contains any additional information.

(5) MATERIAL: Material the component is made of or is assumed to be made of.

(6) INSTALLATION: Component's installation date.

(7) INSPECTION: Inservice inspection date.

(8) RATED PRESSURE: Maximum allowable working pressure (APRES) of the component. This number is arrived at by: information found on the component; information found in the manufacturer's catalog; comparing the components dimensions to dimensions given in the applicable code or standard; by making contact with the manufacturer by phone or by letter; or by using the pipe pressure formula from ANSI B31.

(9) WORKING PRESSURE: Working pressure (WPRES) of the system at the component's location.

(10) CODE: Code or standard that the component is designed to. These codes are abbreviated. The abbreviations are explained on the Definition of Symbols page. Entries in the CODE column come from the Manufacturer's catalogs, crossing the component's dimensions with dimensions listed in the code, or by contacting the manufacturer. ASMD in this column means assumed.

(11) ANALYSIS: Method of analyzing or evaluating the component. Abbreviations are explained on the Definition of Symbols page.

(12) NDE: Method of non-destructive examination used to evaluate the component. Abbreviations are explained on the Definition of Symbols page.

(13) FOOTNOTES: Footnotes which further explain or clarify the information for the component. Footnotes are by system and can be found on the Footnotes page.

(14) REFERENCE: NASA specifications, NASA drawings, Engineering Analysis, and Non-Destructive Examination. These can be referenced on the Recertification Document Reference List.

(15) REC: Recommendation for each component. The component is either recertified or recommended for removal, repair, derating, or waived.

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2.4.4. Evaluation Issues

a. After the initial field surveys are conducted, each component shall be analyzed to determine if they are in compliance with the applicable national consensus code. From time to time, unusual issues are encountered while evaluating the integrity of system components. Table 2-2 lists typical evaluation problems and possible solutions.

Table 2-2, Typical Evaluation Problems With Possible Solutions.

Problem Possible	Solution
Material specification unknown	a) Whenever feasible, a small sample of the material shall be removed for chemical identification. b) When obtaining a sample is not practical, the component shall be assumed to be fabricated of the lowest strength material that has similar chemistry and is used for the same application (e.g., pipes, forgings, castings, or plates)
Component cannot be reasonably analyzed using code provided formulas	a) Use other known engineering analysis methods (closed form equations or finite element analysis) and compare calculated global stresses to code allowables. b) The MAWP for components can be established by proof testing per Section UG-101, “Proof Tests to Establish Maximum Allowable Working Pressure,” of Section VIII Division 1 of the ASME B&PV Code.
Component made of known, but not Code-approved materials	For these components, equivalent Code allowable stresses to be used in analysis shall be calculated using the "Basis for Establishing Stress Values" section for the applicable Code. A variance request from the Pressure Systems Committee shall be required.

b. When the engineering evaluation indicates that all components are adequate for the system’s maximum operating pressure (relief valve setting), the analysis portion of recertification shall be considered complete. Otherwise, the system shall be listed as requiring repairs under Phase 2.

2.4.5. Nondestructive Examination

a. During Phase 1, nondestructive examination (NDE) shall be used to assess the integrity of pressure system components. The selection of the NDE technique to be used shall depend on several issues, such as a component’s material, geometry, fabrication method, and service conditions. In addition, NDE technique selection shall consider the type of defects being sought (e.g., laps and laminations in forgings and plates, voids and shrinkage in castings, slag inclusions in welds, surface cracks.)

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NDE Technique	Use for	Don't use for
X-ray (RT)(*)	• Looking for internal inclusions, voids, incomplete fusion, porosity, incomplete penetration, and improper joint fit-up	• Finding small cracks
Ultrasonic (UT)	• Looking for inclusions, voids, incomplete fusion, and incomplete penetration • Finding and characterizing sub-surface cracks and plate laminations • Determining wall thickness	• Examination of complex geometries
Eddy Current (ET)	• Finding surface or slightly below surface defects on smooth painted surfaces	• Finding deep subsurface defects
Dye penetrant (PT)	• Finding surface cracks and other defects open to the surface on clean, paint-free surfaces (e.g., surface porosity and weld undercut)	• Finding subsurface defects
Magnetic particle (MT)	• Finding surface cracks, other linear surface defects, and weld undercut on clean, paint-free surfaces	• Inspecting non-magnetic materials • Finding subsurface defects
Visual (VT)	• Finding surface defects (e.g., open cracks, corrosion, weld undercut)	• Finding subsurface defects

(*) Radiography is the preferred method of NDE for most generic applications because of the wide range of internal defects that can be detected and the fact that a permanent record (the film) is retained.

b. For the purpose of the initial engineering evaluation, nondestructive examination of non-code-stamped pressure system components shall generally consist of:

(1) Visual inspection of the entire system to look for signs of cracks, corrosion, wear, leakage, vibration, missing fasteners, broken supports, or welds with surface cracks, etc.

(2) Initial x-ray inspection of 10 percent of all welds and high stress areas. If unacceptable welds are found during the initial RT, up to 100 percent of all welds may be radiographed, at the discretion of the PSM.

c. Similarly, the initial nondestructive examination of code-stamped pressure system components shall generally consist of:

(1) Visual inspection of the component to look for signs of corrosion, wear, leakage, support deterioration, etc.

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d. The acceptance criteria that is used for evaluating NDE performed on pressure system components shall be as follows:

Type of weld	Acceptance criteria
All pressure vessel welds	Use the acceptance criteria of the applicable Division of the ASME Boiler and Pressure Vessel Code, Section VIII
Piping butt welds	Use the acceptance criteria for "Severe Cyclic Conditions" in the ASME B31.3 Process Piping code. For steam systems, use the criteria in ASME B31.1 Power Piping code.
Piping socket and branch connection welds	Use the acceptance criteria in LPR 1710.41, "Langley Research Center Standard for the Evaluation of Socket and Branch Connection Welds."

2.4.6. Pressure Vessel Evaluation

a. The procedures for evaluating pressure vessels shall be:

(1) **Code-Stamped Vessels**: Code stamping of a vessel by its manufacturer certifies that the vessel complies with all the design requirements and is fabricated following the quality control measures of the ASME Boiler and Pressure Vessel Code. No additional analysis is performed in recertifying Code-stamped vessels.

(2) **Non-Code-Stamped Vessels**: These vessels shall be analyzed using the criteria of the current edition of the ASME Code Section VIII, Division 1. Use of the more rigorous criteria in ASME Section VIII, Division 2 is allowed for vessels that do not meet the safety factor requirements of Division 1. In the event the vessel being evaluated does not meet the requirements of the current edition of the code, it is permissible to use the edition of the ASME code that was current at the time of the fabrication of the vessel.

2.4.7. Piping Component Evaluation

All piping components, except for steam piping components, shall be evaluated using the ASME B31.3 Process Piping code. All steam piping components shall be evaluated using the ASME B31.1Power Piping code. Refrigeration piping components shall be evaluated using the ASME B31.5 "Refrigeration Piping and Heat Transfer Components" code.

2.4.8. Recertification File

a. The ROME Contractor shall be responsible for creating and maintaining a recertification file for each pressure system to serve as the repository for supporting documentation and information that is not part of a Pressure Systems Document (PSD).

b. Typical documentation in the recertification file shall include, but not limited to:

(1) Stress calculations

(2) Engineering assessments

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(3) Vendor catalog sheets
(4) Manufacturer's drawings
(5) Certificates of compliance
(6) Manufacturer's U-1 or U-2 data reports for pressure vessels
(7) Special welding procedures and procedure qualifications
(8) Inspection reports
(9) Test reports
(10) Records of modifications
(11) Incident reports
(12) Record of approved variances
(13) Recertification letter

c. The engineering evaluation report shall become a part of the recertification file for the pressure system. It shall be referenced within the PSD on the document reference sheet (see Figure 2-2).

2.5. RECERT PHASE 2

The primary objectives of Phase 2 shall be to repair or replace any defective components found during the engineering evaluation part of Phase 1 and to prepare an inspection plan (IP).

2.5.1. Systems Built to a National Consensus Code

In general, repairs are not necessary for pressure systems built to a national consensus code, because they meet the requirements of LPR 1710.40, "LaRC Pressure Systems Handbook." Phase 2 for these systems shall simply consist of the preparation of an inspection plan.

2.5.2. Repairs to Systems With Uncertain National Consensus Code Compliance

a. The following actions shall be conducted during Phase 2 on these systems:

(1) If a significant number of unacceptable welds were identified in the Phase 1, up to 100 percent of all welds shall be radiographed, at the discretion of the PSM.
(2) All unacceptable welds shall be repaired.
(3) All recommended system corrective actions, such as, removal, repair, or derating of components, shall be performed.
(4) An IP shall be developed for the system.

2.5.3. Recertification letter

When all components and welds in the system satisfy the requirements of the applicable National Consensus Codes, a recertification letter shall be issued to the cognizant Facility Safety Head by the PSM or his/her designated representative. See Figure 2-4 for a sample recertification letter.

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2.5.4. Emergency Repairs

If components are identified that are not in compliance with the applicable national consensus code, the ROME Contractor shall make an assessment in conjunction with the PSM to determine whether or not the non-compliance requires emergency repair action or not. Generally, the presence of cracks or wall thicknesses below code required levels shall qualify the non-compliance for emergency repair. In these cases, an Emergency Trouble Call shall be initiated by the ROME Contractor.

2.5.5. Non-emergency Repairs

a. If non-compliant components are identified, and emergency repairs are not warranted, the non-compliant components shall be placed in a list of components to be replaced. The PSM shall then make an assessment of whether the system maximum operating pressure needs to be reduced (i.e., system is de-rated), or if additional analysis or NDE needs to be performed to ensure the non-compliant system's integrity while repair plans are advocated, designed, and implemented. In the event of a de-rating action, a letter shall be sent by the PSM to the Facility Coordinator (FC) and the Facility Safety Head (FSH) indicating the new limits of operation for the pressure system.

b. For non-emergency repairs not exceeding $50,000 in estimated value, the ROME Contractor shall initiate maintenance work orders and shall include photographs and/or sketches as necessary to describe the scope of the required repairs.

c. For non-emergency repairs exceeding $50,000 in estimated value, the ROME Contractor shall prepare a repair package including any photographs and sketches necessary to describe the scope of the required repairs. The PSM shall then be responsible for initiating any necessary funding advocacy, design, and procurement actions to accomplish the repairs.

d. A copy of the repairs conducted as a result of RECERT activities shall be kept in the recertification file.

2.5.6. Inspection Plan Development

a. The purpose of the Inspection Plan (IP) shall be to minimize risk to personnel by ensuring system integrity is maintained. Specific guidelines and recommendations for the development of inspection plans are listed in Appendix F. Guidance and recommendations from the manufacturer of a pressure system component can also be used to supplement the guidelines presented there. At the discretion of the PSM, the recommended inspection intervals in Appendix F can be shortened or lengthened based on a system's inspection history, repair history, and operating environment. As a minimum, an IP shall contain the following information:

(1) **Inspection frequency**: If the inspection plan is based on years of operation as its basis, the IP shall present at least a 10 year schedule of required inspections. If the inspection plan is based on cycles of operation, the IP shall

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present (a) the maximum number of pressure and/or thermal cycles between inspections and (b) the current cycle count. It shall be the responsibility of the owner of the pressure system to maintain a log of the pressure and thermal cycles incurred by the pressure system. The current cycle count shall be updated by the ROME Contractor at the end of each calendar year.

(2) **Inspection Procedure**: The IP lists which applicable procedure shall be followed to perform the inspections, such as LMS-TD-5569, "Performing Visual Inspections", or Section V, "Nondestructive Examination" of the ASME Boiler and Pressure Vessel Code.

(3) **Qualifications**: The IP shall clearly identify the minimum required qualifications of the personnel that will be performing the inspection, such as an ASNT Level I, II, or III.

b. The IP shall be a configuration controlled document maintained in the CMOL system.

2.5.7. Updates to the Documentation

After repairs and modifications are complete, the ROME Contractor shall be responsible for updating the applicable PSD, component database, weld maps, weld database, and recertification file. The ROME Contractor shall then issue the modified CCD documents in the CMOL system.

2.6. RECERT PHASE 3 – INSERVICE INSPECTION

The primary goal of inservice inspection shall be to verify the continued structural integrity of a pressure system. A secondary goal shall be to field verify the current Pressure System Document (PSD).

2.6.1. Performing Inservice Inspection

The ROME Contractor shall be responsible for performing the periodic inspections required by the IP's and for coordinating with the affected Facility Coordinators to schedule the required inspections.

2.6.2. Findings by the Inservice Inspections

a. The ROME Contractor shall develop a report including the results of the inservice inspections that shall be forwarded to the cognizant Facility Safety Head, the Facility Coordinator, and to the PSM. In addition, a copy of this report shall be placed in the recertification file. The inspection report shall include sufficient descriptions, redlined sketches, and/or photographs to clearly convey the findings.

b. If the results of the inservice inspections indicate that repairs are required, the affected pressure system shall be reverted to Phase 2 and the procedures for dealing with non-compliant systems in Phases 2 shall be utilized.

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National Aeronautics and
Space Administration

Langley Research Center
Hampton, VA 23681-0001

Date

447

TO: XXX/Facility Safety Head, Building _____

FROM: 447/Pressure Systems Manager, Center Operations Directorate

SUBJECT: Recertification of the _____

REF: (1) NPD 8710.5, "NASA Safety Policy for Pressure Vessels and Pressurized Systems
(2) LPR 1710.40, "Langley Research Center Pressure Systems Handbook"

The recertification analysis and inspection of the subject system is complete. All components now satisfy the requirements of References 1 and 2.

The pertinent RECERT documentation has been entered into the Pressure Systems Configuration Management system. With your assistance, this documentation will be maintained up to date.

The inspection plan for the subject system is given in the attached plan number _____.

Based upon the successful completion of the recertification analyses and inspections, the subject system is recertified for continued use.

(SIGNED)
Pressure System Manager (PSM)

Figure 2-4, Sample Recertification Letter

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Chapter 3

3. PRESSURE SYSTEMS MAINTENANCE

3.1. GENERAL

Preventive and predictive maintenance are tools used to preserve the structural integrity of a pressure system. This chapter outlines the parts of the LaRC Maintenance program that shall work together with the RECERT program to maintain pressure system integrity.

3.2. PREVENTIVE MAINTENANCE (PM) PROGRAM

a. The preventive maintenance program consists of a time-based schedule of maintenance work orders that are executed with a pre-programmed frequency. The LaRC pressure systems safety program takes advantage of the PM program of the Computerized Maintenance Management System (CMMS) by including in it the requirements for periodic testing of safety relief devices and pressure gages. The ROME Contractor shall be responsible for performing periodic maintenance in accordance with the schedule in the CMMS and for reporting completed actions to the appropriate FC and key COD personnel. The day-to-day management of the CMMS shall be performed by the ROME Contractor. The Center Operations Directorate (COD) manages the CMMS Software Change Control Board and the CMMS Maintenance Change Control Board.

b. Pressure relief valves are the most important safety devices on any pressurized system. These valves are intended to protect equipment and personnel from over pressurization events due to (a) failure of pressure regulators, (b) unexpected combustion of volatile fluids, or (c) evaporation of cryogenic liquids. The ROME Contractor shall be responsible for ensuring periodic testing of safety relief devices is conducted in accordance with the schedule in the CMMS, tagging them after servicing (see Appendix A), and returning them to service.

3.3. COMPONENT VERIFICATION FACILITY

a. The Component Verification Facility is a key element of the pressure system maintenance program. In this facility, hydrostatic testing and pneumatic testing is routinely and safely performed for the purpose of establishing the continued suitability of pressure system components.

b. Safety relief valves shall be periodically tested, refurbished, and repaired using OEM parts and procedures to ensure that these safety-critical components are operating as intended. A log of all the maintenance work performed on relief valves in operation at LaRC shall be kept at the Component Verification Facility. This log shall be considered a part of the RECERT documentation. The ROME Contractor shall be responsible for maintaining this log.

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3.4. INTERFACE WITH PRESSURE SYSTEM DOCUMENTS

As noted in Chapter 2, the recertification file shall include documentation of the changes that have occurred to a pressure system. Whenever maintenance activities result in changes that affect a configuration controlled pressure system, a Change Notification Sheet (CNS) form shall be prepared by the initiator or requester of the maintenance work. This CNS shall be intended to notify the ROME RECERT Group that updating the pressure systems documents is required.

3.5. LOCKOUT / TAGOUT (LO/TO)

Maintenance operations on pressure systems can result in injury to personnel or in damage to equipment due to the energy they contain. All pressure systems shall be locked/tagged out in accordance with the requirements in LPR 1710.10, “Safety Clearance Procedures for the Control of Hazardous Energy (Lockout/Tagout),” prior to removing components from the system or otherwise performing any maintenance activity that requires opening the system to atmosphere.

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Chapter 4

4. OPERATIONS

4.1. GENERAL

Operating procedures and operational logs are critical to the operation of pressure systems. Operational records and logs provide a continuous chronological narrative of the facility operation and a history of servicing activities conducted. In addition, these logs are used to determine trends in system performance, cyclic information, and other issues. Critical issues, incidents, or mishaps associated with pressure systems shall be reported to the SFAB, SMAO for further investigation.

4.2. STANDARD OPERATING PROCEDURES AND CHECKLISTS

Standard Operating Procedures (SOP's) are essential to the safe operation of any pressure system and shall be developed as specified in LPR 1740.4, "Facility System Safety Analysis and Configuration Management." Checklists shall be developed using the same process as the SOP to cover a particular area of system operation and to ensure that specific steps are always executed prior to, during, and after a pressure system is operated.

4.3. OPERATIONAL RECORDS AND LOGS

a. Within any particular facility, based on the judgment of the FSH and the FC, a continuous log of operations shall be maintained. This log shall denote:

(1) The type of test being conducted,
(2) The date/time/duration of the test,
(3) Cause of any delays (e.g. status lights not operating, communication difficulties, clogged filters, filling of tanks, model problems and test equipment failures), and
(4) Significant items of interest (e.g. car crash, power outage, environmental problems (storm, lightning, snow), acute illness of person(s) and fire).

b. Based on the operational complexity and/or material requirements, records pertaining to a specific component or the entire system operation shall be recorded by the operators and retained at the facility. Information recorded in these records shall include, for example, temperatures, pressures, fluid levels, and component status. The FSH shall coordinate with the PSM to determine if recording specific information is required for maintaining the system's integrity and recertification status.

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4.4. ACCIDENTS AND INCIDENTS

As defined in LPR 1740.4, “Facility System Safety Analysis and Configuration Management,” accidents, mishaps, incidents, and close calls shall be documented as specific circumstances dictate. The SFAB, SMAO is responsible for reviewing all accident, mishap, incident and close call reports to determine if pressure systems were involved and if so forward a copy to the ROME Contractor who shall be responsible for placing copies of the reports, if any, in the appropriate recertification file.

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Chapter 5

5. TRAINING

5.1. GENERAL

The introduction of the human element into a perfectly designed and controlled hardware system brings with it the potential for unexpected results. As depicted in statistics compiled by the National Board of Boiler and Pressure Vessel Inspectors, over the past several years, anywhere from 15 to 40 percent of all accidents that have occurred with unfired pressure vessels took place because of human error. Hence, the only way to minimize the occurrence of "operator error" is by using trained, knowledgeable, and qualified operators. The operator shall be intimately familiar with the pressure system's standard operating procedures, safety analysis report, emergency protection systems, safety devices, and operational limits. Several methods shall be employed to ensure personnel are trained/qualified; both in general pressure system safety, as well as specific system procedures and limits. This chapter outlines general and specific training requirements for operators and installation personnel.

5.2. HIGH-PRESSURE SYSTEM AWARENESS TRAINING

The SFAB, SMAO are responsible for periodically providing to all interested LaRC personnel general pressure system awareness training. This training shall cover the basic hazards and controls that are inherent in high-pressure systems. Specifically, the following subjects shall be covered:

a. Definition of high-pressure systems
b. Over pressurization protection (safety relief devices)
c. Relationship between various pressure terms (e.g., maximum expected operating pressure, maximum allowable working pressure, relief pressure, and test pressure)
d. Programs to maintain operational safety of systems (e.g., national consensus codes, configuration management, inspection plans, preventive maintenance, operator qualifications);
e. Review of incidents/accidents that have occurred (either at LaRC or at other facilities as appropriate);
f. Demonstrative illustrations of the potential power that pressurized vessels/systems contain;
g. Roles and responsibilities of key entities, such as the ESC, PSC, PSM, the FSH, and the FC.

5.3. HIGH-PRESSURE SYSTEM OPERATOR TRAINING

a. In addition to attending the high pressure system awareness training offered by SFAB, pressure system operators and handlers shall be certified as required by LPR 1710.40, "Langley Research Center Pressure Systems Handbook," using the procedures in LPR 1740.7, "Process System Certification Program." The FSH and the FC shall be responsible for ensuring that all equipment operators possess the requisite qualifications in the pressure system to be operated. Training shall include:

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(1) An overview of the system's design
(2) Interrelationship of system components such as valves, control systems, safety devices, interlocks and monitoring equipment
(3) Special instructions or procedures for specific jobs
(4) Alarm conditions (visual and audible) and required emergency action/operation
(5) Specific instruction on handling of potentially dangerous fluid or gas used in the process
(6) Review of incident and accident reports and the recommendations to prevent reoccurrence
(7) Review of recent equipment failures and repairs
(8) Review of any changes in system operation and procedures
(9) Review of system notes, cautions, and warnings.

b. Along with the list of certified operators, records of training shall be kept by the FSH and include dates of training, subjects discussed, copies of any handouts or lesson plans, and attendance sheets.

5.4. HIGH-PRESSURE SYSTEM INSPECTOR TRAINING

a. Training shall be in accordance with the American Society for Nondestructive Testing (ASNT) Recommended Practice No. SNT-TC-1A or ASNT CP-189, "ASNT Standard for Qualification and Certification of Nondestructive Testing Personnel," required for all inspection personnel conducting nondestructive examination of pressure systems at LaRC. ASNT Level II or Level III inspectors shall be required to provide final interpretation of the results of nondestructive examination of pressure systems.

b. Training shall be in accordance with the American Welding Society (AWS) Certified Welding Inspectors or Certified Assistant Welding Inspectors recommended for all inspection personnel conducting general construction inspection of pressure systems.

5.5. HIGH-PRESSURE SYSTEM MAINTENANCE PERSONNEL TRAINING

Personnel performing maintenance on pressure systems shall attend the high pressure system awareness training offered by SFAB and shall be trained in the use of LaRC lockout/tagout procedures. Maintenance personnel are strongly encouraged to attend training classes offered by OEM's whenever available and as applicable to their assigned work.

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Chapter 6

6. TAGGING OF RELIEF VALVES AND FLEXIBLE HOSES

6.1. TAGGING OF RELIEF VALVES

a. Relief valves shall be required to be periodically inspected, tested, and tagged. The ROME Contractor shall be responsible for installing tags on relief valves that contain the following information:

(1) Valve number
(2) Set pressure
(3) Test date.

b. Tagging of relief valves shall be required at initial installation and during any required retesting. The ROME Contractor shall be responsible for checking that relief valves are properly tagged during inservice inspections and field surveys.

6.2. TAGGING OF FLEXIBLE HOSES

a. Flexible hoses are required to be tagged at initial installation and during any required retesting with the following information:

(1) Test pressure
(2) Test date.

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Chapter 7

7. VARIANCES

Requests for deviation from the requirements of this LPR shall be submitted to the PSM for approval, with a copy to the SFAB, SMAO. If a request includes a deviation from the requirements of the national consensus codes and standards, the PSM shall forward the request to the Pressure Systems Committee for their consideration. Final approval shall be by the Executive Safety Council.

The PSM shall be responsible for forwarding a copy of the approved deviation request to the ROME Contractor for inclusion in the recertification file.

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Appendix A

A. ACRONYMS

ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASNT	American Society of Nondestructive Testing
B&PV	Boiler and Pressure Vessel
CAD	Computer-Aided Design
CCD	Configuration Controlled Document
CFR	Code of Federal Regulations
CM	Configuration Management
CMMS	Computerized Maintenance Management System
CMOL	Configuration Management On-Line
CNS	Change Notification Sheet
COD	Center Operations Directorate
CoF	Construction of Facilities
DOT	Department of Transportation
FBL	Facility Baseline List
FC	Facility Coordinator
FSH	Facility Safety Head
IP	Inspection Plan
LAPD	Langley Research Center Policy Directive
LPR	Langley Research Center Procedural Requirements
LaRC	Langley Research Center
MAWP	Maximum Allowable Working Pressure
MT	Magnetic Particle Testing
NB	National Board
NDE	Nondestructive Evaluation or Nondestructive Examination
NPD	NASA Policy Directive
NTS	NASA Technical Standard
ORR	Operational Readiness Review
SMAO	Safety and Mission Assurance Office
SFAB	Safety and Facility Assurance Branch
OSHA	Occupational Safety and Health Administration
PM	Project Manager
PSC	Pressure Systems Committee
PSCM	Pressure Systems Configuration Management
PSD	Pressure Systems Document
PSM	Pressure Systems Manager
RT	Radiographic Testing
SOP	Standard Operating Procedure
SPE	Standard Practice Engineer
UT	Ultrasonic Testing
VT	Visual Testing

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Appendix B

B. DEFINITIONS

Alteration – A change which affects the pressure-retaining capability of a pressure system. Non-physical changes such as an increase in the maximum allowable working pressure or the design temperature are considered alterations. A reduction in minimum temperature such that additional mechanical test(s) are required is also considered an alteration.

Change Notification Sheet (CNS) – (LPR 1740.4, "Facility System Safety Analysis and Configuration Management") An electronic form available through the Configuration Management On Line (CMOL) website initiated with the intent to document changes to systems under configuration control.

Configuration Controlled Documents (CCD) – Documents that are part of the Configuration Management system as described in LPR 1740.4, "Facility System Safety Analysis and Configuration Management."

Configuration Management On-Line (CMOL): A LaRC website for initiating and processing CNS's, or to obtain copies of Configuration Controlled Documents (CCD's) (http://cmol.larc.nasa.gov).

De-rating: The lowering of the maximum allowable working pressure or narrowing of the allowable temperature range of a pressure system.

Design Pressure: The pressure used in the design calculations of a pressure system for the purpose of determining the minimum permissible thickness or physical characteristics of the different parts. When applicable, static head is added to the design pressure.

Design Temperature: The metal temperature used in the design calculations of a pressure system for determining the minimum required thickness of the components and for selecting the maximum allowable stress for the material used in the vessel or system.

Facility Coordinator (FC): An individual who has overall responsibility for the operations of an assigned facility.

Facility Safety Head (FSH): An individual who is responsible for the day to day safe operation of a facility.

Inspection Plan (IP): A configuration controlled document describing the requirements for periodic inspection of a pressure system.

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Maximum Allowable Working Pressure (MAWP): The maximum gauge pressure permissible at a designated temperature for a particular vessel or system. The MAWP is the basis for the pressure setting of the pressure relieving devices protecting the system.

Maximum Expected Operating Pressure (MEOP): The highest pressure expected during the operation of a system, under normal conditions.

National Consensus Standard: Any standard which (1) has been adopted or distributed by a nationally recognized standards producing organization under procedures whereby it can be determined by the Secretary of Labor or by the Assistant Secretary of Labor for Occupational Safety and Health that persons interested and affected by the standard have reached substantial agreement on its adoption; (2) was formulated in a manner that afforded an opportunity for diverse view to be considered; and (3) has been so designated by the Secretary or the Assistant Secretary, after consultation with other appropriate Federal Agencies.

Operating or Working Temperature: The metal temperature that is normally maintained in the part of the vessel or system under consideration during operation.

Operating Pressure: The gauge pressure at which a system normally operates.

Project Manager (PM): Individual designated to supervise and coordinate the design, fabrication, installation and initial certification of pressure systems.

Recertification File: A compendium of all documentation regarding a particular pressure vessel or system that contains inservice inspection reports, special inspections, test results, accident/incident reports, CNS forms, recertification letters, engineering assessments, nameplate data facsimile, any National Board Forms, and other documentation as outlined in Chapter 2.

PHASE 1: The engineering evaluation phase of the recertification process where documentation is gathered, components identified, and initial non-destructive examinations performed.

PHASE 2: The repair phase of the recertification process where either additional repairs and modifications or more complete NDE are performed before recertification.

PHASE 3: The maintenance phase of the recertification process after the pressure system has been recertified and the system is then periodically inspected.

Piping system – An assembly of components, which may include pipes, valves, fittings, and other such piping components, with the primary purpose to convey, distribute, mix, separate, discharge, meter, control, or snub the flow of a fluid. For the purpose of this definition, tubing and piping shall be considered to be interchangeable.

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Pressure system – A collection of piping systems and/or pressure vessels used jointly to convey or contain a pressurized fluid or a vacuum.

Pressure Systems Configuration Management (PSCM) (LPR 1740.4, "Facility System Safety Analysis and Configuration Management"): A subprogram under the Configuration Management (CM). In this subprogram, the component databases shall be constantly updated as modifications are made to the pressure systems.

Pressure Systems Document (PSD): A Configuration Controlled Document (CCD) that includes isometric sketches of a pressure system and a database of all the components that comprise the pressure system. PSD's are useful to engineering and facility personnel in preparing design changes and maintenance requests, repairs and system inspections.

Pressure Systems Manager (PSM): A technical expert, designated by the Center Director, responsible for all matters involving pressure systems, their operation, and recertification activities.

Pressure vessel – An assembly of components, which may include plates, pipes, fittings, and piping components, with the primary purpose to hold, contain, or enclose a finite volume of a fluid under pressure.

Recertification: The procedure (appropriate tests, inspections, examination, analyses, and documentation) which qualifies a pressure system to continue or be returned to operation for a particular service.

Repair – The work necessary to restore a pressure system to a safe and satisfactory operating condition, provided that no deviation from the original design is made.

Safety-Relief Device Set Pressure: The value of increasing inlet static pressure at which the relief device begins venting fluid. For different relief device types, this value may be called opening pressure, popping pressure, start-to-leak pressure, burst pressure, or breaking pressure.

Standard Practice Engineer (SPE): Individual designated to review and approve the design and specifications of all pressurized ground systems, and verify compliance with applicable codes, standards, guides, and supplementary requirements of these regulations.

Variance: A document used to request acceptance of a design, fabrication, or use of a pressure system which is not in compliance with applicable national consensus codes, standards, guides, or LaRC supplementary requirements. This document is a part of the recertification file. Variances require the approval of the Pressure Systems Committee and the Executive Safety Council.

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Appendix C

C. RECOMMENDED PRACTICES FOR THE DEVELOPMENT OF PRESSURE SYSTEMS INSPECTION PLANS

C.1 General

a. The tables presented in this Appendix are intended as a guide for the selection of inservice inspection intervals for pressurized systems. Tables are presented for various fluid media. Each table is divided by categories of components and further subdivided by a measure of the energy content of the component.

b. The possible consequences of the failure of a system under positive pressure include the release of pressure shock waves, the expulsion of fragments, explosions, and the release of flammable, toxic, or corrosive fluids. A conservative approach to determine the destructive potential of these failures is the TNT-equivalency technique developed by the Naval Ordnance Laboratory and detailed in Appendix F.

c. The destructive potential of a vacuum vessel is caused by the vessel's implosion and the subsequent drop of pressure in the surrounding area. The consequences of this type of failure depend on the volume contained by the system and include high velocity air movement, equipment and personnel drawn towards the vacuum source, the expulsion of fragments, and the possible collapse of surrounding structures.

C.2 Construction of Inspection Plans

a. The inspection tables presented in this Appendix are divided on the basis of the contents of the pressure system (flowing media). Within each listed table, recommendations for time-based inspection intervals are further subdivided by the type of component (e.g., vessels, relief valves, expansion joints, flexible hoses, and piping components) and by a measure of their energy content.

b. The inspection tables do not make any explicit recommendation of nondestructive examination (NDE) techniques to be used. The selection of NDE techniques for a specific system should be based on an engineering evaluation of the suitability of the NDE techniques to detect the development and/or growth of flaws in the pressure retaining walls, for the purpose of reducing the risk of unforeseen system failure.

c. Figures E-1 and E-2 are samples of inspection plans that could result from the application of the guidelines in this Appendix.

C.3 Variances in Inspection Plans

a. Variances from the guidelines presented in the tables are allowable to account for special issues such as (a) environment-induced factors (b) cyclic duty, (c) proximity or remoteness of untrained personnel, and (d) past history. Inspection plans for pressure systems shall document the rationale for variances from the inspection tables.

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All variances in inspection plans shall be approved by the LaRC Pressure Systems Manager and the cognizant Facility Safety Head.

(1) *Environment-induced factors* – (e.g., corrosion, erosion, UV ray degradation.) Shortening or lengthening of the recommended time-based intervals shown in the inspection tables may be done based on known rates of degradation.

(2) *Cyclic duty* – A fatigue analysis per the rules of the ASME Boiler and Pressure Vessel Code, Section VIII, Division 2 should be conducted whenever the pressure system is subject to pressure and/or thermal cycling. A damage tolerance analysis should be conducted to determine fatigue crack growth behavior and to determine whether a “leak before break” condition exists. The results of these analyses may be used to determine critical areas to be examined and to establish alternate inspection intervals based on pressure and thermal cycles instead of time-based inspection intervals.

(3) *Proximity or remoteness of personnel*– When personnel not trained in the risks associated with high pressure systems are regularly required to work inside the perimeter of Zone 4 from a pressure system (as defined in Appendix F), the recommended inspection intervals may be shortened to mitigate the risk. When a pressure system is located in a remote location such that all personnel are normally outside the perimeter of Zone 1, or when the pressure system is located within a structure designed to contain the potential blast forces, the recommended inspection intervals may be extended in response to the reduced risk.

(4) *Past history* – When the results of at least three consecutive inservice inspections performed at the intervals specified in the inspection plan show that no defects are present, it is permissible to extend the intervals recommended in the tables. When the results of two consecutive inservice inspections performed at the intervals specified in the inspection plan show signs of degradation in a particular area even though corrective actions have been performed, the recommended inspection interval shall be shortened.

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Figure C-1 Sample Time-based Inspection Plan

	INSPECTION SCHEDULE						SPECIAL REQUIREMENTS
DESCRIPTION	**Y2000**	**Y2002**	**Y2004**	**Y2006**	**Y2008**	**Y2010**	
All Piping Components			VE	UT - Thick	UT - Thick		UT-Thick - Ultrasonic Check for Thickness (Spot Check) ASNT Level II or III shall perform all nondestructive examinations. VE shall be in accordance with LMS-TD-5569, "Visual Inspections"
Elbow #24		UT - Thick			UT - Thick		
Valve #3	VE		MT		VI & MT	VE	
Valves 1, 2, and 4 thru 14			VE		VI		
Water Pump "A"	VE				VI	VE	
Relief Valve		CRVT & VE		VI	CRVT & VI		

Figure C-2 Sample Time-based and Cycle-based Inspection Plan

	INSPECTION SCHEDULE					SPECIAL REQUIREMENTS
DESCRIPTION	**Y2000**	**Y2002**	**Y2004**	**Y2006**	**Y2008**	N_F – Number of Equivalent Full Pressure Cycles
Complete System		VE			VE	
Manifold Joints					UT - Shear	$N_{CURRENT}$ – Current cycle count as of 12/31/2004
Manifold Exit Joints			UT - Shear		UT - Shear	ASNT Level II or III shall perform all nondestructive examinations.
Tank #3010	N_F = 1000 cycles		$N_{CURRENT}$ = 865	PT (all internal surfaces)		VE shall be in accordance with LMS-TD-5569, "Visual Inspections"

TABLE C-1 Recommended Inspection Intervals (in years) for Systems Containing Inert Gases, such as Argon, Helium, Nitrogen, and Dry Air

	Measure of Energy Content			Recommended Inspection Interval				
				1/2	1	2	5	10
Pressure Vessels	Pressure (psig) times Volume (ft^3)	< 5,000	Psi – ft^3				I	
		5,000 – 500,000				I		
		≥ 500,000			I			
Piping Components	Pressure (psig) times Diameter^2 (in^2)	< 500,000	Psi – in^2				I	
		≥ 500,000				I		
Expansion Joints	Pressure (psig) times Diameter^2 (in^2)	< 500,000	Psi – in^2			I		
		≥ 500,000			I			
Flex Hoses	Pressure	≥ 125			I	T		
Relief Valves	Outdoors, carbon steel				I	T	R	
	All others					I	T,R	

Notes:
I = Inspection
T = Testing (Note: some flex hoses may be exempt from testing, see LPR 1710.40). For relief valves, testing means checking its setpoint through pressure testing.
R = Refurbishing

TABLE C-2 Recommended Inspection Intervals (in years) for Systems Containing Gaseous Oxygen

	Measure of Energy Content			Recommended Inspection Interval				
				1/2	1	2	5	10
Pressure Vessels	Pressure (psig) times Volume (ft^3)	< 1,000	Psi – ft^3				I	
		1,000 – 400,000				I		
		≥ 400,000			I			
Piping Components	Pressure (psig) times Diameter^2 (in^2)	< 100,000	Psi – in^2				I	
		100,000 – 400,000				I		
		≥ 400,000			I			
Expansion Joints	Pressure (psig) times Diameter^2 (in^2)	< 400,000	Psi – in^2			I		
		≥ 400,000			I			
Flex Hoses	Pressure	≥ 125	Psig		I	T		
Relief Valves	ALL					I	T, R	

Notes:
I = Inspection
T = Testing (Note: some flex hoses may be exempt from testing, see LPR 1710.40). For relief valves, testing means checking its setpoint through pressure testing.
R = Refurbishing

TABLE C-3 Recommended Inspection Intervals (in years) for Systems Containing Gaseous Hydrogen or Natural Gas

	Measure of Energy Content			Recommended Inspection Interval				
				1/2	1	2	5	10
Pressure Vessels	Pressure (psig) times Volume (ft^3)	< 10,000	Psi – ft^3				I	
		10,000 – 200,000				I		
		≥ 200,000			I			
Piping Components	Pressure (psig) times Diameter^2 (in^2)	< 20,000	Psi – in^2				I	
		20,000 – 400,000				I		
		≥ 400,000			I			
Expansion Joints	Pressure (psig) times Diameter^2 (in^2)	ALL	Psi – in^2		I			
Flex Hoses	Pressure	< 125	psig		I		T	
		≥ 125			I	T		
Relief Valves	Outdoors, carbon steel				I	T	R	
	All others					I	T,R	

Notes:

I = Inspection

T = Testing (Note: some flex hoses may be exempt from testing, see LPR 1710.40). For relief valves, testing means checking its setpoint through pressure testing.

R = Refurbishing

TABLE C-4 Recommended Inspection Intervals (in years) for Systems Containing Gaseous Fluorine

	Measure of Energy Content			Recommended Inspection Interval				
				1/2	1	2	5	10
Pressure Vessels	Pressure (psig) times Volume (ft^3)	< 13,000	Psi – ft^3				I	
		13,000 – 67,000				I		
Piping Components	Pressure (psig) times Diameter^2 (in^2)	< 13,000	Psi – in^2				I	
		13,000 – 100,000				I		
		≥ 100,000			I			
Expansion Joints	Pressure (psig) times Diameter^2 (in^2)	ALL	Psi – in^2		I			
Flex Hoses	Pressure	< 125	psig		I		T	
		≥ 125			I	T		
Relief Valves	Outdoors, carbon steel				I	T	R	
	All others					I	T,R	

Notes:

I = Inspection

T = Testing (Note: some flex hoses may be exempt from testing, see LPR 1710.40). For relief valves, testing means checking its setpoint through pressure testing.

R = Refurbishing

TABLE C-5 Recommended Inspection Intervals (in years) for Systems Containing Liquid Water, Nonflammable Hydraulic Fluids, or Nonflammable refrigerants

	Measure of Energy Content			**Recommended Inspection Interval**				
				1/2	1	2	5	10
Tanks	Capacity (gallons)	< 50,000	gal					I
		≥ 50,000					I	
Piping Components	Pressure (psig) times Diameter^2 (in^2)	< 50,000	Psi – in^2					I
		≥ 50,000					I	
Expansion Joints	Diameter (in)	ALL	in			I		
Flex Hoses	Pressure	≥ 125				I		
Relief Valves	Outdoors, carbon steel				I	T	R	
	All others					I	T,R	

Notes:

I = Inspection

T = Testing (Note: some flex hoses may be exempt from testing, see LPR 1710.40). For relief valves, testing means checking its setpoint through pressure testing.

R = Refurbishing

TABLE C-6 Recommended Inspection Intervals (in years) for Systems Containing Cryogenic Liquids of Argon, Helium, or Nitrogen

	Measure of Energy Content			Recommended Inspection Interval				
				1/2	1	2	5	10
Tanks	Capacity (gallons)	< 50,000	gal				I	
		≥ 50,000				I		
Piping Components	Diameter (in)	< 36	in				I	
		≥ 36				I		
Expansion Joints	Diameter (in)	< 36	in			I		
		≥ 36			I			
Flex Hoses	Pressure	< 125	psig			I, T		
		≥ 125			I	T		
Relief Valves	ALL					I	T, R	

Notes:
I = Inspection
T = Testing (Note: some flex hoses may be exempt from testing, see LPR 1710.40). For relief valves, testing means checking its setpoint through pressure testing.
R = Refurbishing

TABLE C-7 Recommended Inspection Intervals (in years) for System Components Containing Liquid Oxygen (LOX)

	Measure of Energy Content			Recommended Inspection Interval				
				1/2	1	2	5	10
Tanks	Capacity (gallons)	< 20,000	gal				I	
		≥ 20,000				I		
Piping Components	Diameter (in)	< 24	in				I	
		≥ 24				I		
Expansion Joints	Diameter (in)	< 24	in			I		
		≥ 24			I			
Flex Hoses	Pressure	< 125	psig			I, T		
		≥ 125			I	T		
Relief Valves	ALL					I	T, R	

Notes:
I = Inspection
T = Testing (Note: some flex hoses may be exempt from testing, see LPR 1710.40). For relief valves, testing means checking its setpoint through pressure testing.
R = Refurbishing

TABLE C-8 Recommended Inspection Intervals (in years) for Systems Containing Liquid Hydrogen (LH2) or Liquid Natural Gas (LNG)

	Measure of Energy Content			**Recommended Inspection Interval**				
				1/2	1	2	5	10
Tanks	Capacity (gallons)	< 1,300	gal				I	
		1,300 – 6,500				I		
		≥ 6,500			I			
Piping Components	Diameter (in)	< 18	in			I		
		≥ 18			I			
Expansion Joints	ALL		-		I			
Flex Hoses	Pressure	< 125	psig			I		
		≥ 125			I	T		
Relief Valves	ALL					I	T, R	

Notes:
I = Inspection
T = Testing (Note: some flex hoses may be exempt from testing, see LPR 1710.40). For relief valves, testing means checking its setpoint through pressure testing.
R = Refurbishing

TABLE C-9 Recommended Inspection Intervals (in years) for Systems Containing Liquid Fluorine

	Measure of Energy Content			Recommended Inspection Interval				
				1/2	1	2	5	10
Tanks	Capacity (gallons)	< 1,300	gal				I	
		1,300 – 6,500				I		
		≥ 6,500			I			
Piping Components	Diameter (in)	< 6	in					I
		≥ 6					I	
Expansion Joints	ALL		-		I			
Flex Hoses	Pressure	< 125	psig			I		
		≥ 125			I	T		
Relief Valves	ALL					I	T, R	

Notes:
I = Inspection
T = Testing (Note: some flex hoses may be exempt from testing, see LPR 1710.40). For relief valves, testing means checking its setpoint through pressure testing.
R = Refurbishing

TABLE C-10 Recommended Inspection Intervals (in years) for Systems Containing Furfuryl Alcohol or Kerosene (RP-1)

	Measure of Energy Content			Recommended Inspection Interval				
				1/2	1	2	5	10
Tanks	Capacity (gallons)	< 380	gal				I	
		380 – 3,800				I		
		≥ 3,800			I			
Piping Components	Diameter (in)	< 10	in				I	
		≥ 10				I		
Expansion Joints	ALL		-		I			
Flex Hoses	Pressure	< 125	psig			I		
		≥ 125			I	T		
Relief Valves	ALL					I	T, R	

Notes:
I = Inspection
T = Testing (Note: some flex hoses may be exempt from testing, see LPR 1710.40). For relief valves, testing means checking its setpoint through pressure testing.
R = Refurbishing

TABLE C-11 Recommended Inspection Intervals (in years) for Vacuum Systems

	Measure of Energy Content			Recommended Inspection Interval				
				1/2	1	2	5	10
Vacuum Vessels	Capacity (ft^3)	100 – 15,000	ft^3				I	
		15,000 – 100,000				I		
		≥ 100,000			I			
Piping Components	Diameter (in)	< 24	in					I
		≥ 24					I	
Expansion Joints	ALL		-		I			
Flex Hoses	Pressure	< 125	psig			I		
		≥ 125			I	T		
Relief Valves	ALL					I	T, R	

Notes:
I = Inspection
T = Testing (Note: some flex hoses may be exempt from testing, see LPR 1710.40). For relief valves, testing means checking its setpoint through pressure testing.
R = Refurbishing

TABLE C-12 Recommended Inspection Intervals (in years) For Steam Systems (Excluding Boilers and Boiler External Piping)

	Measure of Energy Content			Recommended Inspection Interval				
				1/2	1	2	5	10
Pressure Vessels	Pressure (psig) times Volume (ft^3)	< 5,000	Psi – ft^3				I	
		5,000 – 50,000				I		
		≥ 50,000			I			
Piping Components	Pressure (psig) times Diameter^2 (in^2)	< 50,000	Psi – in^2				I	
		≥ 50,000				I		
Expansion Joints	Pressure (psig) times Diameter^2 (in^2)	< 50,000	Psi – in^2			I		
		≥ 50,000			I			
Flex Hoses	Pressure	< 125	psig		-	-	-	-
		≥ 125			I	T		
Relief Valves	Outdoors, carbon steel				I	T, R		
	All others				I		T,R	

Notes:
I = Inspection
T = Testing (Note: some flex hoses may be exempt from testing, see LPR 1710.40). For relief valves, testing means checking its setpoint through pressure testing.
R = Refurbishing

Appendix D

D. RECOMMENDED PRACTICE FOR THE ASSESSMENT OF FAILURE DAMAGE PRODUCED BY HIGH PRESSURE GAS SYSTEMS

D.1 General

a. The consequences of the sudden failure of a gaseous system subject to internal pressure include the release of pressure shock waves and the expulsion of debris. The destructive potential of these failures can be established using the TNT-equivalency technique that was developed by the Naval Ordnance Laboratory and documented in the technical report NOLTR 70-208, "Failure-Damage Assessment Technique for High-Pressure Gas Containment Vessels," by V. C. D. Dawson and A. E. Seigel (1970). The procedure delineated below is recommended for establishing personnel exclusion perimeters associated with pneumatic testing of pressure systems and for determining the potential need to increase or decrease inservice inspection intervals (see LPR 1710.40 for additional requirements for pneumatic testing at LaRC and Appendix E of this LPR for additional requirements for inspection plans). The calculated exclusion perimeter is not intended as a means of determining how close personnel can work next to an active pressure system during normal operation.

b. The general procedure includes the following steps:

(1) Establish the water volume of the vessel or system (**V**, cubic feet). For piping systems, use the volume of the longest run of pipe in the system between welded joints, threaded fittings, flanges, or other structural discontinuity capable of arresting a moving crack front.

(2) Determine the system's maximum operating pressure (**P**, pounds per square feet absolute) and temperature (**T**, degrees Rankine.)

(3) Calculate or look up the standard atmospheric pressure (**P_{atm}**, pounds per square feet absolute.)

(4) Look up the specific heat ratio of the gas (γ, non-dimensional, 1.4 for air.)

(5) Calculate the potential energy contained in the pressurized gas by using the formula (result is in units of ft-lb_f)

$$E = \frac{PV}{\gamma - 1}\left[1 - \left(\frac{P}{P_{atm}}\right)^{\frac{1-\gamma}{\gamma}}\right]$$

(6) Convert the potential energy calculated previously (in ft- lb_f) to an equivalent mass of TNT (units of lb_m) by using the equation

$$m = \frac{E}{1{,}424{,}033}$$

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(7) Calculate radii of the different overpressure zones using Table F-1 and the following formula

$$R = \lambda \cdot m^{1/3}$$

Table D-1 Effects of Blast Overpressure by Zone Number

Zone	**ΔP,** psi	**λ,** ft/(lb$^{1/3}$)	**Comment**
1	0.2	147.8	Safe distance for all personnel. During system pressure testing, a personnel exclusion perimeter should be normally set at this distance.
2	0.5 – 1.0	76.7 – 45.8	Slight damage may occur; glass windows may shatter. During system pressure testing, and under space critical conditions, the exclusion perimeter may be set in this zone.
3	1.0 – 5.0	45.8 – 14.7	Moderate damage to wood frame structures may occur. Corrugated asbestos siding may shatter. Corrugated steel or aluminum paneling may buckle.
4	5.0	14.7	Eardrums may rupture.
5	7.0 – 8.0	12.1 – 11.2	Non-reinforced brick walls 8" to 12" thick may shear and fail.
6	10.000	10	Lung damage may occur.

<u>Example:</u>
A compressed air piping system consists of mainly 3" schedule 160 piping, operating at 4500 psig. The longest run of piping between two discontinuities is 20 feet.

$$V = \frac{\pi}{4} \cdot \left[\frac{2.624}{12}\right]^2 \cdot (20)$$ → 2.624" is nominal ID of pipe

$$V = 0.751 \cdot ft^3$$

$$P = (4500 + 15) \cdot (144) = 650{,}160 \cdot psfa$$

$$P_{atm} = 15 \cdot 144 = 2160 \cdot psfa$$

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$$T = 520 \cdot Rankine$$

$$\gamma = 1.4$$

$$E = \frac{(650160)(0.751)}{(1.4-1)}\left[1-\left(\frac{650160}{2160}\right)^{\frac{(1-1.4)}{1.4}}\right] \qquad E \cong 982{,}000 \cdot lb_f \cdot ft$$

$$\therefore \quad m = \frac{982000}{1424033} = 0.69 \cdot lb_m$$

Then, the distance from the center to the 0.2 psi perimeter (Zone 1) is

$$R = \lambda \cdot m^{1/3} = 147.8 \cdot (0.69)^{1/3} = 131\, feet$$

Similarly, the range of distances defining each zone can be calculated.

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Langley Research Center

LPR 1710.5

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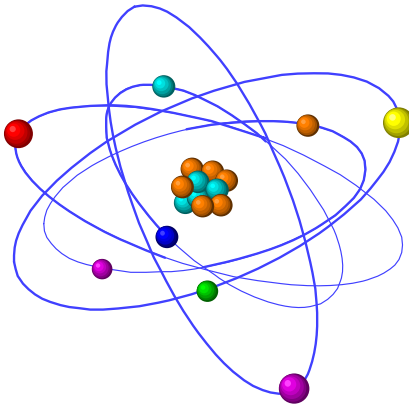
IONIZING RADIATION



National Aeronautics and Space Administration

Responsible Office: Safety and Mission Assurance Office

PREFACE

P.1 PURPOSE

This Langley Procedural Requirement (LPR) prescribes the Nuclear Regulatory Commission (NRC) regulations by assigning responsibilities and authorities at LaRC. Ionizing radiation sources not covered by NRC regulations (such as x-ray machines) are included in this LPR. The standards and regulations contained herein do not in any way relieve supervisors, employees, or contractors of their responsibilities for the conduct of safe operations.

P.2 APPLICABILITY

The procedures and radiation protection practices as set forth in this LPR apply to all organizational elements of LaRC and to all contractors working in facilities under the administrative control of LaRC. It should be noted that referenced regulations are Federal statutes imposed on NASA under terms of licenses with the Nuclear Regulatory Commission (NRC), and applicable regulations promulgated by the Occupational Safety and Health Administration (OSHA), the Food and Drug Administration (FDA), and the Department of Transportation (DOT). Questions concerning details of current regulations or the applicability of regulations should be referred to the Radiation Safety Officer (RSO), Safety and Facility Assurance Branch (SFAB), Safety and Mission Assurance Office (SMAO).

It is the responsibility of Contractors to provide and implement their own ionizing radiation program for facilities solely operated by the Contractor. As a minimum, this program shall be in accordance with the LaRC program as described in this LPR.

P.3 AUTHORITY

a. Department of Labor, OSHA Title 29 Codes of Federal Regulations (CFR), Part 1910.1096.
b. NRC License Applications (NRC Form 313).
c. U.S. Nuclear Regulatory Commission (NRC), Title 10, Code of Federal Regulations (CFR), Parts 0 to 50.
d. U.S. NRC 10 CFR 20, Standards for Protection Against Radiation.
e. U.S. NRC 10 CFR 19, Notices, Instructions and Reports to Workers: Inspection and Investigations.
f. U.S. NRC Form No. 3, “Notice to Employees.”

NOTE: The below documents are available from the Radiation Safety Officer:

CODE OF FEDERAL REGULATIONS (CFR)
Title 10 - Atomic Energy

Part 19	Notices, Instructions and Reports to Workers; Inspection
Part 20	Standards for Protection Against Radiation
Part 30	Licensing of Byproduct Material
Part 31	General Licenses for Certain Quantities of Byproduct Material and Byproduct Material Contained in Certain Items
Part 33	Special Licenses of Broad Scope for Byproduct Material
Part 35	Human Uses of Byproduct Material
Part 36	Export and Import of Byproduct Material
Part 40	Licensing of Source Material
Part 70	Special Nuclear Material
Part 71	Packaging of Radioactive Material for Transport

Title 29 - Occupational Safety and Health Administration
Part 1910.1096 Ionizing Radiation

PROVISIONS OF SPECIFIC NUCLEAR REGULATORY COMMISSION (NRC) LICENSES

g. Title 14 – Aeronautics and Space, Chapter 1 – Federal Aviation Administration, Department of Transportation (parts 1-199).
h. Title 39 – Postal Service Regulations, Chapter 1, United States Postal Service, Subchapter K – Special Requirements.
i. Title 46 – Shipping, Chapter 1 – Coast Guard, Department of Transportation Subchapter N – Dangerous Cargoes
j. Title 49 - U.S. Department of Transportation Parts 171 178 Rules and Regulations
k. Postal Guide, Part I, Article 37, Chapter IV, Radioactive Materials

P.4 REFERENCES

LAPD 1150.2, "Councils, Boards, Panels, Committees, Teams, and Groups."
LAPD 1700.2, "Safety Program."
LPR 1046.1, “NASA Langley Research Center Emergency Plan.”
LPR 1740.6, “Personnel Safety Certification.”
NASA Langley Form 38, "Safety Permit Request - Radioactive Material."
NASA Langley Form 44A, “Radiation Hazard Form."
NASA Langley Form 48, "Safety Permit Request - Radiation Machine."
NASA Langley Form 66, “Worker Appointment and Certification Form.”
NASA Langley Form 145, "Maintenance Shipping Form."
NASA Langley Form 492, "Radiation Worker's Certification Card

P.5 CANCELLATION

LPR 1710.5, dated October 3, 2004, is rescinded and should be destroyed.

Original signed on file

Lesa B. Roe
Director

Distribution:
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Chapter 1

1. INTRODUCTION

1.1 PURPOSE

It is LaRC policy to comply with NASA regulations and federal laws as prescribed in Appendices A and B of this LPR and to:

- Exercise centralized control over operations involving the use of radioactive materials and radiation producing equipment.
- Assure that exposure of personnel to ionizing radiation from radioactive materials or radiation-producing equipment is kept to a minimum.
- Assure that compliance with federal, state, and local regulations is maintained.

The responsibility for implementation of these safety policies with respect to a particular radiation device is given to the responsible Organizational Facility Safety Head (OFSH) (line management). OFSH's shall establish normal and emergency operating procedures and ensure all personnel operating devices within their facility are trained. The NASA Langley Form 498, "Safety Permit," review system is established to ensure that the procedures are in compliance with the protection standards adopted herein.

1.2 SCOPE

This LPR defines the requirement for the procurement, use, handling, storage, shipment, and disposal of sources of ionizing radiation, as well as personnel monitoring and emergency procedures. They also indicate sources from which more detailed information may be obtained when necessary.

1.3 ISSUANCE AND CONTROL OF PROCEDURAL REQUIREMENTS REVISIONS

It is the SFAB's responsibility to issue, distribute, and control this LPR. Revisions to this LPR shall be developed by the LaRC Ionizing Radiation Committee (IRC) (Ref. Langley Policy Directive [LAPD] 1150.2, "Councils, Boards, Panels, Committees, Teams, and Groups").

1.4 DEFINITIONS AND TERMINOLOGY

Appendix A contains definitions and terminology used in this LPR.

1.5 RECORDS

- Ionizing radiation inventory records:
- Current list of employees who are required to be certified as radiation workers.
- Incident and over-exposure reports
- Receipts and shipments of ionizing radiation sources.
- Records of trained and safety certified radiation workers.
- Records of personnel monitoring.

- Records of calibration of monitoring instrumentation.
- Personnel dosimetry reports.
- Records of all radioactive waste disposals.

The following forms were completed when implementing requirements:

NASA Langley Form 38, "Safety Permit Request - Radioactive Material."
NASA Langley Form 44A, “Radiation Hazard Form."
NASA Langley Form 48, "Safety Permit Request - Radiation Machine."
NASA Langley Form 66, “Worker Appointment and Certification Form.”
NASA Langley Form 145, "Maintenance Shipping Form."
NASA Langley Form 492, "Radiation Worker's Certification Card."

Chapter 2

2. IONIZING RADIATION COMMITTEE (IRC)

2.1 AUTHORITY

The IRC is established under the authority of LPR 1700.1, “Safety Program,” and LPR 1150.2, "Councils, Boards, Panels, Committees, Teams, and Groups.” Its establishment is necessary in the public interest and to:

- Ensure compliance with licensing requirements for radioactive material under the rules and regulations of the U.S. Nuclear Regulatory Commission, Title 10, Code of Federal Regulations, (CFR), Parts 0 to 50.
- Ensure compliance with the U.S. Department of Labor, OSHA, Title 29, Code of Federal Regulations (CFR), Part 1910.1096 (29 CFR 1910.1096).

Any member of this committee is authorized to investigate any questionable radiation source, equipment, system, and so forth; and is authorized to act in the name of the LaRC Director to stop work; to prevent the use of equipment which is considered unsafe; and, to start action to eliminate the unsafe condition. This action shall be documented within 24 hours by formal memorandum to the LaRC Safety Manager with a copy to the Chairperson, IRC. Work can be resumed after the corrective action has been taken. If line management is not in agreement with the corrective action recommended by the official who stopped the work, however, the line manager is to submit the reasons for disagreement to the Chairperson, Executive Safety Council, who shall make an appropriate review. In these cases, work shall not resume without the approval of the Chairperson, Executive Safety Council.

Due to the need for the IRC to maintain an overview of ionizing radiation activities at LaRC, a review system is established for major radiation facilities. This review system is described in Chapter 4, “Routine Procedures and Requirements.”

2.2 STRUCTURE AND ORGANIZATION

The IRC functions as a subcommittee of the Executive Safety Council. Its position in the organization for radiation safety is shown in Figure 2.1, LaRC Organization for Radiation Safety.

The IRC consists of a Chairperson, Vice-Chairperson, Secretary and ten additional members. Committee members (including Chairperson and Vice Chairperson) are appointed by the Vice-Chairperson, Executive Safety Council, by virtue of their technical and/or educational expertise in the field of ionizing radiation. Members serve for a two-year term with the exception of the LaRC Safety Manager, the RSO, and a representative from the Environmental Management Team (EMT), Center Operations Directorate (COD), who are committee members and serve as long as the committee continues to function. Members may serve for multiple terms on the IRC.

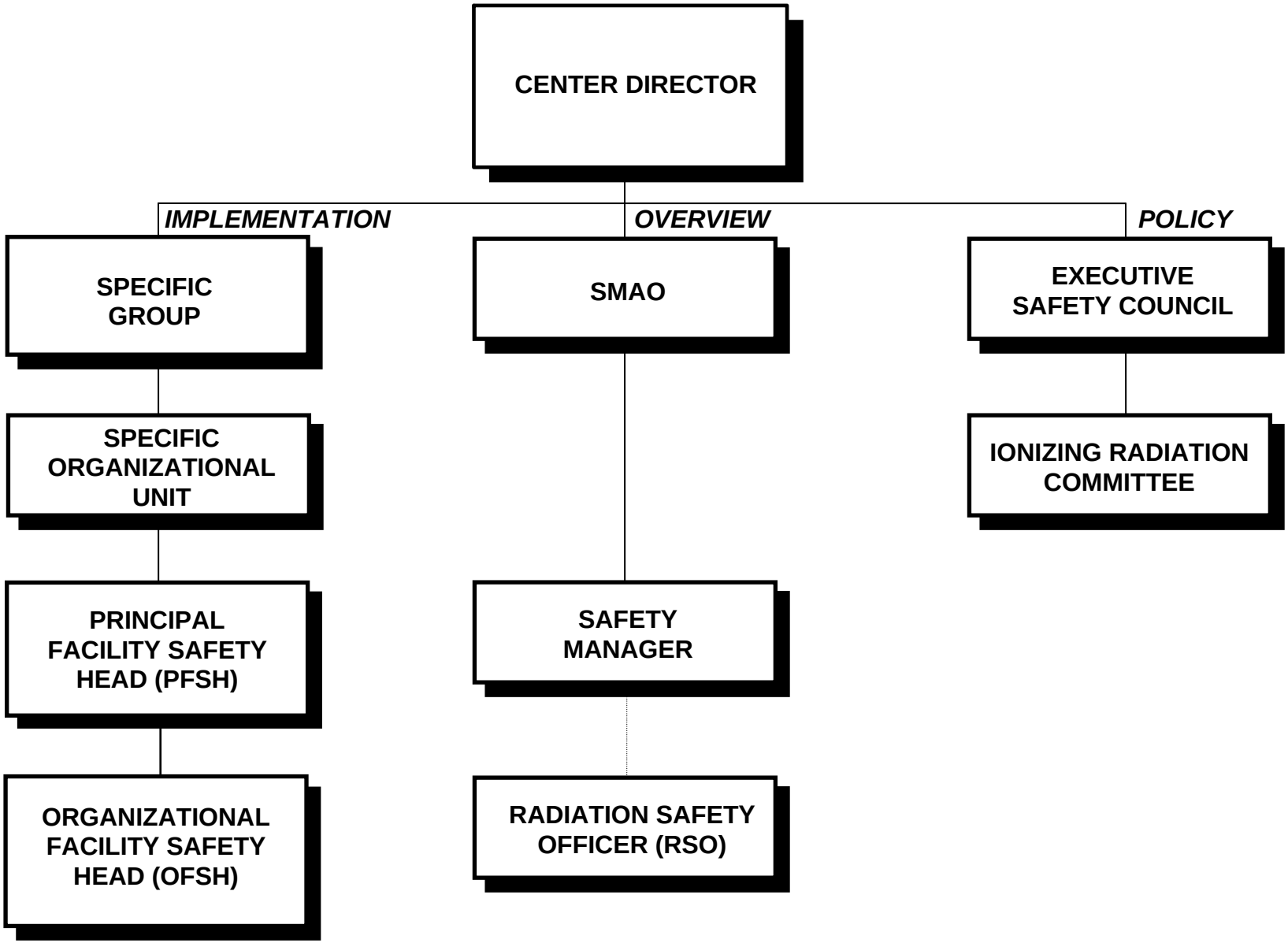

Figure 2.1, LaRC Organization for Ionizing Radiation Safety

During the first meeting of a new calendar year, the committee shall elect a committee secretary from its full membership. The committee secretary shall be responsible for preparing and distributing committee minutes in addition to other responsibilities.

2.3 DUTIES AND RESPONSIBILITIES

2.3.1 General

The general duties and responsibilities of the IRC are to:

- Ensure compliance with Federal regulatory statutes.
- Exercise a centralized control over sources of ionizing radiation at LaRC. This control is accomplished by a review and approval of all procurement, handling, use, storage, and disposal of radioactive materials and radiation producing machines (Chapter 4).
- Ensure that an audit is conducted annually of each facility's possession and use of sources of ionizing radiation (Chapter 5).
- Develop and coordinate material incorporated in this LPR as needed.

2.3.2 Specific

The specific duties of the officials and members of the IRC are described herein.

2.3.2.1 Chairperson

The chairperson shall:

- Prepare an agenda and call meetings as required, at least quarterly.
- Act as the presiding officer at committee meetings.
- Act as the signature authority for actions approved by the committee (safety permits, and so forth).
- Be cognizant of all matters pertaining to ionizing radiation at LaRC.

2.3.2.2 Vice Chairperson

The Vice-Chairperson shall:

- Assist the Chairperson whenever necessary.
- Serve as the Chairperson when the Chairperson is absent.

2.3.2.3 Secretary

The secretary shall:

- Prepare and distribute minutes of committee meetings, which, are to contain, as a minimum, a record of persons present and a description of matters discussed and conclusions reached, including the opinions of dissenting members.
- Distribute minutes to all members; the affected FSH's; the Chairperson, Executive Safety Council; and the Director, SMAO.

- Process official correspondence for the committee as needed.

2.3.2.4 Members

Other members of the IRC shall:

- Be cognizant of all matters pertaining to radiation safety at LaRC. This is chiefly, but not entirely, achieved by attending the committee meetings and participating in the decisions made by the committee.
- Serve on ad-hoc committees appointed by the Chairperson, when necessary.

Chapter 3

3. SAFETY AND HEALTH FUNCTIONS

3.1 GENERAL

The responsibility for implementing this LPR shall be divided among five safety and health functions. The interface requirements of these functions and their duties and responsibilities are presented in this chapter.

3.2 ORGANIZATIONAL FACILITY SAFETY HEAD (OFSH)

The Principal Facility Safety Head (PFSH) of each facility where ionizing radiation operations are performed shall appoint an OFSH for each operation, which is functionally or generically distinct. The OFSH shall, in each case, be a representative of line management who is thoroughly familiar with the operation and its hazards. In some cases, the OFSH may also be the prime user of the source(s) of ionizing radiation.

3.2.1 Interfaces

The OFSH is the first point of contact for the individual who has a requirement for the procurement, use, or disposal of sources of ionizing radiation. The first point of contact for the OFSH is the RSO.

3.2.2 Responsibilities

Responsibilities of the OFSH with an operation involving sources of ionizing radiation are to:

- Supervise and coordinate, in a safe manner, the procurement, use, and disposal of sources of ionizing radiation.
- Maintain a continual inventory of all radioactive sources and all radiation-producing machines used in operations. The inventory is to include locations of use, type of radiation emitted and maximum radiation intensities produced by these sources and machines.
- Maintain an inventory of radiation-monitoring instruments in operation, which are required for the purpose of monitoring personnel exposure to ionizing radiation (Chapter 5, “Special Procedures and Requirements”). The instrument inventory shall include the manufacturer, model number, serial number, and the date of calibration for each instrument required.
- Furnish inventory records to the RSO.
- Secure dosimetry service from the RSO for all personnel in the operation who are likely to receive ionizing radiation exposure in excess of 10 percent of the limits specified in Chapter 5.
- Maintain a current list of employees in the operation who are required to be certified as radiation workers. Chapter 5 presents the certification requirements.

3.3 RADIATION SAFETY OFFICER (RSO)

The position of the RSO has been assigned to a contractor located in the Safety and Facility Assurance Branch, SMAO.

3.3.1 Interfaces

The RSO is responsible for reporting information to SMAO and the LaRC Safety Manager. The RSO is a member of the IRC. Recommendations to the committee for approval or disapproval of new uses of ionizing radiation shall be made by the RSO following pre-operational surveys and review of safety procedures. The RSO assists the radiation user as primary contact on a day-to-day basis for matters relating to radiation safety, other than procurement.

3.3.2 Responsibilities

In general the RSO provides administrative and technical guidance to LaRC personnel in the safe use of ionizing radiation. Specific duties of the RSO include:

- Assume control and initiate corrective action in radiation emergencies.
- Coordinate with NRC on matters concerning licensing and other regulatory functions through the LaRC Safety Manager.
- Prepare incident and over-exposure reports required by the NRC and other agencies.
- Perform pre-operational surveys and radiation hazard analyses of all proposed uses of facilities for radioactive material and radiation machines to assure conformity with applicable regulations, standards, and good practice. Recommend to the IRC approval or disapproval of these facilities.
- Perform annual audits of ionizing radiation activity in each organizational unit.
- Maintain a program of personnel dosimetry (film badges, pocket chambers, and so forth). Interpret reports and maintain permanent dosimetry records.
- Perform periodic radiation protection surveys and radiation safety evaluations including leak tests required by the NRC license.
- Assist line management in implementing radiation safety rules and procedures as promulgated by the IRC and/or Federal regulatory authorities.
- Assure that the disposal of radioactive waste is safe and complies with Federal, state, local, and LaRC requirements.
- Maintain OSFH's provided inventories, and forward updates to the LaRC Fire Chief for incorporation into the Emergency Alarm Response System (EARS).
- Provide training and indoctrination of personnel in radiation safety.
- Review all purchase requests for ionizing radiation sources for compatibility with approved programs and licensing requirements.
- Review, sign and forward to the LaRC Safety Manager safety permit requests for the use of radioactive materials (NASA Langley Form 38 “Safety Permit Request-Radioactive Material.”) or radiation emitting machines (NASA Langley Form 48 “Safety Permit Request- Radiation Machine”).
- Inspect and maintain records of all receipts and shipments of ionizing radiation sources.

- Periodically inform the IRC of new developments in the field of ionizing radiation, as they are applicable to activities at LaRC.

3.4 LARC SAFETY MANAGER (HEAD, SAFETY AND FACILITY ASSURANCE BRANCH, SMAO)

3.4.1 Interfaces

The LaRC Safety Manager's interfaces include:

- Responsibility for the technical management of contractual health physics services at LaRC.
- Serving as a member of the IRC (or assign a designee).
- Acting as the primary contact for LaRC management on matters relating to radiation safety.
- Representing the government as the liaison between the RSO and federal regulatory authorities (NRC, OSHA, and so forth).

3.4.2 Responsibilities

The LaRC Safety Manager's responsibilities include:

- Exercising general surveillance over all uses of ionizing radiation at LaRC, including on-site contractor activities to assure radiation use is in conformance with safe practice, pertinent regulations, and with provisions approved by the IRC for specific radiation use authorizations (that is, NASA Langley Forms 38 and 48).
- Deciding whether or not to have the RSO perform the above function.
- Serving as the final reviewing and/or certifying authority on the following documents:
  - NRC License Applications (NRC Form 313).
  - NASA Langley Form 66, "Worker Appointment and Certification Form."
  - NASA Langley Form 44A, "Radiation Hazard Form."
  - NASA Langley Form 38 "Safety Permit Request- Radioactive Material."
  - NASA Langley Form 48 "Safety Permit Request- Radiation Machine."

3.5 RADIATION WORKERS

The OFSH having direct involvement with sources of ionizing radiation shall forward recommendations for appointment of radiation workers as described in Chapter 4, "Routine Procedures and Requirements." Radiation workers are the only persons permitted to handle radioactive materials or to approach sources of radiation closely enough to receive a dose in excess of 100 mrem in a year or a dose rate in excess of 2 mR per hour.

3.5.1 Interfaces

Radiation workers interfaces include:

- Working under the direct authority of the OFSH.
- Exercising authority over all personnel in connection with the safe operation of the device to which the radiation worker is assigned.

3.5.2 Responsibilities

Radiation workers are required to:

- Be cognizant of and comply with the LaRC regulations pertaining to ionizing radiation safety.
- Adhere to the limitations stated in the “Description of Duties” section of the appointment form, and notify the OFSH when:
  - A change in the definition of the limitations is needed.
  - The need to work in restricted areas has ended.
- Ensure that persons who are not qualified radiation workers are not exposed to radiation levels, which produce a dose in excess of 0.1 rem.

Chapter 4

4. ROUTINE PROCEDURES AND REQUIREMENTS

4.1 GENERAL

This chapter sets forth procedures and requirements for processing documents and materials related to ionizing radiation. Questions concerning these procedures and requirements shall be directed to the RSO.

4.2 PROCUREMENT AND RECEIPT

Prior to the procurement and receipt of any source of ionizing radiation, the user or operator of the source shall complete NASA Langley Form 44A, and route to the RSO as the final repository. If an OFSH has not been appointed, the user shall submit NASA Langley Form 44A to the PFSH who then appoints an OFSH for the organization procuring the source of ionizing radiation.

4.2.1 Organizational Facility Safety Head (OFSH)

The OFSH is to:

- Review and approve NASA Langley Form 44A for system compatibility with research objectives.
- Forward approved NASA Langley Form 44A to the RSO.

4.2.2 Radiation Safety Officer (RSO)

The RSO is required to:

- Schedule a pre-operational review with the OFSH upon receipt of NASA Langley Form 44A. The purpose of this review is to provide the OFSH with guidance and assistance in the following areas:
  - Applicability of NASA Langley radiation safety permit requirements.
  - Preparation of NRC license (if applicable).
  - Preparation of safety procedures.
  - Preparation of authorizing documents specified in this chapter.
- Sign NASA Langley Form 44A after the survey and forward to the LaRC Safety Manager.
- Perform receipt inspections and surveys of radioactive material that is delivered to the center.

4.2.3 LaRC Safety Manager

The LaRC Safety Manager is required to:

- On receipt of NASA Langley Form 44A, review the RSO's review and approve or disapprove the purchase of the source of ionizing radiation.
- If disapproved, return NASA Langley Form 44A to the OFSH with a written explanation of disapproval attached. The OFSH may appeal disapproval(s) through his/her Organizational Unit Manager to the Executive Safety Council.

4.2.4 Purchasing Officer, Office of Procurement

Upon receipt of an **approved** NASA Langley Form 44A, complete the information indicated in the upper right hand corner of the form. If a contract is let for purchase of the material, detach Copy 3 of NASA Langley Form 44A and forward Copy 4 to the Logistics Management Team (LMT).

4.2.5 Receiving (LMT)

Upon receipt of any incoming source of ionizing radiation authorized by NASA Langley Form 44A, notify the RSO of its arrival at LaRC within one business day after its arrival. The material shall not be opened or released to the user until the RSO has surveyed the package to document radiation intensities and/or contamination.

4.3 AUTHORIZATION OF USE (SAFETY PERMIT)

Some sources of ionizing radiation require the completion of a NASA Langley Form 38, "Safety Permit Request - Radioactive Material" or NASA Langley Form 48, "Safety Permit Request - Radiation Machine," (referred to generically as radiation safety permits) before the source can be used or operated at any LaRC facility. The RSO is responsible for the determination of radiation safety permit requirements during the processing of NASA Langley Form 44A. The pertinent determining factors which require a radiation safety permit include: duration of exposure, source quantity (mass, volume, etc.), potential exposure configuration, number of handlers, and commercial certifications. The IRC reviews the need for radiation safety permits based on these factors during its quarterly meetings for final dispensation rendering.

The radiation safety permit is a written designation that the particular research experiment, rig, or operation has been reviewed by technically qualified members of the LaRC staff and that all reasonable safety precautions and environmental requirements have been considered and subsequently implemented. The NASA Langley Form 48 for radiation machines or NASA Langley Form 38 for radioactive materials shall be used as appropriate. The NASA Langley Form 38 or NASA Langley Form 48 shall describe the maximum potentially hazardous operating parameters (that is, maximum source strength, kilovoltage, amperage, and so forth) expected during the life of the experiment or operation. Changes in the operational configuration which do not exceed the authorized maximum parameters or change the authorized safety features will not require the processing of a modified Form 38 or 48. Other changes require additional

review and approval by the IRC. The NASA Langley Forms 38 and 48 are valid for a period of one year from date of approval of a modification or initial issuance. Permits which do not require modification can be renewed for a period of four years.

4.3.1 Organizational Facility Safety Head (OFSH)

The OFSH responsibilities include:

- Preparing NASA Langley Form 38 or NASA Langley Form 48 and attaching pertinent drawings, sketches, and supporting information, in conjunction with principle person responsible for the activity. If safety procedures and precautions cannot be adequately described in Block 2 of the form, an attachment may be used.
- Ensuring that all personnel listed as workers on the form are certified radiation workers.
- Forwarding NASA Langley Form 38 or NASA Langley Form 48 and attachments to the RSO.
- Posting the approved radiation safety permit in a conspicuous place at the specified site, or if more practical, in the applicable control center for the site.
- Submitting a memorandum to the LaRC Safety Manager requesting renewal of the safety permit at least 30 days prior to the expiration date or submitting a new NASA Langley Form 38 or NASA Langley Form 48 through channels anytime a change is required in the authorized maximum operating parameters.

4.3.2 Radiation Safety Officer (RSO)

The RSO is required to:

- Perform a radiation hazard analysis of the proposed operation upon receipt of NASA Langley Form 38 or NASA Langley Form 48 and attachments. Work closely with the OFSH during this analysis to provide guidance and assistance in the preparation and acquisition of safety procedures, protective equipment, medical surveillance, and NRC licensing (if required).
- Forward NASA Langley Form 38 or NASA Langley Form 48, attachments, and the hazard analysis (with appropriate recommendations) to the IRC for their review and approval.

4.3.3 Ionizing Radiation Committee

The IRC is required to review NASA Langley Form 38 or NASA Langley Form 48 to determine that all reasonable precautions have been taken and the proposed operations can be carried out with an acceptable level of risk to personnel and equipment. Based on this review the IRC shall recommend approval of the radiation safety permit by the committee Chairperson if sufficiently satisfied upon completion of review that radiation hazards have been adequately addressed, or return the request to the requester if problem areas are evident.

4.3.4 Committee Chairperson

The IRC Chairperson is to:

- Sign the Form 38 or 48 and specify, when appropriate, any special conditions on which approval is based.
- Forward NASA Langley Form 38 or Form 48, and attachments to the Safety Manager.

4.3.5 LaRC Safety Manager

The LaRC Safety Manager is required to:

- Review existing radiation safety permits as part of the annual audit to ensure that they are valid (either not expired or have been reviewed before expiration date).
- Notify the requester when a review will be completed.
- Review NASA Langley Form 38 or NASA Langley Form 48 for impact on the environment or creation of safety hazards outside the scope of radiological health. Based on this review:

  - Approve the NASA Langley Form 38 or 48 and return all attached documentation to the requester, or return NASA Langley Form 38 or 48 and all attached documentation to the requester if problem areas are evident.

Chapter 5

5. SPECIAL PROCEDURES AND REQUIREMENTS

5.1 SPECIAL REQUIREMENTS FOR OFF-SITE RADIATION USE AUTHORIZATION

Prior to approving a NASA Langley Form 38 or 48 for an organizational element of LaRC in which LaRC-owned radiation-producing material or equipment will be used at a temporary job site (a facility not under the administrative control of LaRC), the following requirements shall be satisfied:

- Written authorization shall be obtained from the administration of the facility. If the facility or institution holds a byproduct license from the NRC or an agreement (Appendix A), then the use of byproduct materials should be concurred by that Center's RSO and/or its IRC.
- To assure minimal radiation exposure to individuals and confirm no residual radioactive contamination remains in the off-site facilities, an individual with adequate training and experience in radiological health activities shall be named to select suitable instrumentation and perform monitoring tasks as determined necessary by the LaRC IRC.
- Procedures and arrangements for disposal, to handle radioactive waste generated at the temporary job site, shall be formally specified and approved by the LaRC IRC. The preferred waste disposal method shall be by direct transfer to NRC or agreement state licensee authorized to perform collection and/or disposal of radioactive waste.

All records of radiation surveys, personnel monitoring, and radioactive material transfers shall be maintained by the use supervisor and submitted to the RSO at the completion of the authorized use. Any incidents involving individuals overexposed, lost sources, or contamination problems shall be reported immediately to the RSO.

5.2 INTERIM APPROVALS

5.2.1 RSO/IRC Chairperson

When an immediate use of ionizing radiation is determined necessary, the RSO, with concurrence from the Chairperson, IRC, may temporarily:

- Extend an expiration date of a NASA Langley Form 38 or 48 for a period not to exceed 60 days.
- Add to the sources of ionizing radiation named on an approved authorization provided the sources added will not change the kinds of radiation emissions previously authorized.
- Authorize activities under a new radiation safety permit if the activity must start prior to the next IRC meeting.

The IRC shall evaluate these temporary modifications and, if satisfied that the RSO's action was proper, shall ratify the actions at the next committee meeting. Approvals may be withdrawn at any time if safety violations occur or use of a regulated source is found not to be in compliance with conditions of the approved authorization.

Chapter 6

6. IONIZING RADIATION PROGRAM REQUIREMENTS

The LaRC ionizing radiation program requirements include: audits, training and certification, medical surveillance, receipt, shipping, area designations, radiation dose limits, airborne concentration limits, personnel monitoring, posting and labeling, leak testing, radioactive waste disposal, contract radiography, and in-house mobile radiography.

6.1 AUDITS

The RSO shall be responsible for conducting no less than annually an audit of each facility possessing sources of ionizing radiation. The results of those audits shall be presented to the IRC during their quarterly meetings.

Typical items covered during an audit are:

- Inventories of:
  - All radioactive material.
  - Radiation producing machines.
  - Monitoring instrumentation.

- Records of:
  - Trained and safety certified radiation workers.
  - Personnel monitoring.
  - Calibration of monitoring instrumentation.

- Compliance with terms of the radiation safety permit.
- Conduct of routine radiation protection surveys.

An annual assessment of the radiation safety program will be performed by an individual who does not have direct responsibility for the program. This review will cover topics suitable to meet the annual assessment required by the Nuclear Regulatory Commission in 10 CFR 20.1101(c).

6.2 TRAINING AND CERTIFICATION

All personnel (including contractors) who operate, manipulate, or who have any other type of physical control over the use of radiation-producing equipment or material specifically authorized by a radiation safety permit, are required to be properly trained and certified as radiation workers. Additionally, any person who is likely to receive a radiation dose in excess of 10 percent of the limits as specified in this chapter, as a result of LaRC operations, is to be trained and certified as a radiation worker. It is the responsibility of each OFSH to see that personnel within the facility are properly trained and certified. Questions concerning this requirement shall be directed to the RSO.

6.2.1 Qualifications

As a minimum, and prior to working with ionizing radiation, individuals shall have had either radiation experience and/or training on specific topics. NASA Langley Form 66, is used for Government personnel to determine and certify that the qualifications for worker training and safety certification described above and in accordance with LPR 1740.6, “Personnel Safety Certification.” Contractor personnel shall use a form, which supplies the equivalent information contained in NASA Langley Form 66.

6.2.2 Safety Permits

All radiation workers performing work under an approved radiation safety permit must be certified radiation workers and listed on the permit. Certified personnel may be added to or removed from a permit by the OFSH or RSO without modifying the permit.

6.2.3 Certification Card

Based on the satisfactory completion of NASA Langley Form 66 and/or other documentation of the qualifying status of the worker, the RSO shall issue, revalidate, or terminate a NASA Langley Form 492, "Radiation Worker's Certification Card." The worker shall have the card on-hand or readily accessible, as proof of his/her certification, while performing applicable tasks. Contractors may be issued equivalent cards by their employer.

6.2.4 Recertification

Ionizing Radiation workers are required to be recertified every 2 years. Recertification involves attending refresher training and revalidation of the Certification Card by the RSO. Refresher training can be scheduled by contacting the RSO.

6.3 MEDICAL SURVEILLANCE

Medical surveillance is no longer required for radiation workers.

6.4 RECEIPT

The RSO shall be notified of all arrivals of sources of radiation at LaRC for documentation and inspection. Leak testing is performed, if applicable. The LMT shall furnish the RSO with a copy of the receiving document. All radioactive material shall be delivered by the RSO to the custodian.

6.5 SHIPPING

Sources of radiation, once documented by the RSO and located in a particular facility, shall not be transferred to the accountability of another organization, or transferred from one location to another within LaRC, or removed from the center, without prior notification of the RSO. The RSO notification is in addition to action required for property control procedures.

Off-site shipments (both commercial and by NASA vehicle) require documentation and completion of a NASA Langley Form 56, “Radioactive Material Transfer,” which is to be

included with other relevant shipping documents. Each shipment is to be made in accordance with the applicable Federal, State, and local transportation regulations. These regulations are referenced in Appendix A. All commercial shipments of radioactive material shall be under the cognizance of LMT when the shipment is sponsored by or shipped in connection with a LaRC sponsored project.

6.6 RADIATION GENERATING DEVICES (RGD)

Electronic equipment with high voltage potentials greater than 10 kV under vacuum have the potential of generating x-rays, either intentionally or as a byproduct of their operation. Owners of equipment meeting these criteria shall contact the RSO to have the equipment evaluated. The equipment will be categorized by the RSO based upon equipment design and the results of a radiation survey.

6.6.1 Class 1 RGD

A device may be classified as a Class 1 RGD if its design is such that there is little potential for workers to be exposed to radiation in excess of the dose limits for members of the general public. This category may include equipment such as electron microscopes, certified cabinet x-ray devices, or x-ray package scanners.

Operators of Class 1 RGDs do not require certification as Radiation Workers, but safety guidelines shall be posted near the device. Class 1 RGDs may be monitored using work area dosimetry to verify that workers are not exposed to radiation levels that would require individual monitoring.

6.6.2 Class 2 RGD

Devices which have the potential to cause personnel exposure to radiation above the limits for members of the general public will be categorized as Class 2. This category will include devices such as x-ray machines for non-destructive testing, high energy electron beam devices, and any x-ray device that has an accessible x-ray beam, such as unshielded x-ray fluorescence devices.

Operators of Class 2 RGDs require certification as Radiation Workers and Class 2 RGDs require approved Radiation Safety Permits for their operation.

6.6.3 General Requirements

Regardless of the classification of x-ray devices, operators of RGDs may not move, alter the physical structure, or increase the emission characteristics of an RGD without prior approval from the RSO. The RSO shall make periodic inspections of RGDs to ensure that the classification is still accurate.

NOTE: The RSO will label RGDs with their classification and serial number.

6.7 AREA DESIGNATIONS

There are several area designations, which apply to radiation control at LaRC.

6.7.1 Controlled Area

Any area to which access is controlled for purposes of protection of individuals from exposure to radiation and radioactive material. The term “controlled” is meant to be synonymous with the term “restricted” as used in the NRC Regulations.

6.7.2 Radiation Area

Any area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of .005 rem (0.05 msv) in one hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.

6.7.3 High Radiation Area

Any area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.1 rem (1 msv) in one hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.

6.7.4 Very High Radiation Area

Any area, accessible to individuals, in which radiation levels could result in an individual receiving an absorbed dose in excess of 500 rads (5 grays) in one hour at one meter from a radiation source or from any surface that the radiation penetrates.

6.7.5 Airborne Radioactivity Area

An airborne radioactive area is a room, enclosure, or area in which airborne radioactive materials composed wholly or partly of licensed material exist in concentrations:

- in excess of the derived air concentrations (DAC’s) specified in Appendix B of 10 CFR 20, or
- to such a degree that an individual present in the area without respiratory protective equipment could exceed, in one week, an intake of 0.6 percent of the annual limit on intake (ALI) or 12 DAC-hours.

6.7.6 Uncontrolled Area

Any area to which access is not controlled for purposes of protection of individuals from exposure to radiation and radioactive materials. The dose rate in uncontrolled areas shall not exceed 0.002 rem in one hour. The term “uncontrolled” is meant to be synonymous with the term “unrestricted” as used in the NRC Regulations.

6.8 RADIATION DOSE LIMITS

Radiation dose limits at LaRC are based upon limits specified by the NRC in 10 CFR 20, and by OSHA in 29 CFR 1910.1096. It should be recognized that the LaRC limits

are established as maximum values and, in all cases, personnel exposure should be maintained as far below the limits specified in this part as practical.

6.8.1 Occupational Dose Limits for Adults

Radiation workers shall not be exposed routinely to radiation or radioactive material in a manner that exceeds the following limits:

Exposed Body Area	Rem/Year
Whole body (head, trunk, active blood forming organs, and internal organs)	5 rems total effective dose equivalent or 50 rems total dose to any single organ or tissue, whichever is the more limiting (effective dose equivalent being the sum of the deep dose equivalent (external dose) and the committed effective dose equivalent (internal dose))
Skin or extremities (hands, forearms, leg below the knee, feet and ankles)	50 rem
Lens of the eye	15 rem
Embryo/fetus (declared pregnancy and estimated time of conception)	0.5 rem during entire gestation period

NOTE: In exceptional cases, an individual may be permitted a planned special exposure separate from, and in addition to, the annual dose limits.

6.8.2 Occupational Dose Limits for Minors

An individual under the age of 18 years shall not be permitted to enter or be employed in controlled areas if the individual will receive doses of radiation in amounts exceeding 10 percent of the specified dose limits for adult radiation workers (i.e., 0.5 rem for whole body).

6.8.3 Annual Dose to Members of the Public

Annual dose to members of the public shall not exceed 100 mrem, excluding medical and background radiation and other exposures not related to working in the environs of radiation. Center employees who are not radiation workers are considered to be members of the public.

6.8.4 Dose Limits for Pregnant Workers

Federal regulations provide for a reduced radiation dose limit for declared pregnant radiation workers of 500 mrem for the duration of the gestational period. In order for this dose limit to be implemented the worker must formally declare herself to be pregnant to the RSO. The RSO will perform an evaluation of the work area to determine if any work restriction or alteration will be necessary to minimize exposure.

The worker is provided protection of seniority, time in grade and promotion potential. The declaration is voluntary and may be withdrawn at any time with no stated reason.

Radiation workers who are pregnant or believe that they may be pregnant are urged to contact the RSO for counseling and further details about declaring pregnancy. All discussions and pregnancy declarations will be kept confidential if requested by the employee.

6.9 AIRBORNE CONCENTRATION LIMITS

Airborne concentrations of radioactive materials to which personnel at LaRC may be exposed are specified by the NRC in 10 CFR 20, Appendix B Again, the LaRC limits are established as maximum values, and in all cases airborne concentrations shall be maintained at the lowest practical level.

Working in areas of airborne radioactivity requires extensive engineering and administrative controls. Every effort shall be made to prevent the generation of airborne radioactivity. The RSO should be contacted well in advance of any activity that has the potential to generate airborne radioactivity to ensure that a detailed analysis and work plan are done.

6.10 PERSONNEL MONITORING

Personnel monitoring requirements include:

- Personnel monitoring shall be required in any area where there is a probability that an individual may receive a radiation dose in excess of 10 percent of the specified radiation dose limits described in this chapter.
- The details of the monitoring procedure shall be determined in each case by the RSO in consultation with the OFSH and with consideration of the dose limits.
- Personnel monitoring procedures shall include, as a minimum, the wearing of radiation dosimeters. In addition, an audible warning device shall be worn by all operators and monitoring personnel engaged in the work of radiography. Personnel monitoring devices are available from the RSO with the exception of audible warning devices which are to be procured from the Center Operations Directorate.
- The RSO shall maintain a permanent record of all personnel dosimetry reports. If a report indicates an overexposure, an investigation shall be initiated to determine the cause and to suggest remedial action. The overexposure shall be reported to the NRC in compliance with 10 CFR 19.
- Individuals determined to require radiation monitoring shall be advised annually of their measured dose.

6.11 POSTING AND LABELING

The posting and labeling requirements for LaRC are based on the regulations in 10 CFR 19, 10 CFR 20, and 29 CFR 1910.1096. The radiation symbols prescribed by this Chapter shall be the conventional magenta or purple three bladed design on a yellow background. Any additional information that may minimize exposure to radiation or to

radioactive material shall be on or near signs and labels. Posting and labeling requirements are stated below.

6.11.1 Radiation Area

Each radiation area shall be conspicuously posted with a sign or signs bearing the radiation symbol and the words “CAUTION RADIATION AREA.”

6.11.2 High Radiation Area

Each high radiation area shall be conspicuously posted with a sign or signs bearing the radiation symbol and the words “CAUTION HIGH RADIATION AREA” or “ DANGER HIGH RADIATION AREA.”

All high radiation areas established for a period of 31 days or more, shall be equipped with a control device which will cause the level of radiation to be reduced below that at which an individual might receive a dose of 100 millirem in one hour upon entry into the area or will energize a conspicuous, visible, or audible alarm signal to ensure that the individual entering and the supervisor of the operation are made aware of the entry.

6.11.3 Airborne Radioactivity Area

Each airborne radioactivity area shall be conspicuously posted with a sign or signs bearing the radiation symbol and the words “CAUTION AIRBORNE RADIOACTIVITY AREA.”

6.11.4 Storage Area

In addition to the above, each area in which radioactive material is used or stored and which contains any radioactive material, other than natural uranium or thorium, in an amount exceeding ten times the quantity of such material specified in 10 CFR 20, or which contains natural uranium or thorium in an amount exceeding 100 times the quantity specified in 10 CFR 20, shall be conspicuously posted with a sign or signs bearing the radiation symbol and the words “ CAUTION RADIOACTIVE MATERIAL(S).”

6.11.5 Operating Procedures and General Information

Areas in which individuals are employed in activities covered by these procedural requirements shall be posted with the following to ensure that they are seen by individuals on their way to or from their place of employment, or kept in a suitable place so that they are available for examination upon request:

- A current copy of 10 CFR 19.
- A current copy of 10 CFR 20.
- A current copy of 29 CFR 1910.1096.
- A copy of the NRC license and its reference documents.
- A copy of these procedural requirements (LPR 1710.5).

- A notice of cited violations of appropriate Federal regulations and the resulting LaRC actions.

In addition to the above, NRC Form No. 3, “Notice to Employees,” shall be posted to ensure that it is seen in areas utilizing radioactive materials.

6.11.6 Containers

Each container of radioactive material shall bear a durable, clearly visible label identifying the radioactive contents as to radionuclide, quantity, and date of assay. The label shall bear the radiation symbol and the words “CAUTION RADIOACTIVE MATERIAL(S).”

6.11.7 Radiation-Producing Machines or Equipment

All x-ray machines, x-ray diffraction units, electron microscopes, and other similar equipment shall bear a durable, clearly visible label bearing the radiation caution symbol and these or similar words “CAUTION THIS MACHINE PRODUCES X RADIATION WHEN ENERGIZED.”

6.11.8 Exemptions to Posting and Labeling Requirements

Exemptions to posting and labeling requirements at LaRC shall be approved by the RSO and limited to the following:

- An area is not required to be posted with a sign because of the presence of a sealed source provided the radiation level 12 inches from the surface of the source container or housing does not exceed five millirem per hour.
- Areas are not required to be posted with signs because of the presence of radioactive materials packaged and labeled in accordance with applicable transportation regulations.
- Containers that do not contain materials in quantities greater than amounts specified in 10 CFR 20.
- Containers of only natural uranium or thorium in quantities no greater than ten times amounts specified in 10 CFR 20.
- Containers that do not contain licensed materials in concentrations greater than amounts specified in 10 CFR 20.
- Containers which are attended by an individual who will take precautions necessary to prevent the radiation exposure to any individual in excess of the LaRC limits.
- Containers which are in transport and packaged and labeled in accordance with applicable transportation regulations.

6.12 LEAK TESTS AND INVENTORY OF RADIOACTIVE SOURCES

Tests for leakage and/or contamination shall be performed by the health physics staff as authorized by the NRC to perform such services. Leak tests requirements include the following:

- Each sealed source containing byproduct material, other than Hydrogen 3 and Kr-85, with a half-life greater than 30 days and in any form other than gas shall be tested for leakage and/or contamination at intervals not to exceed six months. In the absence of a certificate from a transferor indicating that a test has been made within six months prior to the transfer, the sealed source shall not be put into use until tested.
- All alpha sources greater than 10 microcuries shall be wipe-tested on a three month interval.
- Notwithstanding the periodic leak test required by the above paragraph, any licensed sealed source containing byproduct material is exempted from periodic leak tests provided the quantity of byproduct material contained in the source does not exceed 100 microcuries of beta and/or gamma emitting material or 10 microcuries of alpha emitting material.
- All other sealed sources in storage are exempted from this test. However, all sources shall be tested for leakage prior to any use or transfer to another person unless they have been leak tested within six months notwithstanding the three months for alpha emitting sources prior to the date of use or transfer.
- The test shall be capable of detecting the presence of 0.005 microcurie of radioactive material on the test sample. The test sample shall be taken from the sealed source or from the surfaces of the device in which the sealed source is permanently mounted or stored on which one might expect contamination to accumulate. Records of leak test results shall be kept and maintained for inspection by the NRC.
- If the test reveals the presence of 0.005 microcurie or more of removable contamination, the RSO shall immediately withdraw the sealed source from use and shall cause it to be decontaminated and repaired or to be disposed of in accordance with NRC regulations. A report shall be filed within five days of the test with the office that is charged with Byproduct Material Licensing, Nuclear Regulatory Commission, Washington, DC 20555, describing the equipment involved, the test results, and the corrective action taken. The report shall also be sent to the Regional Administrator, Region II, Office of Inspection and Enforcement, NRC.

Sealed sources shall be inventoried on a semi-annual basis. Lost sources must be reported to the NRC in accordance with Section 20.2201 of 10 CFR 20.

6.12.1 Requirement

A working and calibrated radiation survey meter may be assigned to facilities housing source(s) of ionizing radiation that require an approved radiation safety permit. The survey meter shall be appropriate for measuring the specific type of radiation emanating from the source (i.e., alpha, beta, gamma, neutron, x ray).

6.12.2 Responsibilities

Specific personnel are responsible for the issuance, maintenance, and calibration of radiation survey meters.

6.12.2.1 Issuance

The RSO, in consultation with the requester of the radiation safety permit, shall designate the appropriate type of survey meter for each application and shall make arrangements for its issuance.

6.12.2.2 Maintenance

The OFSH shall be responsible for assuring that survey meters are kept in good working order and calibrated every year while in use, and after any repair.

6.12.2.3 Calibration

Radiation survey meters used for quantitative measurements must be calibrated annually. Uncalibrated instruments shall be removed from service or labeled to indicate that they are not for quantitative measurements.

6.13 RADIOACTIVE WASTE DISPOSAL

Disposal of radioactive wastes require the following:

SPECIAL WASTE RECEPTACLES SHALL BE PROVIDED BY THE EMT FOR THE DISPOSAL OF LOW-LEVEL RADIOACTIVE WASTE. THESE RECEPTACLES SHALL BE CONSPICUOUSLY MARKED WITH THE RADIATION SYMBOL AND THE WORDS “CONTAMINATED WASTE CAUTION RADIOACTIVE MATERIALS.”

- Separate receptacles shall be provided for low-level waste, and these wastes shall be strictly segregated. Concentrated stock solutions of radioactive materials, sealed sources, and other high-level materials shall not be disposed of in low-level waste containers. The health physics staff, upon request by the OFSH, shall be responsible for disposal or removal and storage of such high-level material.
- The contents of the radioactive waste receptacles shall be collected by the health physics staff periodically. The arrangements for ultimate disposal of all radioactive waste resulting from LaRC operations shall be the responsibility of EMT in conjunction with LMT. Radioactive waste shall be handled as hazardous waste. Disposal of high-level material is limited to an appropriate licensee of the NRC or one of its agreement states who shall conduct final disposal operations.
- Records of all radioactive waste disposals shall be maintained by the RSO.

6.14 CONTRACT RADIOGRAPHY

The Center Operations Directorate often requires the use of contract radiography operations for the nondestructive testing of welds, castings, new construction, and so forth. While the sporadic and uncertain nature of these operations prohibits the effective

use of the NASA Langley radiation safety permit system, the following procedural and safety criteria shall be observed for all contract radiography performed at LaRC.

6.14.1 NASA LaRC Inspector Responsibilities

NASA Inspectors must attend specialized training conducted by the LaRC RSO prior to being certified by their employer as Radiography Monitors.

The NASA LaRC Radiography Monitor responsibilities include:

- at least four hours prior to initiating contract radiography operations, notify the personnel listed below, by telephone, of the location, starting time, and expected duration of the operation:
  - The RSO.
  - NASA LaRC Dispatcher.
  - The Duty Officer at the West Heating Plant, 14 West Taylor Street (Facility 1215).
  - The Facility Coordinator for the facility where the operation is to be performed.
- Be present for the entire duration of the radiographic operation.
- As a trained Radiography Monitor, ensure that the contractor:
  - Establishes a “controlled area” as defined in this Chapter. This shall include the use of physical barriers, as defined in these procedural requirements, and clearly visible signs to prevent unauthorized entry into the controlled radiation area.
  - Complies with this chapter.
  - Attempts to further minimize exposure by the use of shielding devices and beam collimators when available.
- Notify the personnel listed below when contract radiography operations have been completed:
  - NASA LaRC Security.
  - The Duty Officer at the West Heating Plant, 14 West Taylor Street (Facility 1215).
  - The NASA LaRC Fire Department.

The LaRC RSO has prepared a checklist for the Radiography Monitors to use to ensure that the radiographer is operating safely. The checklist shall be completed to the extent possible and forwarded to the RSO after completion of the operation.

6.14.2 Scheduling of Operations

Due to the difficulty encountered in the control of personnel, contract radiography shall not normally be allowed to start until 5:00 p.m. or later on weekdays. Exceptions shall have the prior written approval of the Chairperson, IRC.

6.14.3 Incidents During Radiography

If any of the following situations occur during the conduct of radiography, immediately notify the Duty Officer, the Emergency Dispatcher, and the LaRC RSO:

- The radiography source becomes separated from the control cable or otherwise cannot be retracted into the camera.
- There is a suspected overexposure of personnel.
- Activity is being performed that is unsafe, in the opinion of the radiography monitor.

6.14.4 Conduct of Radiography on Langley Air Force Base (LAFB)

As a tenant of LAFB, LaRC is responsible for complying with all radiation control procedures established by the LAFB RSO. The LaRC and LAFB RSO's have a written agreement for the conduct of operations on LAFB which may be obtained from the LaRC RSO.

6.15 IN-HOUSE MOBILE RADIOGRAPHY (NASA)

When performing mobile radiography operations outside of an approved x-ray laboratory facility, the OFSH shall follow the procedures as presented above. The OFSH shall not be required to submit a new NASA Langley Form 38 or 48 for the mobile operation if the equipment and personnel involved have been authorized by an approved NASA Langley Form 38 or 48 for a permanent x-ray laboratory facility.

6.16 STORAGE OF RADIOACTIVE MATERIAL

Radioactive materials shall be stored in approved locations only. Radioactive materials shall not be stored alongside other items that may cause unintentional releases, such as corrosive chemicals. Radioactive materials shall be kept locked up when they are not in use or in the presence of authorized users. This requirement may be satisfied by either locking the material up in a cabinet or locker or by locking up the work area. In either case, only authorized users may be allowed to have a key to access the material. Radioactive material installed in a piece of equipment that requires disassembly to access the material is exempt from this requirement.

Chapter 7

7. EMERGENCY PROCEDURES

7.1 GENERAL

Contamination is easily spread during an emergency situation such as a fire, explosion, accidental breakage of a container, or spill. The air currents set up by a fire can spread radioactive materials very rapidly and easily. They may also find their way into an air conditioning system, or, if spilled on the floor, personnel may track them around. This contamination is undetectable except by the use of special radiation detecting devices, such as the Geiger counter. Since it is extremely difficult to set up adequate detection controls in an emergency, preplanned emergency procedures are included in these procedural requirements. Personnel whose work involves the use of radioactive materials shall familiarize themselves with these procedures. Should there be a catastrophic radioactive release, response procedures shall be in accordance with LPR 1046.1, “NASA Langley Research Center Emergency Plan.”

7.2 PROCEDURES AFTER RELEASE OF RADIOACTIVE MATERIAL

7.2.1 General Responsibilities

Immediately after the occurrence of a release or spill, the involved person shall:

- Vacate all affected personnel to a safe area and segregate them from other personnel.
- Notify the RSO by telephone or the most rapid method of communication.
- Follow the instructions given by the RSO or an authorized representative.

7.2.2 Specific Precautions

Unless instructions given by the RSO are different, the person involved in the spillage shall take the following steps, provided they do not place themselves at additional risk:

- Prevent all non-emergency personnel from approaching the contaminated area, or from attempting to deal with the spillage.
- Secure sources of ventilation such as HVAC and shut doors and windows as appropriate.
- For incidents that have a potential to cause significant exposure, such as with high dose rate sources or airborne radioactivity, ensure that personnel have evacuated to an area of low exposure potential.

7.2.3 Rules Affecting Conduct of All Personnel

Personnel shall conduct themselves by the following rules:

- No person shall enter an affected area until the health physics staff has conducted a contamination survey and has pronounced the area safe to resume work.
- Unauthorized personnel shall not attempt to make a survey, or to clean up the spillage.
- Decontamination procedures shall ALWAYS be conducted under the supervision of the RSO or an authorized qualified representative.
- Personnel shall be instructed to keep their movements in the contaminated area to a minimum to avoid spreading the contaminant by tracking.

7.3 FIRES IN RADIATION AREAS

Fires in radiation areas shall be handled as described herein.

- In case of fire in areas where radioactive materials are in use, every practical effort shall be made by the user to replace the material in its shielded container. If this is not possible, it shall be the responsibility of the user to promptly notify the NASA LaRC Fire Department and the RSO or alternate.
- NASA LaRC Fire Department personnel shall be knowledgeable of radiation hazards, and are encouraged to contact the health physics staff for periodic instruction. The RSO shall periodically notify the NASA LaRC Fire Department in writing of all locations of radioactive materials in amounts that may prove hazardous to NASA LaRC Fire Department personnel either externally or internally or that may present a serious contamination problem. When responding to one of these locations, the NASA LaRC Fire Chief, in consultation with the RSO, shall ensure that proper procedures are implemented to minimize radiation exposure to personnel and prevent the spread of contamination.

7.4 LOST, MISPLACED, OR STOLEN SOURCES OF RADIATION

Lost, misplaced, or stolen sources of radiation shall be reported immediately to the RSO. The RSO shall promptly prepare all reports required by the NRC after a theft or loss of licensed material. These reports shall then be transmitted by the Safety Manager.

7.5 NOTIFICATION OF ACCIDENTS

Accident notification shall be in accordance with the following procedures:

- A user or operator shall immediately report to the RSO any incident or accident-involving radiation sources, or malfunction of radiation producing equipment. The RSO shall promptly investigate any report and advise NASA LaRC management of the findings. The OFSH and Chairperson, IRC, shall be informed periodically of the progress of the investigation.

- The RSO shall assure that the NRC is notified immediately following an accident as described in 10 CFR 20, Paragraph 20.2202.
- The RSO shall submit a written report, for transmission by the LaRC Safety Manager, to NRC within 30 days following an overexposure to radiation levels and concentrations of radioactive material as described in 10 CFR 20, Paragraph 20.405.

Chapter 8

8. VISITOR CONTROL

Visitors will be allowed to enter radiation areas at LaRC only with approval of the cognizant OFSH and subsequent notification to the RSO. Visitors shall be required to submit their full name, date of birth, social security number, and a statement of previous exposure history so that they can be issued a film badge prior to entry into a radiation area. Visitors within a radiation area shall be accompanied by a certified radiation worker at all times.

Langley Research Center

LPR 1710.6

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ELECTRICAL SAFETY

National Aeronautics and Space Administration

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Responsible Office: Safety and Mission Assurance Office

PREFACE

P.1 PURPOSE

This Langley Research Center (LaRC) Procedural Requirement (LPR) sets forth minimum electrical safety requirements and standards within the framework of LaRC safety policies and constraints. It is for use by professionals routinely engaged in electrical work. It is not an instruction manual for untrained personnel nor is it a substitute for detailed procedures judged necessary for the safe conduct of a specific task by individuals and their supervisors.

These procedural requirements contain both guidance and requirements for the assurance of safe working environments for professionals routinely engaged in electrical work at LaRC.

P.2 APPLICABILITY

These procedural requirements apply to all persons performing work at LaRC, including civil servants, contractors, research associates, and others. Non-compliance with this LPR will result in appropriate disciplinary action that may include termination for a civil servant employee or exclusion from the Center for a contractor employee.

LaRC is a multi-building industrial complex, whereby electrical power is obtained from the local electrical utility and distributed to the various buildings and facilities via a Center-owned and operated power distribution system comprised of industrial substations, high-voltage cabling, and power distribution equipment. For the application of referenced codes, standards, and regulations in this document, the “service points” for buildings and facilities at LaRC are identified on Effort Code 300 Switching Diagrams, which are described in Paragraph 3.3.1. The power distribution system up to the “service point” is covered by ANSI/IEEE C2-NESC, and electrical installations beyond the “service point” are covered by the NFPA 70, “National Electrical Code (NEC).” NFPA 70E is applicable for the same installations covered by the NEC.

P.3 AUTHORITY

Compliance with the latest editions of the following standards and codes is a requirement of this document. A brief explanation of the scope of coverage for each is provided.

a. NFPA 70, NEC: This code covers electrical installation requirements for electrical conductors and equipment installed beyond the “service point” within or on public and private buildings and other premises.

b. NFPA 70B, "Recommended Practice for Electrical Equipment Maintenance": This document covers maintenance of industrial-type electric systems and equipment, electrical testing, and methods for safe de-energization of equipment.

c. NFPA 70E, "Standard for Electrical Safety in the Workplace": This standard is a companion document to the NEC and covers electrical safety-related work practices for the same industries and installations covered by the NEC.

d. ANSI/IEEE C2-NESC, "National Electrical Safety Code": This code covers power and communication lines, equipment, and associated work practices used by both public and private electric supply and similar utilities. It also covers power distribution systems serving multi-building industrial complexes, which are under the control of qualified persons such as the LaRC power distribution system. Major coverage includes methods and installation and maintenance rules for: 1) Grounding, 2) Electric Supply Stations and Equipment, 3) Overhead Electric Supply Lines, 4) Underground Electric Supply Lines, and 5) Operation of Electric Supply Lines and Equipment.

e. OSHA, "Occupational Safety and Health Act": These standards represent federal law and cover conditions, practices, or operations to assure safe and healthful work places. Specific coverage is as follows:

(1) OSHA 29 CFR 1910.147 of Subpart J – Control of Hazardous Energy Sources (Lockout-Tagout): While not an electrical standard, with certain additions this rule can be used for electrical tagout as permitted under OSHA CFR 1910, Subpart S.

(2) OSHA 29 CFR 1910.269 of Subpart R – Power Generation, Transmission, and Distribution: This subpart covers operation and maintenance of equipment used for power generation, transmission, or distribution and under the control of an electric utility.

(3) OSHA 29 CFR 1910, Subpart S – Design Safety Standards and Safety-Related Work Practices: The first paragraph of this subpart covers design and installation requirements for utilization equipment. The remainder covers the procedures required to ensure optimum safety of employees when working around energized or potentially energized equipment.

(4) OSHA 29 CFR 1926, Subpart K – Electrical: This subpart covers electrical safety requirements for employees involved in construction activities.

(5) OSHA 29 CFR 1926.550 of Subpart N – Cranes and Derricks: This subpart covers safety requirements for use of cranes and lifting equipment, including use around exposed energized conductors.

(6) OSHA 29 CFR 1926, Subpart V – Power Transmission and Distribution: This subpart covers electrical safety requirements for employees involved in the construction of new electric transmission and distribution lines and equipment.

f. In addition, the recommendations of industrial consensus standards for electrical equipment design and manufacturing shall be followed to the greatest extent practicable when designing and installing electrical systems at LaRC. Some of these standards- making organizations and coverage are described below:

(1) National Electrical Manufacturer's Association (NEMA) - These standards cover electrical power equipment including standard ratings, performance, testing, manufacturing, and marking.

(2) Electronic Industries Association (EIA) - These standards cover electronic-type electrical equipment and components.

(3) The Insulated Power Cable Engineers Association (IPCEA) and Association of Edison Illuminating Companies (AEIC) - These standards cover insulated power, control, and communication cable.

(4) Institute of Electrical and Electronic Engineers, Inc. (IEEE) - These standards consist of technical reports, testing procedures generally used in electrical power generation, distribution, and utilization.

(5) American National Standards Institute (ANSI) - These standards are a cataloging of new and existing standards under a common file system. The ANSI standard often has dual cataloging designations.

(6) Instrumentation, Systems, and Automation (ISA) Society - These standards and recommendations cover the development and application of industrial instrumentation and process controls.

P.4 APPLICABLE DOCUMENTS

a. NPR 8715.3, “NASA Safety Manual” – The central Agency document that defines the NASA Safety Program.

b. LAPD 1150.2, “Councils, Boards, Panels, Committees, Teams, and Groups” – Defines charter, membership and other responsibilities of boards, panels, committees, and teams at LaRC.

c. LAPD 1700.2, “Safety Assignments” – Defines the duties, functions, and responsibilities of Facility Safety Heads and Facility Coordinators at LaRC.

d. LPR 1710.10, “Safety Clearance Procedures for the Control of Hazardous Energy (Lockout/Tagout)” – Defines the requirements to ensure personnel and equipment safety by controlling hazardous energy sources.

e. LPR 1740.2, “Facility Safety Requirements” – Defines the minimum safety requirements for facilities under LaRC management.

f. LPR 1740.4, “Facility System Safety Analysis and Configuration Management” – Defines the requirements for the LaRC Safety and Configuration Management (CM) programs for the Center’s ground-based research facilities.

g. LPR 1740.6, “Personnel Safety Certification” – Defines the certification requirements for personnel who perform functions at LaRC that require unique occupational safety qualifications.

h. NASA Langley Form 60, "Confined Space Entry Permit.”

i. NASA Langley Form 416, “LaRC Energized Electrical Work Permit.”

j. NASA Langley Form 453, “NASA Langley Safety Operators Permit.”

k. NASA Langley Form 495, “Safety Operation Clearance Procedure.”

P.5 MEASUREMENT/VERIFICATION

None

P.6 CANCELLATION

LPR 1710.6, dated June 5, 2007, is rescinded and should be destroyed.

Original signed on file

Lesa B. Roe
Director

DISTRIBUTION:
305/Safety and Facility Assurance Branch, Safety and Mission Assurance Office
(25 copies)

1 WORK REQUIREMENTS

1.1 Implementation of the NEC

1.1.1 The NEC is revised and a new edition is issued on a 3-year cycle. The policy for implementation of the revised edition of the NEC for use at LaRC is:

1.1.1.1 The Chairperson, Electrical Systems Committee (ESC), will issue a memorandum establishing the date of implementation for all new editions of the NEC. (See LAPD 1150.2, "Councils, Boards, Panels, Committees, Teams and Groups.")

1.1.1.2 There is no general provision in the NEC requiring any NEC changes or updates to be retroactive. Therefore, the upgrade of an electrical system merely to meet the changed NEC is not required.

1.1.1.3 The revised NEC requirements shall immediately be implemented if the implementation will improve the safeguarding of personnel or will protect LaRC equipment. Such determinations will be made in consultation with the Office of the Chief Counsel, the Center Operations Directorate, and the Safety and Mission Assurance Office.

1.1.1.4 The requirements of the latest adopted version of the NEC shall be used for all new electrical work unless there are more stringent requirements imposed by LaRC policy.

1.1.1.5 If a facility is being constructed when the new NEC is adopted, the ESC will evaluate the new NEC requirements and determine if there are reasons to incorporate any changes into the construction contract. If so, the ESC will issue a memorandum to the appropriate line organizations requesting that these changes be incorporated into the contracts.

1.1.1.6 Electrical equipment, which is modified, shall be brought up to the requirements of the latest version of the NEC unless the modifications to the equipment do not significantly change the function or design of the system. Electrical wiring and equipment that is not included in the modification does not have to be updated.

1.2 Definitions

1.2.1 Buddy System: The practice of employing a second qualified person to directly observe the electrical work of a qualified electrical person working on or near unguarded electrical equipment. System voltage and work location will determine the qualifications of the second person.

1.2.2 Cardiopulmonary Resuscitation (CPR): A procedure designed to restore normal breathing after cardiac arrest that includes the clearance of air passages to the lungs and heart massage by the exertion of pressure on the chest.

1.2.3 De-energized: Free from any electrical connection to a source of potential difference and from electrical charge; not having a potential different from that of the earth. (NFPA 70E)

1.2.4 Electrically Safe Work Condition: Energized at less than 50 volts or de-energized, locked and tagged, tested to ensure the absence of voltage, and grounded if deemed necessary. (NFPA 70E)

1.2.5 Energized: Electrically connected to a source of potential difference.

1.2.6 Energized Electrical Work Permit: A management approved, written permit required by NFPA 70E to work on energized equipment that cannot be placed in an electrically safe work condition.

1.2.7 Exposed (as applied to energized parts): Capable of being inadvertently touched or approached nearer than a safe distance by a person, especially parts that are not suitably guarded, isolated, or insulated. (NFPA 70E)

1.2.8 Fail-Safe: The capability to go to a predetermined safe state (i.e. minimum energy or minimized hazard condition) in the event of a specific malfunction.

1.2.9 Field Verified (as applied to electrical configuration controlled drawings): Verification that the drawing accurately depicts the configuration of installed systems or equipment by visual comparison and by point-to-point wire checks prior to placing the system into service. Point-to-point wire checks require ringing out or talking down the wiring between points of termination and are usually done during installation.

1.2.10 Functionally Verified (as applied to electrical configuration controlled drawings): Verification that the drawing accurately depicts the configuration of a functional system or equipment by visual comparison.

1.2.11 Grounded: Connected to earth or to some conducting body that serves in place of the earth. (NFPA 70E)

1.2.12 Guarded: Covered, shielded, fenced, enclosed, or otherwise protected by means of suitable covers, casings, barriers, rails, screens, mats, or platforms to remove the likelihood of approach or contact by persons or objects to a point of danger. (NFPA 70E)

1.2.13 High Voltage: Voltage class designation for electric power systems and equipment operating above 600 volts.

1.2.14 Live Part: Energized conductive component. (NFPA 70E)

1.2.15 Lockout/Tagout (LOTO): The full procedure of determining what is required to make a system safe; the action of making the system safe; and the placing of locks, locking devices, and red tags to preclude changing from the safe condition.

1.2.16 Low Voltage: Voltage class designation for electric power systems and equipment operating at 600 volts or less.

1.2.17 Qualified Electrical Person: One who has been trained in and demonstrates adequate knowledge of the installation, construction, and operation of electrical equipment and has received electrical safety training on the hazards involved. One who is undergoing on-the-job training and, who in the course of such training, has demonstrated an ability to perform duties safely at that level of training, and who under the direct supervision of a qualified electrical person, is considered to be a qualified electrical person for the performance of those duties.

1.2.18 Qualified Industrial Person: One who has been trained in and demonstrates adequate knowledge of the installation, construction, and operation of industrial equipment and has received safety training on the hazards involved, has received electrical safety training, and is a non-electrical Safety Operator with an electrical designation of 600 Volts. The 600 Volt designation permits operation of switches, circuit breakers, or disconnects to isolate electrically driven equipment for non-electrical maintenance but does not permit the use of electrical test equipment on exposed energized parts.

1.2.19 Safety Operator (SO): Individual who has been qualified and certified to perform Red Tag Lockout/Tagout on electrical systems for which the Red Tag LOTO is requested and possesses a current NASA Langley Form 453, "NASA Langley Safety Operators Permit." LaRC SO's are the only persons authorized to hang or remove red locks, red tags, and associated locking hardware.

1.2.20 Service Point: The point of connection between the facilities of the serving utility and the premises wiring. (NEC) Service points for the facilities at LaRC are identified on Effort Code (EC) 300 Switching Diagrams.

1.2.21 Unqualified Person: A person who is not qualified. (NFPA 70E)

1.2.22 Voltage (of a circuit): The greatest root-mean-square (rms) (effective) difference of electrical potential between any two conductors of the circuit concerned. (NFPA 70E)

1.3 General Requirements

1.3.1 Consider all electrical circuits and equipment energized until properly tested by a qualified electrical person and witnessed by a second qualified person.

1.3.2 Equipment operating at or above 50 volts shall be de-energized and have lockout/tagout performed prior to performing maintenance, service, and troubleshooting if there is a possibility that an employee may work on or near exposed energized parts in accordance with NFPA 70E, Art. 130.1. Energized parts that operate at less than 50 volts to ground need not be de-energized if there will be no increased exposure to electrical shock or other injuries resulting from direct or indirect electrical contact.

1.3.3 The buddy system, a second qualified person directly observing the operation, is mandatory whenever electrical work (including measurements) is to be performed on exposed energized parts exceeding 250 volts to ground or is conducted in a high risk area with exposed energized parts exceeding 600 volts. For voltages up to 600 volts, the second person may be qualified electrical person or a qualified industrial person. For voltages exceeding 600 volts, the second person must be a qualified electrical person. Table 1.3.3 provides specific buddy system requirements based on type of work and voltage.

Table 1.3.3 – Buddy System Requirements

	Voltage			
Type of Work	**Less than 50V**	**50 – 250 V**	**251 – 600 V**	**Greater than 600 v**
De-energized	NBR	NBR	NBR (1)	NBR (2)
Diagnostics & Testing	NBR	NBR	QEP or QIP	QEP
Energized (3)	NBR	NBR + LF 416	QEP or QIP + LF 416	QEP + LF 416

NBR = No Buddy Required
QEP = Qualified Electrical Person
QIP = Qualified Industrial Person

(1) QEP or QIP required until system is verified to be de-energized.
(2) QEP required until system is verified to be de-energized.

(3) Energized work is not permitted without an Approved LF 416, LaRC Energized Electrical Work Permit.

1.3.4 Before commencing work on any mechanical equipment or systems which have electrical connections or contain explosive, combustible, or other dangerous gases or fluids, the equipment or systems shall be properly grounded and/or made safe in accordance with other LaRC safety regulations concerning these materials.

1.3.5 Disconnecting means shall be legibly marked to indicate its purpose, unless located and arranged so the purpose is evident. Labeling shall indicate the source of power for the disconnecting means.

1.3.6 Up-to-date circuit directories shall be provided on all panelboards to clearly identify the purpose or load of each circuit. Circuit identification shall be in sufficient detail to distinguish each circuit from all others.

1.3.7 Switchboards, panelboards, and motor control centers shall be clearly labeled to warn qualified persons of potential arc flash hazards when working on energized equipment. Labeling shall meet the requirements of the NEC.

1.3.8 Electrical wall outlets shall be labeled to indicate the source electrical panel number and circuit number.

1.3.9 Identification markings on building light and power distribution panels, circuits, and components shall not be relied on for establishing safe work conditions.

1.3.10 Ground wires or connections to frames or cases are not to be removed from any energized equipment.

1.3.11 Earth return shall not be used in the wiring of any power circuit.

1.3.12 Non-conductive fish tape shall be used when pulling wires through a conduit into energized equipment.

1.3.13 Commutating-type tools shall not be operated in close proximity to volatile materials.

1.3.14 Portable ladders shall have non-conductive side rails, if they are used where the employee or ladder could contact exposed live parts operating at 50 volts or more or where an electrical hazard exists. Nonconductive ladders shall meet the requirements of ANSI standards for ladders in NFPA 70E, Table

130.7(F). Metal ladders shall be marked with signs or decals reading **CAUTION - DO NOT USE NEAR ELECTRICAL EQUIPMENT**.

1.3.15 When possible, stand to the side away from the door/cover when operating (opening or closing) disconnect switches.

1.3.16 Only devices designed for voltage testing and rated for the nominal voltage of the circuit under test shall be used to make voltage checks. Test voltage indicators shall be verified immediately before and after use by application to an energized circuit or by using an appropriate test unit.

1.4 Specific Requirements

1.4.1 Live Work Requirements

1.4.1.1 Live parts to which an employee might be exposed shall be put into an electrically safe work condition and locked/tagged out before an employee works on or near them, unless the employer can demonstrate that de-energization introduces additional or increased hazards or is infeasible due to equipment design or operational limitations. (NFPA 70E, Art. 130.1)

1.4.1.2 Equipment normally energized above 600 volts shall always be considered energized unless protective grounds and/or other appropriate safety measures, in accordance with LPR 1710.10, “Safety Clearance Procedures for the Control of Hazardous Energy (Lockout/Tagout),” are confirmed to be in place.

1.4.1.3 If de-energizing equipment introduces additional or increased hazards or is infeasible due to equipment design or operational limitations, a detailed procedure shall be developed for the energized work and documented on NASA Langley Form 416, “Energized Electrical Work Permit.” The detailed procedure may be a separate document referenced by the Energized Electrical Work Permit. Work authorized by the Energized Electrical Work Permit shall be performed only by electrically-qualified personnel.

1.4.1.4 No work (other than performing routine testing, troubleshooting, and voltage measurements) shall be performed on energized power circuits of 600 volts or less without a NASA Langley Form 416.

1.4.1.5 Removal of switchgear panels or panel door barriers from energized circuits above 600 volts for inspection, data gathering or infrared testing of the exposed energized bus shall not be performed without an NASA Langley Form 416.

1.4.1.6 Workers shall not work alone on equipment with exposed energized parts operating at greater than 250 volts to ground.

1.4.2 Personal Protection Equipment (PPE)

1.4.2.1 Personal Protective Equipment (PPE) shall be used to mitigate the hazards of electrical shock and electrical burns from arc-flash when work is to be performed on energized equipment and personnel are within the approach boundaries for shock protection as defined in NFPA 70E, Art. 130.2, and within the flash protection boundary for arc flash as defined in NFPA 70E, Art. 130.3(A).

1.4.2.2 PPE shall be selected based on the requirements of NFPA 70E, Art 130, Table 130.7(c)(9)(a) defining hazard/risk category for electrical tasks and Table 130.7(c)(10) defining required PPE based on hazard/risk categories. (See Appendices A and B.)

1.4.2.3 Conductive articles of jewelry and clothing (such as watchbands, bracelets, rings, key chains, necklaces, metalized aprons, cloth with conductive thread, metal headgear, or **metal frame glasses**) shall not be worn without appropriate PPE where they present an electrical contact hazard with exposed live parts.

1.4.2.4 Rubber gloves alone shall not be relied upon for protection from energized circuits of more than 3500 volts to ground.

1.4.3 Storage of Protective Devices

1.4.3.1 Protective equipment shall be maintained in a safe, reliable condition. The protective equipment shall be visually inspected before each use. Specific requirements for periodic testing of electrical equipment are given in NFPA 70E, Art. 130.7(C)(8).

1.4.4 Hard Hat Area

1.4.4.1 Electrical substations with exposed bus are designated as “hard hat” areas. Personnel within the confines of these substations shall wear Class E, Type 1, or Type 2 hard hats.

1.4.5 Welding

1.4.5.1 Welding or burning shall not be permitted in the immediate vicinity of electrical equipment. This requirement shall not restrict the work associated with the splicing or termination of lead-sheathed cable. Any deviations to this paragraph shall have the concurrence of the Facility Coordinator and the Electrical Standard Practice Engineer.

1.4.6 Lockout/Tagout

1.4.6.1 The application of lockout/tagout devices shall be in accordance with LPR 1710.10, “Safety Clearance Procedures for the Control of Hazardous Energy (Lockout/Tagout).”

1.4.7 Confined Space Entry

1.4.7.1 A LaRC approved NASA Langley Form 60, “Confined Space Entry Permit,” shall be required before entry into confined spaces, such as manholes or vaults, in accordance with LPR 1740.2, “Facility Safety Requirements.”

1.4.8 Portable Equipment Grounding

1.4.8.1 The cases of all portable electrical motor-driven hand tools are to be grounded by use of standard three-prong plugs and receptacles and all other electrical equipment supplied with 50 volts or above are to have their cases or frames connected to ground, except:

(a) Devices operated solely from self-contained batteries

(b) Devices which have cases and all exposed parts protected by insulating material

(c) “Double insulated” tools

1.4.9 Temporary Wiring

1.4.9.1 Temporary wiring shall be permitted during periods of construction, remodeling, maintenance, repair, emergencies, and demolition of buildings, structures, equipment, or similar activities.

1.4.9.2 Temporary wiring shall be permitted during tests, experiments and developmental work lasting no longer than 90 days. For tests, experiments and developmental work lasting more than 90 days, permanent wiring methods must be used unless temporary wiring is approved by the LaRC Safety Manager for the required time period exceeding 90 days.

1.4.9.3 Temporary wiring shall be installed with the same level of safety and quality as required for permanent wiring methods.

1.4.9.4 Temporary wiring shall be removed immediately upon completion of construction or purpose for which the wiring was installed.

1.4.9.5 Temporary wiring shall not be run directly on ungrounded conductive surfaces but shall be supported by suitable wood or other insulating materials.

1.4.9.6 Temporary wiring shall be kept out of water at all times unless listed for that purpose.

1.4.9.7 Temporary wiring shall conform to the requirements of NFPA 70 - NEC.

1.4.10 Extension Cords

1.4.10.1 Extension cords usage shall abide by the restrictions for temporary wiring as delineated in Section 1.4.9 of this document.

1.4.10.2 Extension cords may be used for temporary applications only and shall not be used for more than 90 consecutive days without LaRC Safety Manager Approval.

1.4.10.3 Where extension cords are utilized, they shall not be:

(a) Used as a substitute for the fixed wiring of a structure

(b) Routed through holes in walls, ceiling, or floors

(c) Run through doorways, windows, hinged door openings in enclosures, or similar openings. If it is absolutely necessary to run an extension cord through a doorway or open window for short-term use, it shall be protected from damage should the door or window slam shut, and shall be removed immediately when no longer in use, and shall not pose a trip hazard.

(d) Attached to building surfaces

(e) Concealed behind building walls, ceilings, or floors

1.4.10.4 Unmodified, commercially manufactured extension cords rated “Heavy Duty” or “Extra-Heavy Duty” in continuous lengths without splices, and Underwriter’s Laboratory (UL) listed shall be used for 120 Vac single-phase service, except as permitted in 1.4.10.5.

1.4.10.5 Extension cords for special applications, such as 120 Vac single-phase in lengths longer than those commercially available, and 208 Vac or 480 Vac three-phase service, may be fabricated as required by qualified electrical personnel only using cords classified as SO, ST, or SJ in continuous lengths and UL listed plugs and receptacles. At the time of fabrication extension cords shall be tested by a qualified electrical person for proper wiring and grounding and a blue tamper-proof padlock inspection seal installed on the plug and receptacle to indicate the cord is properly constructed and to prevent unauthorized modification. The blue tamper-proof inspection seals

can be obtained from the LaRC Safety Manager by qualified electrical personnel only along with justification for fabrication of the extension cords.

1.4.10.6 Extension cords shall have adequate current carrying capacity to handle the maximum current draw of the connected electrical device. Extension cords shall be sized in accordance with NFPA 70B, Table 20-5 based on cord length and load current.

1.4.10.7 Extension cords shall not be used to power high current equipment. High current equipment (i.e. Microwave ovens, space heaters, and coffee pots) shall be plugged directly into wall receptacles.

1.4.10.8 Extension cords shall be of the three-pronged grounded type, and suitable for the conditions of use and location. Two-conductor extension cords shall not be used, even if the device it serves uses a two-prong plug.

1.4.10.9 In outdoor or wet locations, and in areas where a person may come in contact with a solidly grounded conductive object, such as building structural steel or pressure vessel, extension cords shall utilize integral or separate Ground Fault Circuit Interrupters (GFIC's) for shock protection.

1.4.10.10 Extension cords shall not be daisy-chained (one extension cord plugged into another extension cord) except that a GFCI cord set, 3 feet in length or less, may be connected between a wall receptacle and an extension cord to provide shock protection. A GFCI cord set longer than 3 feet is considered to be an extension cord with integral GFCI protection and shall not be daisy-chained with other extension cords.

1.4.10.11 Extension cords with molded multiple receptacles are permitted provided that the total connected load does not exceed the cord ampacity.

1.4.10.12 Extension cords that are frayed, cut, or damaged such that inner conductors are visible, or that have outer sheaths that have pulled away from their molded plugs shall not be used and shall be removed from service.

1.4.10.13 Examples of acceptable and unacceptable extension cord configurations are shown in Appendix D.

1.4.11 Relocatable Power Taps (RPT) or Power Strips

1.4.11.1 A Relocatable Power Tap (RPT), commonly referred to as a power strip, is a variation of an extension cord, where the cord terminates in a row or grouping of receptacles. RPTs are commonly used in offices to provide multiple receptacles to office equipment. Because an RPT is a variation of an extension cord, in additiion to the requirements for RPT usage deliniated in

this section, RPT usage shall comply with the requirements for extension cords as delineated in Section 1.4.10.

1.4.11.2 Only UL approved RPTs shall be permitted for use.

1.4.11.3 Except as permitted in 1.4.11.4, RPTs shall not be permanently mounted to any facility surface; however, RPTs may hang from screws or hooks if the RPT is manufactured with slots or keyholes for that purpose.

1.4.11.4 RPTs specifically designed for installation in equipment racks is a permissible method for supplying utility power to rack mounted equipment.

1.4.11.5 A surge protector power strip is an RPT intended to protect sensitive electronic equipment from transient over-voltages. Surge protectors shall only be permitted to supply power to sensitive electronic such as computers, printers, monitors, scanners, and printers. Only surge protectors UL approved and listed as a “Transient Voltage Surge Suppressor” may be used in surge protector applications.

1.4.11.6 Surge protectors shall have an internal circuit breaker to protect the unit from being overloaded and to prevent overheating and fire.

1.4.11.7 Surge protectors shall not be located in moist or damp locations, or in areas where the unit may be covered by carpet, furniture, or any other item that will limit or prevent air circulation.

1.4.11.8 Surge protectors shall have a minimum energy suppression rating of 1200 joules.

1.4.11.9 Extension cords or additional RPTs may not be plugged into an RPT because this is considered daisy chaining, which is a prohibited application of extension cords.

1.4.11.10 RPTs shall not be used to power high current equipment. High current equipment (i.e. Microwave ovens, space heaters, and coffee pots) shall be plugged directly into wall receptacles.

1.5 Above 600 Volts (High Voltage)

1.5.1 Protective Grounding - General

1.5.1.1 Protective grounds are temporary grounding and short circuiting conductors, which are placed on de-energized electrical equipment for personnel protection. These grounds are a temporary protective measure and should not be confused with the fixed ground system required by NEC. Protective grounds are normally used to prevent accidental energizing of equipment and systems and shall be applied to any equipment when, in the opinion of the worker, the worker's supervisor, or the safety supervisor, the application is required. If protective grounds are determined to be necessary, they shall be applied before beginning work on systems or equipment, which may bring

personnel into contact with parts, which are normally energized above 600 volts.

1.5.1.2 The Safety Operator shall be responsible for testing the system to ensure that no voltage is present prior to providing safety clearance. When grounds are determined to be necessary, it shall be the responsibility of the Safety Operator to ensure that adequate grounds are placed for the protection of the workers.

1.5.1.3 Before attaching protective grounds, the equipment or circuit to be protected shall be de-energized, tested to verify that the voltage is zero, and locked and tagged as required by LPR 1710.10. All conductors, static wires, circuit neutrals, and cable sheaths shall be connected in a manner which will ground all conductive portions of the circuit to a common point. The protective grounds shall not be removed until all workers are clear of the circuit or equipment. The ground end of the protective grounding cable shall always be connected first and disconnected last. Protective grounding cables shall not be less than 2/0 AWG copper or equivalent. Special requirements for some specific configurations are given below.

1.5.2 Protective Grounding - Overhead Lines and Pole Work

1.5.2.1 All protective grounding cables shall be connected to an approved ground point, which may be a grounded metal structure, a substation ground point, an anchor rod, or a driven or screw-type ground rod. A multi-grounded common neutral of 2/0 AWG copper or equivalent is an acceptable ground for pole work. Pole guy wires are not acceptable ground points.

1.5.2.2 Circuit conductors shall be grounded by attaching the grounded cables to the conductors, progressing upward and outward from the work point. Personnel shall remain as far below the conductors as possible, keeping clear of the grounded cables and clamps. At the completion of work, grounding cables shall be removed in reverse order from installation, keeping clear of the cables and clamps until all conductors have been ungrounded.

1.5.3 Protective Grounding - Transformers

1.5.3.1 Before working on transformers, the following shall be performed:

(a) Open the transformer primary disconnect switch

(b) Remove the secondary fuses or open the secondary breaker

(c) Check the system to verify that the voltage is zero

(d) Install protective grounds

(e) Install insulated barriers or boards to isolate energized studs

1.5.3.2 Where connected transformers are in the zone between protective grounds, the primary side of the transformer shall be disconnected by either removing the line taps or opening the fuse cutouts. Where primary line work is to be performed on the transformer, the secondary wires shall also be disconnected or protective grounds applied. The secondary neutral, if established as grounded, may be considered as an adequate ground. On distribution transformers, the secondary neutral shall be considered an adequate ground for protective grounding, if the permanent ground is interconnected with the secondary neutral, the transformer case and a ground electrode.

1.5.4 Protective Grounding - Current and Potential Transformers

1.5.4.1 Before working on an instrument or other device in a current transformer secondary circuit, the transformer secondary circuit shall be shorted together or bridged in such a manner as to prevent opening the secondary circuit.

1.5.4.2 Current transformer cases and secondaries shall be grounded.

1.5.4.3 When more than one set of current transformer secondaries are electrically connected, a ground point shall be selected that provides grounding for the network.

1.5.4.4 When the primary circuit is energized, secondaries of current transformers shall not be opened.

1.5.4.5 The case and one wire on the low-voltage side of a potential transformer shall always be grounded before energizing the transformer.

1.5.5 Protective Grounding - Power Capacitors

1.5.5.1 A period of at least five minutes shall elapse after de-energizing power capacitor units or banks before protective grounds are installed. All capacitor units in the working area, and any other capacitor units adjacent to the working area that could be contacted, shall be short circuited and grounded.

1.5.5.2 All individual power capacitor tanks shall be grounded. In the case of capacitors installed in banks on insulated conductive mounting racks, the racks shall also be grounded before working on the bank.

1.5.6 Protective Grounding - Underground Cables

1.5.6.1 Protective grounding of conductors in underground cables cannot always be performed at the point of work. Protective grounds shall be attached at the nearest location where the conductors can be reached. Conductive sheathing or shielding tape shall have a protective ground applied on both sides of the work point.

1.5.7 Underground Utilities and Operations - General Requirements

1.5.7.1 A LaRC approved NASA Langley Form 60, “Confined Space Entry Permit,” shall be required before entry into any manhole or vault as required in Paragraph 1.4.7.1 of this document. For specific requirements related to confined space entry, see LPR 1740.2.

1.5.7.2 Manhole cover hooks, cover lifters, or recessed handles shall be used for removing or replacing manhole covers.

1.5.7.3 Open manholes, hand holes, or vault gratings shall be protected by suitable barriers or guards and adequate lighting shall be provided during hours of darkness. In addition, safety cones and warning flags shall be used to direct vehicular and pedestrian traffic around such openings.

1.5.7.4 When practicable, manholes shall be entered or exited by means of a ladder.

1.5.7.5 When working in manholes, hand holes, or vaults, one person shall be stationed on the surface, to be readily available to those working below the surface.

1.5.7.6 Tools and materials shall be raised or lowered in manholes by means of a suitable bucket, toolbox, or rope.

1.5.7.7 Manhole covers and gratings shall be properly seated when replaced.

1.5.7.8 Approved lighting units shall be used when working underground, or below grade.

1.5.7.9 Air-driven tools used around energized cables shall be grounded.

1.5.7.10 Digging permits shall be required for excavations of 6 inches or deeper in accordance with LPR 1740.2.

1.5.8 Gas and Fumes

1.5.8.1 No one shall smoke, strike matches, or permit any other type of open flame in, or in close proximity to, a manhole or vault being ventilated until tests have determined that it is safe from gases or fumes.

1.5.8.2 Before entering a manhole or vault, forced ventilation shall be provided or appropriate gas detection tests (approved by the LaRC Safety Manager) shall be performed. If gas or fumes are detected, no one shall enter the manhole or vault (except as provided for in Paragraph 1.5.8.5) until thorough ventilation has been accomplished and tests made to ascertain that the gases or fumes have been eliminated.

1.5.8.3 When ventilating a manhole or vault to eliminate gases or fumes, the manholes on either side shall be opened when practicable.

1.5.8.4 Except where forced ventilation is provided, gas tests shall be made at regular intervals when underground work is in progress in manholes, hand holes, and vaults. If gases or fumes are detected, the manhole or vault shall be vacated promptly, ventilation started, and the condition reported to the supervisor.

1.5.8.5 If it should become necessary to perform work in a manhole or vault containing gases or fumes, no one shall enter except under direct authorization of the LaRC Safety Manager. The LaRC Safety Manager's representative shall be present and responsible for seeing that approved respiratory protective equipment and ventilation equipment are used.

1.5.9 Energized Cables in Manholes

1.5.9.1 All cables in manholes shall be considered as sources of potential shock and arc flash. Tests shall be made to verify that there is no voltage between the outer sheaths and grounds.

1.5.9.2 Even though cables are shown to have no potential between their outer sheath and ground, contact shall be avoided unless necessary to complete some specific item of work. High voltage gloves shall be worn unless the cable has been de-energized.

1.5.9.3 When working around energized cables in manholes, a physical barrier shall be provided to prevent contact of new cables, equipment or personnel with the existing energized cables. If energized cables cannot be physically isolated such that barriers can be installed to prevent potential arc flash hazards created by inadvertent contact with the energized cables, appropriate arc flash PPE shall be utilized.

1.5.9.4 Only qualified workers shall be permitted to work in electrical manholes or cable tunnels if energized cables are present. Unqualified workers may assist in these operations if adequate supervision and safety guarding of the unqualified worker is provided.

1.5.9.5 The conductive sheathing or shielding tape of all energized cables adjacent to the underground work area shall be verified to be grounded prior to commencing work. If ground verification is not feasible, then barriers shall be installed to prevent workers from making contact with energized cables or equipment. If neither barrier erection nor ground verification is feasible, all cables adjacent to the work area shall be de-energized.

1.5.10 Cutting and Splicing Power Cables

1.5.10.1 Splicing or taping of energized power cables shall not be permitted.

1.5.10.2 Before cutting into de-energized high voltage cables (above 600 volts) for the purpose of making repairs or removing the cables from the raceway system, workers shall also comply with the instructions elsewhere in these procedural requirements covering clearing, tagging, testing, grounding, and short circuiting, and shall also comply with the following requirements.

1.5.10.3 Before spiking or cutting, cables shall be identified by tags, ducts, and/or duct records. Tags and ducts associated with the cables shall be checked against records. Physical checks will be made on either side of the location where the work is to be performed. When the ends of the high voltage power cable are accessible and can be "open circuited," apply a pulsating test current to the conductor and use a current measuring instrument to positively identify the cable. After the cable has been identified, either procedure "A" or "B" shall be followed to ensure that the cable is de-energized. After spiking, if no voltage is detected, the cable may be cut. Workers shall be located outside of the manhole during remote spiking or cutting of cables located in a manhole.

<u>1.5.10.4 PROCEDURE “A”</u>

(a) Spike the cable by using a remotely operated grounded, spiking device. The spiking device shall be installed on the cable using rubber gloves or an insulated stick and shall be actuated remotely by an insulated stick or by a hydraulically actuated or other mechanically actuating device. A spiking device that cuts through the cable is permitted provided that the cutting head is grounded.

1.5.10.5 PROCEDURE "B"

(a) Rubber gloves shall be worn when removing sheathing or shielding tape, when testing for voltage, and when cutting or spiking cables.

(b) A metallic jumper shall be installed to bond the metallic sheathing or shielding tape on each side of the proposed location for cutting the cable.

(c) At least 10 inches of sheathing or shielding tape shall be removed for the full circumference of the cable without disturbing the insulation. The cable shall then be tested for voltage with a voltage detector. The voltage detector shall be given a reliability test before and after the voltage test.

(d) If no voltage is detected, one-half of the insulation shall be removed. Test the cable for voltage. If no voltage is detected, the cable may be spiked with a remotely actuated, grounded spiking device. A spiking device that cuts through the cable is permitted provided that the cutting head is grounded.

1.5.11 Racking Medium and High Voltage Circuit Breakers

1.5.11.1 Racking of medium and high voltage circuit breakers for clearance to work on electrical circuits or during facility operations shall be performed by personnel who have been certified as Safety Operators for the specific equipment in accordance with LPR 1710.10.

1.5.11.2 The buddy system shall be used during the "rack in" or "rack out" of a circuit breaker.

1.5.11.3 Circuit breakers shall not be racked into operating position with the closing springs charged or fully compressed.

1.5.11.4 All unqualified personnel shall be cleared from the immediate and adjacent areas during racking operations, a minimum distance no less than the "Flash Protection Boundary" for flash protection defined by NFPA 70E, Art. 130.3(A) and Paragraph 4.1.5 of this document.

1.5.11.5 Appropriate PPE shall be selected and used during racking operations.

1.5.12 High Voltage Switching

1.5.12.1 All electrical switching required for clearance to work on electrical circuits shall be performed by personnel who have been certified as Safety Operators for the specific equipment in accordance with LPR 1710.10.

1.5.12.2 Appropriate PPE shall be used when operating high-voltage disconnecting switches. The minimum clear insulating length for disconnect poles shall be in accordance with OSHA 29 CFR 1926.950, Table V-1 and as indicated below. The minimum length for disconnect poles is the combination of minimum clear insulating length between the head and protective collar (or identifying mark) and the minimum handle length for the applicable voltage range.

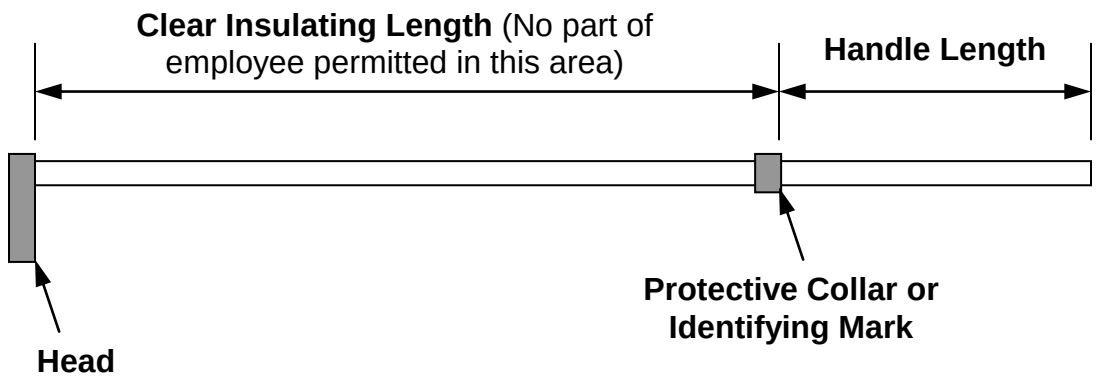

Figure 1.5.12.2 – Lengths for Disconnect Poles

	Minimum Disconnect Pole Lengths		
Voltage Range (Phase to Phase)	**Minimum Clear Insulating Length**	**Minimum Handle Length**	**Minimum Pole Length**
601 to 2,000	2 ft	1 ft	3 ft
2,100 to 15,000	2 ft	1 ft 8 in	3 ft 8 in
15,100 to 35,000	2 ft 4 in	2 ft	4 ft 4 in
35,100 to 46,000	2 ft 6 in	2 ft	4 ft 6 in
72,600 to 121,000	3 ft 4 in	2 ft 2 in	5 ft 6 in

1.5.12.3 When work is to be performed on secondary circuits or equipment, which are only disconnected from sources of power by switches with non-visible contacts, the following procedures shall be incorporated into the NASA Langley Form 495, "Safety Operator Clearances Procedure," associated with each switch being locked and tagged:

(a) Obtain concurrence from qualified electrical technician and the Facility Coordinator.

(b) De-energize the switch.

(c) Perform tests to verify that there is no voltage on the secondary circuits where the work is to be performed. Tests shall measure voltage from phase-to-phase and from each phase-to-ground.

(d) Apply lockout/tagout(s). Indicate on the red tag(s) that no work shall be performed on the high voltage (primary) side of the equipment.

(e) Apply protective grounding as close as physically possible to the secondary circuit power source.

(f) Before operating any switch used for maintenance or for isolating circuits above 600 volts, the switch operator is to be accompanied by a second electrically qualified person who is to stand at a safe distance and be prepared to respond in the event of an emergency.

2 TRAINING REQUIREMENTS

2.1 Technical Training

2.1.1 Qualified workers shall be technically trained and experienced in the work methods required by their electrical work assignments and shall have safety training on the operation of the equipment and the use of safe work practices.

2.1.2 Technical training commensurate with the assignments of the qualified electrical person shall be documented and shall meet the requirements of the person's job description. Refresher technical training shall be taken as required by the qualified electrical person's job assignments and certification requirements.

2.1.3 An individual that is undergoing on-the-job electrical technical training and that has demonstrated competence in performing work safely shall be considered "qualified" if the individual is under the direct supervision of a "qualified" electrical person. This individual shall have completed safety training on the hazards involved prior to performing the work.

2.2 Safety Training

2.2.1 The direct supervisor of any person who works with electrical equipment shall ensure that the person has completed the minimum electrical safety training defined below. The level of electrical safety training shall be based on the level of electrical risk and hazard to which the person will be exposed.

	Required Training	Type and Frequency	
		Initial	Every 3 Years
Qualified Persons, Less Than 600 V	• NFPA 70E •	Comprehensive	Refresher
Qualified Persons, Over 600 V	• NFPA 70E • OSHA 29 CFR 1910.269 •	Comprehensive	Refresher
Unqualified Persons	• NFPA 70E	Comprehensive	Refresher

2.2.2 Safety training for qualified persons shall include as a minimum:

(a) Training in the skills and techniques to distinguish exposed energized parts from other parts of the electrical equipment

(b) Training in the skills and techniques necessary to determine the nominal system voltage of the exposed energized part

(c) Training to determine the minimum approach distances to exposed energized parts as specified in NFPA 70E, Table 130.2(C) and Sections 4.1.4 and 4.1.5 of this document

(d) Training to determine the degree and extent of an electrical hazard and in the proper use of PPE required to perform the task safely

2.3 Additional Training

2.3.1 Electrical Safety Operators shall meet the training and qualification requirements for Safety Operator Certification as required by LPR 1710.10, Chapter 6, “Safety Operators.”

2.3.2 Non-Electrical Safety Operators performing electrical lockout/tagout for mechanical equipment operating at less than 600 volts shall complete the safety training for qualified electrical persons as defined in Paragraph 2.2.1.

3 ELECTRICAL SYSTEM DOCUMENTATION REQUIREMENTS

3.1 Area of Responsibility

3.1.1 It shall be the responsibility of the person or group preparing design drawings to initiate action to document changes to the electrical drawings described in the following paragraphs. In the event that changes are made to the electrical system and drawings are not produced prior to the changes, the personnel performing the work shall be responsible for preparing drawings of such detail that the information can be entered onto the record drawings.

3.2 Configuration Management

3.1.2 LPR 1740.4, “Facility System Safety Analysis and Configuration Management,” defines the Configuration Management (CM) Program. It also identifies the facilities, which are under CM and defines the minimum electrical drawings required for these facilities. No changes shall be made to these drawings or equipment without the changes conforming to the requirements of LPR 1740.4.

3.1.3 It is the intent for all drawings and diagrams included in the CM program to be updated to the “as-built” configuration. It is recognized that this is a difficult and expensive process. The updating of the drawings is currently a requirement of the Research Operation, Maintenance and Engineering (ROME) contract. The schedule for updating the drawings will be based on the approved drawing update schedule in accordance with the requirements of the ROME contract.

3.3 Type of Drawings

3.3.1 Switching and Metering One Line Diagrams (Effort Code 300)

3.3.1.1 Switching and metering one line diagrams shall be maintained in LaRC’s Configuration Management On-Line (CMOL) system under Effort Code 300. These drawings shall be kept in an “as-built” condition as defined by LPR 1740.4.

3.3.1.2 The list of disconnect devices (switches, circuit breakers, etc.) shall be included in Effort Code 300 as a device list.

3.3.1.3 The following cable and switch legend applies to the switching diagrams:

Series Number	Voltage Level
1000	115 kV
2000	22 kV
3000	6.6 kV and 6.9 kV
4000	2.4 kV
5000	125 VDC and 115 VAC
6000	120/208 V
7000	277/480 V
8000	4.16 kV and 4.6 kV (Variable Frequency)
9000	13.8 kV
9500	34.5 kV

3.3.2 Manhole Drawings (Effort Code 301)

3.3.2.1 Manhole drawings shall be maintained in LaRC's CMOL system under Effort Code 301. These drawings shall be kept in an "as-built" condition as defined by LPR 1740.4.

3.3.3 Building Drawings - Low Voltage One Line Diagrams (Effort Code 302)

3.3.3.1 Building drawings (low voltage one line diagrams) shall be maintained in LaRC's CMOL system under Effort Code 302. As a minimum, building drawings shall include single line diagrams of the 208 volt and 480 volt power distribution system and floor plans showing the location of the power distribution equipment (transformers, panelboards, switching centers, motor controls centers, etc.) The single line diagrams shall reference the applicable high voltage switching diagram maintained in CMOL under Effort Code 300. These drawings shall be kept in an "as-built" condition as defined by LPR 1740.4.

3.3.4 Major Electrical Substation Drawings (Effort Code 303)

3.3.4.1 Major electrical substation drawings shall be maintained in LaRC's CMOL system under Effort Code 303. These drawings shall be kept in an "as-built" condition as defined by LPR 1740.4. Major electrical substations are delineated in the Stratton Substation Facility Resume under Appendix 3.

3.3.5 Underground Utilities Drawings

3.3.5.1 Underground systems, because of their high potential for damage during excavation and the associated danger to personnel performing work on these systems, have special requirements. LPR 1740.2, "Facility Safety Requirements," defines the requirements for "as-built" drawings. The locations of underground electrical systems shall be documented on drawings in the LaRC Facility Utilities Electronic Database (FUED) system. These drawings are not included in the CMOL system.

3.3.6 System Design Drawings

3.3.1.1 Drawings for facilities not under the CM Program may not be up-to-date and should be field verified for accuracy prior to designing or implementing any changes. The following "as-built" documentation should be provided for each system/building which is not included in the CM Program:

(a) A control criteria document that includes sign off by the design engineers for each discipline involved and which identifies the basic interlock logic needed to assure safe and practical control for each process system

(b) An overall system functional or block diagram clearly describing the engineering design intent for each system giving the function of each major component

(c) System schematics and/or elementary wiring diagrams, including one-line distribution diagrams for building power systems including the building unit substation, secondary breakers, panelboards, and motor control centers

(d) Individual equipment wiring diagrams and interconnection drawings showing each terminal strip connection, excluding building light and power panels

(e) Panel schedules for building light and power

(f) Facility location or plot plans showing all basic equipment, panelboards, motor control centers, main distribution panels, unit substations, and major facility equipment

3.3.7 On-Site Drawings

3.3.1.2 Except as defined for facilities in the LaRC CMOL system, it is the responsibility of the respective Facility Coordinator to determine the type and location of drawings to be kept on-site.

3.4 Drawing Distribution

3.4.1 Copies of Effort Code 300 switching diagrams for the high-voltage power distribution system (over 600 volts) shall be distributed to personnel on a list approved by the Chairperson of the Electrical Systems Committee who shall assure that corrected copies of drawings affected by modifications are promptly provided to holders of switching diagram sets. In addition, electronic copies of these diagrams are included in the LaRC CMOL system and are accessible for viewing and making copies (but not revising) by LaRC employees who have been assigned an appropriate computer access password. The Center Operations Directorate has the responsibility for initiating Change Notification Sheets (CNS) for updating the electronic copies on CMOL.

3.4.2 Copies of other drawings will be distributed to personnel as defined in LPR 1740.4 and/or as determined by the Chairperson of the Electrical Systems Committee.

3.5 Equipment Operating Procedures

3.4.3 Each facility with complex or high energy systems shall have written operating procedures to ensure the safety of personnel and the protection of equipment. These procedures include, but are not limited to, operating sequences, safety precautions, and emergency actions required. (LPR 1740.4 defines the requirements for operating procedures, records, etc.)

4 OPERATIONS AND MAINTENANCE REQUIREMENTS

4.1 General

4.1.1 Color Coding – Indicating Lights

4.1.1.1 The color of indicating lights designating the condition or position of the contacts on circuit breakers or switches for new or modified systems shall conform with the following:

(a) Contacts closed – red

(b) Contacts open – green

(c) Contact automatically tripped open - amber

Note 1: The above color coding of indicator lights is specific to switchgear as referenced in IEEE C37.11 and C37.100.

4.1.1.2 The color of indicating lights designating the position of valves that allow flow or block flow shall conform with the following:

(a) Allows flow – green

(b) Blocks flow - red

4.1.1.3 The required designation as indicated here may be waived by the LaRC Safety Manager if, for reason of prior usage in a facility, it is deemed safer to use other designations. This special ruling shall require written notification and approval from the LaRC Safety Manager.

4.1.1.4 The color coding of indicating lights (and pushbuttons) for industrial control systems is not consistent throughout industry, nor is it consistent for facility control systems at LaRC. The color coding of indicating lights (and pushbuttons) for control systems within a facility shall be consistent. Existing control systems are not required to be updated to meet this requirement unless they are being modified or upgraded, at which time they shall utilize the prevailing color scheme for control systems within the facility. Guidance for color coding or indicator lights (and pushbuttons) may be found in NFPA 79, IEC 60204-1, and IEC 60073.

4.1.2 Control Voltages for Devices

4.1.2.1 All controls subject to “routine” operational adjustments of exposed electrical components or controls that are not packaged in a manner to preclude casual

or random entry by unauthorized individuals shall conform to the NEC Art. 725 for Low Energy Power and/or Low Voltage Power Circuits.

4.1.3 Working Space Around Equipment

4.1.3.1 Sufficient access and working space shall be provided and maintained around all electrical equipment to permit ready and safe operation and maintenance of such equipment.

4.1.3.2 Working space around electrical equipment shall be based on providing sufficient clearance to avoid body contact with grounded parts while performing maintenance on energized equipment.

4.1.3.3 Minimum working space around equipment operating at 600 volts or less and working space entrance requirements shall be as required by the NEC, Art. 110.32 through 110.34.

4.1.3.4 Except for substations, the minimum working space around equipment operating over 600 volts shall be as required by the NEC, Art. 110.32. For substation locations, the minimum working space shall be as required by ANSI/IEEE C2-NESC, Rule 125.B.

4.1.4 Approach Distances to Exposed Energized Parts – Shock Protection

4.1.4.1 NFPA 70E defines three shock protection boundaries (Limited Approach Boundary, Restricted Approach Boundary, and Prohibited Approach Boundary) for workers approaching exposed energized parts. The distances for these boundaries, (based on system voltage) are listed in NFPA 70E, Table 130.2(C). The requirements for crossing the shock protection boundaries by qualified and unqualified persons are defined in NFPA 70E, Art. 130.2, summarized in the table below, and illustrated in Figure 4.1.4.1.

	Boundary Crossing Requirement based on Worker Qualifications	
Shock Protection Boundary	**Unqualified Worker**	**Qualified Worker**
Limited Approach Boundary	Prohibited from crossing unless escorted by qualified worker	Permitted to cross
Restricted Approach Boundary	Prohibited from crossing	Prohibited from crossing except as permitted by NFPA 70E, Art. 130.2 (C) and Paragraph 4.1.4.2 below
Prohibited Approach Boundary	Prohibited from crossing	Crossing this distance treated the same as making contact with energized parts

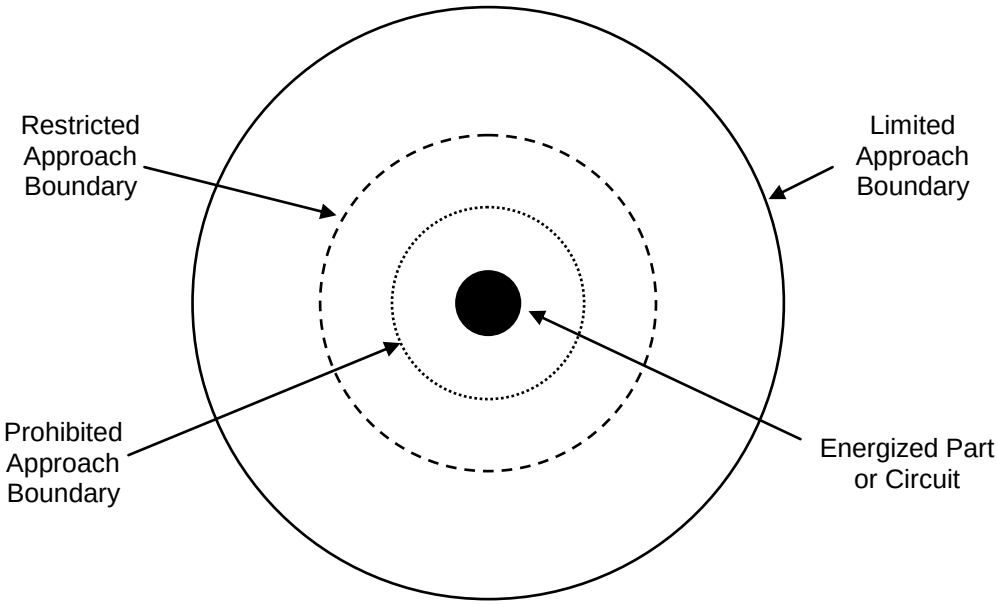

Figure 4.1.4.1 – Boundaries for Shock Hazard Protection Based on System Voltage Levels

4.1.4.2 Qualified persons shall not approach or take any conductive object closer to exposed energized parts than the "Restricted Approach Boundary" defined in NFPA 70E, Table 130.2(C) and listed below, for any reason unless such parts are adequately guarded as required by NFPA 70E, Art. 130.2(C). Voltage ranges shown are those applicable to systems at LaRC.

Nominal System Voltage Range - Phase-to-Phase	Distance from Energized Parts to Restricted Approach Boundary
50 – 300 volts	Avoid contact
301 - 750 volts	1 ft
751 - 15,000 volts	2 ft 2 in
15,100 – 36,000 volts	2 ft 7 in
36,100 – 46,000 volts	2 ft 9 in
72,600 – 121,000 volts	3 ft 3 in

4.1.5 Approach Distances to Exposed Energized Parts – Arc Flash Protection

4.1.5.1 If work on or near exposed energized parts is required, as permitted by Paragraph 1.4.1.1, flash protection PPE shall be utilized as required by NFPA 70E, Art. 130.3(B).

4.1.5.2 The need for and level of flash protection PPE is determined by whether or not the worker is closer than the Flash Protection Boundary (FPB) and what the available Incident Energy (IE) level is at the Working Distance (WD) from the exposed energized part resulting from an arc flash. FPB and WD are illustrated in Figure 4.1.5.2.

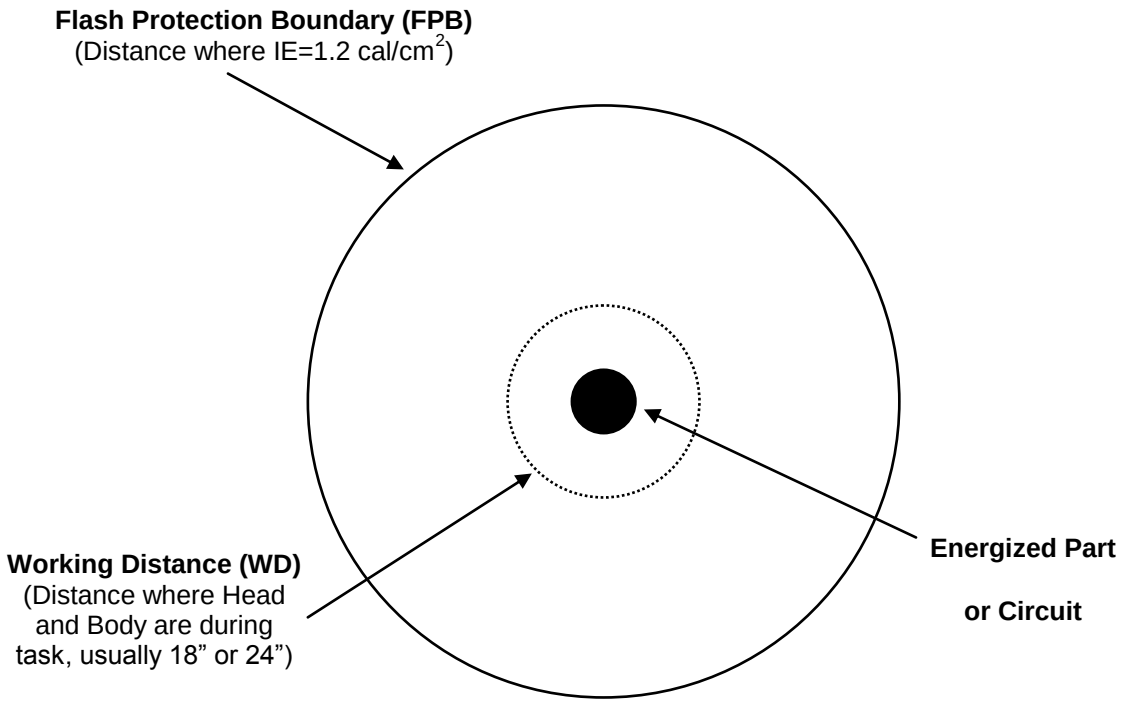

Figure 4.1.5.2 – Boundaries for Arc – Flash Protection Based on Arc Flash Incident Energy Levels

4.1.5.3 The FPB is the distance that the incident energy is no greater than 1.2 cal/cm^2, which is the energy that will result in a second degree burn when not using arc flash PPE. For systems that are 600 volts or less, the FPB is 4 ft. (assuming a maximum available bolted fault current of 50 kA and a 6 cycle clearing time) unless marked on the equipment by an arc flash hazard label. Alternatively, and for equipment operating above 600 volts, NFPA 70E, Art. 130.3(A) may be used to calculate the FPB or contact the Electrical Standard Practice Engineer to obtain this distance.

4.1.5.4 The WD is the distance between the worker's head or body and the exposed energized part for the specific task. The WD for electrical tasks is 18", unless specifically marked on the equipment as 24".

4.1.5.5 Incident energy levels for the selection of PPE shall be based on the calculated energy level at the working distance for the task. If not marked on the equipment by an arc flash hazard label, the incident energy level can be obtained from the Electrical Standard Practice Engineer. The Hazard/Risk categories based on incident energy levels are listed in NFPA 70E, Table 130.7(C)(11). Alternatively, NFPA 70E, Table 130.7(C)(9)(A) may be used to select PPE for various electrical tasks in lieu of calculating incident energy levels at the WD. (See Appendices A and C.)

Note 1: Flash Protection PPE does not prevent injury resulting from an arc flash. It is designed only to limit the injury resulting from an arc flash to a second degree burn, which has been determined to be a survivable burn.

4.1.6 High Voltage Verification Test Conditions

4.1.6.1 High voltage dielectric testing shall be preceded by the following actions:

(a) Red tag the applicable circuits

(b) Check for absence of voltage

(c) Secure the area

(d) Perform a low voltage dielectric test (Megger test)

(e) Perform grounding procedures

4.1.6.2 During these tests all safety precautions listed in Section 6, Paragraph 6.9 of ANSI/IEEE 95-1977 shall be followed.

4.1.6.3 Operational electrical equipment shall be periodically validated to determine that the dielectric strength has not fallen below safe levels. The responsible operations group shall maintain procedures specifying the method and frequency of the tests. A DC "Megger" appropriate to the circuit working voltage shall be used to obtain the readings. Validation is mandatory prior to energizing after any repair, which may have affected the equipment insulation system. In general, power system equipment shall be tested for minimum values of 1 megohm or 1 megohm per 1000 volts of operating voltage, whichever is greater. If lesser values are obtained, an appraisal shall be made by the responsible engineering organization before the equipment is energized.

4.1.7 Cranes and Lifting Equipment Adjacent to Exposed Electrical Energized Parts

4.1.7.1 Where cranes or other lifting equipment are used in or around high-voltage substations, overhead lines, or exposed energized parts, the operations and equipment shall be in conformance with OSHA 29 CFR 1926.550. See Paragraph 4.3.1.6 for additional requirements on crane usage.

4.1.7.2 All lifting equipment shall be effectively grounded when being moved or operated in close proximity to energized lines or equipment. Consideration shall also be given to grounding the load, particularly if insulated lifting straps are in use.

4.1.7.3 Lifting equipment shall be operated with a dedicated observer to warn the equipment operator of potentially hazardous situations and/or movements.

4.1.7.4 Exposed energized conductors of up to 115kV are in use in high-voltage substations at LaRC. The following clearances shall be maintained between cranes and lifting equipment and exposed energized conductors as required by OSHA 29 CFR 1926.550(a)(15):

Conductor Voltage	Minimum distance between conductors and equipment
50 kV and below	10 ft
115 kV	12 ft, 2 in (Note 1)

Note 1: Distance calculated for 115 kV based on requirements from OSHA 29 CFR 1926.550(a)(15). See this standard for distance requirements for voltages other than those shown here.

4.2 Facilities and Equipment

4.2.1 General Requirements

4.2.1.1 A daily log shall be maintained at each facility, which has major electrical systems. The Electrical Standard Practice Engineer shall determine which facilities are required to maintain a daily log. This log shall record pertinent information for each operating shift, including as a minimum: operator's name, time of entry, explanation of any equipment malfunction or unusual operation, and any special work performed on the equipment.

4.2.2 Installation or Major Repair – General

4.2.2.1 Prior to selecting and installing any new electrical equipment or systems, the design engineer shall consult and coordinate the work with the Facility Safety Head.

4.2.2.2 The Facility Safety Head shall be responsible for the overview of safety aspects for the repair or overhaul of major research equipment, which requires partially or totally disabling of the research operations of a facility.

4.2.3 Installation or Repair of Transformers

4.2.3.1 Whenever work is to be performed on connected transformers, protective grounds shall be applied as required by Paragraph 1.5.3 of this document.

4.2.3.2 When transformers are installed or replaced, the secondaries shall be checked for correct voltage and phase rotation.

4.2.3.3 When transformers are installed and before they are energized, the ground connection shall be made to the case, and where applicable, to the neutral.

4.2.3.4 Transformer covers or hand hole plates shall not be removed from energized transformers.

4.2.3.5 All transformers shall be considered energized at full voltage unless they are disconnected from the primary and secondary power source, or unless they are disconnected from the primary power source and protective grounds have been applied to the transformer secondary. The opening of a fused primary cutout or switch shall not be considered as a primary disconnection unless the de-energized side of the cutout or switch is grounded.

4.2.3.6 When removing transformers, the case and neutral ground shall be disconnected last.

4.2.3.7 Because it is possible to have up to full phase-to-ground voltage on the transformer neutral, transformer neutrals shall always be treated as phase conductors, unless established as grounded.

4.2.4 Removal of Obsolete Equipment

4.2.4.1 When equipment is removed, the electrical wiring, conduit, and control boxes shall be removed from the equipment to the power source in accordance with the following:

(a) The power source shall be de-energized and disconnected prior to disconnecting the load or cutting the cables or wiring. Overhead power lines shall be removed. All cable and wiring shall be removed from conduit, ductbanks, etc. Cable and wire that are direct buried does not have to be removed and may remain below ground. The ends of the direct buried cable or wire shall be buried below ground and the location(s) identified on the Underground Utility Drawings. In unique situations and at the discretion of LaRC's Electrical Standard Practice Engineer, cables rated 2400 volts and above may remain.

(b) All exposed conduits shall be removed. Conduit that is direct buried or in ductbanks may remain.

4.2.4.2 After the equipment has been removed, the controlled electrical wiring diagrams, schematics, and so forth, shall be revised to show this change. See Section 3 for documentation update requirements.

4.2.5 Control Systems

4.2.5.1 Whenever control systems are dependent on electrical power for safe operation, provisions shall be made to have these systems operate to the failsafe position in the event of an electrical power failure.

4.2.6 Standby Electrical Power

4.2.6.1 A minimum of two 60-kW or larger diesel electric or equivalent portable power plants shall be available for emergency use. This power shall be provided at a voltage rating of 480 volts and/or 208 volts, three-phase, 60 Hertz that will permit connections to the bus on the secondary side of building unit substations.

4.2.7 Contractor Connections into Government Electrical Utilities

4.2.7.1 Prior to permitting the contractor to make connection into any part of the Government electrical power distribution system, the contractor shall:

a. Make written application to the Government Contracting Officer stating the date, time, location, and the service desired.

b. Jointly with the Government representative, make the necessary checks of the contractor's system and the Government's supply to ensure their compatibility and safety.

4.2.8 Initial Energization of Electrical Systems Above 600 Volts

4.2.8.1 Initial energizing of all new electrical equipment shall be performed in the presence of the appropriate Government representative.

4.2.8.2 All power feeder circuit breakers shall be checked for adjustment and operation in accordance with the manufacturer's instructions. Molded case circuit breakers without solid state trip devices are excluded from this requirement.

4.2.8.3 All protective relays and other such devices shall be tested to verify their capability of operating in the range required. Where possible, tests shall include “loading in” at the current transformer secondaries to validate the circuitry as well as the device.

4.2.8.4 All wiring shall be field verified for conformity to the design, fabrication, and functional requirements.

4.2.8.5 All electrical equipment shall be tested in accordance with industry standards at voltage levels approved for the specific type of equipment by the LaRC cognizant engineering group or approved designee. In general, the minimum acceptable insulation resistance for electrical equipment shall be the greater of 1 megohm or 1 megohm per 1000 volts of operating voltage.

4.2.9 Protective Relay Settings

4.2.9.1 Protective relay settings shall be coordinated and concurred with by the Electrical Standard Practice Engineer to provide selective tripping. The responsible electrical engineering organization shall review and approve the coordination. The responsible operations organization shall maintain a listing of the required settings and the frequency of periodic testing of all protective relays in use.

4.2.9.2 All protective relays for 22 kV and 115 kV circuits on the LaRC power system shall be checked and calibrated once every two years. Protective relays for circuits less than 22 kV shall be checked and calibrated once every four years. Every reasonable effort shall be made to perform an end-to-end check of the relay circuitry in the process of this check.

4.2.10 Circuit Interruption Devices

4.2.10.1 All circuit interruption devices shall be rated to interrupt the maximum short circuit current of the power system at the point of application of the device.

4.2.10.2 Short circuit system studies shall be made by the responsible electrical engineering organization and concurred with by the Electrical Standard

Practice Engineer to obtain data on short circuit interrupting duty requirements whenever large loads are added or major system changes are made which may affect the short circuit duty of the circuit breakers on the LaRC power distribution system.

4.2.10.3 Re-closing Circuits After Protective Device Operation - After a circuit is de-energized by a circuit protective device, the circuit may not be manually re-energized until it has been determined that the equipment and circuit can be safely energized.

4.2.10.4 Molded-case circuit breakers or fuses can be reset if it can be determined that the trip was due to an overload condition and not a fault. Otherwise the circuit must be checked to determine that it is safe to energize. Circuit breakers can be reset, however repetitive re-closing is prohibited. The problem should be traced to the root cause if a circuit breaker trips twice in succession.

4.2.10.5 Circuit breakers shall be immediately inspected and checked to assure suitability for reuse after any operation in which the circuit breaker opens under short circuit or fault conditions. When a trip occurs on breakers above 600 volts, the troubleshooting process shall verify the settings of all breakers between the fault and the tripped breaker. Molded case circuit breakers without solid state trip devices are excluded from this requirement.

4.2.10.6 All 115 kV circuit breakers shall be operated at least once every 24 months to assure satisfactory mechanical operation.

4.2.11 Infrared (IR) Thermography

4.2.11.1 Infrared Thermography of electrical systems 600 volts or below may be performed by a thermographer who is not electrically qualified provided that an electrically qualified person is present anytime an electrical panel is open to exposed energized conductors, the thermographer is certified, has received the appropriate NFPA 70E training, and stays outside the approach distances specified in NFPA 70E.

4.2.11.2 Infrared Thermography of electrical systems exceeding 600 volts may be performed by a thermographer who is not electrically qualified provided there are two electrically qualified personnel present anytime an electrical panel is open to exposed energized conductors, the thermographer is certified, has received the appropriate NFPA 70E training, an approved form LF 416 is in place, and stays outside of the approach distances specified in NFPA 70E.

4.2.11.3 Infrared Thermography of overhead connections in substations may be performed by a thermographer who is not electrically qualified provided that an electrically qualified person is present, the thermographer is certified, has

received the appropriate NFPA 70E training, and stays outside of the approach distances specified in NFPA 70E.

4.3 Work in Energized Substations

4.3.1 General Requirements

4.3.1.1 In addition to the other industry electrical safety codes, rules, and regulations specified elsewhere in this document, work in energized substations shall comply with the requirements of ANSI/IEEE C2-NESC, all applicable OSHA standards for substations, and Section 1.5 of this document.

4.3.1.2 Work areas shall be clearly defined by the installation of barriers and rope guards. Barriers and rope guards shall be sufficient to restrain the workers from inadvertently moving out of the work area.

4.3.1.3 Use physical barriers whenever practicable. When adequate barriers cannot be installed around all energized parts adjacent to the work area, action shall be taken to provide the continuous safeguarding of each worker.

4.3.1.4 Establish a safe zone area between the work area and the energized parts of the substation so that all live circuits and parts clear the designated work area by at least five feet.

4.3.1.5 Electric power outages required to execute work in the substation shall be requested at least seven days in advance of the need.

4.3.1.6 Refrain from using any crane in or near an energized substation with exposed conductors where movement of the crane might cause objects to fall into or strike energized parts of the substation. If crane usage is required to support the work, a power outage shall be requested for the work area. See Section 4.1.7 for clearance requirements for cranes working around exposed energized conductors.

4.3.1.7 When work involves handling of lengths of conduit, bus, steel, or large equipment in substations with exposed energized bus, a full-time employee knowledgeable of the safety required and without other duties shall be assigned to assure the safety of the work area.

4.3.1.8 After execution of a power outage by an LaRC certified Safety Operator as evidenced by receipt of the red tag stubs the lockout/tagout responsible person shall check to ensure the designated circuits have been de-energized and properly grounded and verify that the immediate work area and a zone beyond the work area have been made safe before permitting employees to work in the substations.

4.3.1.9 Additional safety supervisors shall be assigned as needed for the protection of the workers when the work is so divided and extensive that one safety supervisor cannot effectively maintain safety surveillance over the workers and their operations.

4.3.2 Contractors other than NPS Contractors

4.3.2.1 Except for Non-Personal Service (NPS) Contractors that provide on-site operational and maintenance support for electrical systems at LaRC, contractors who are required to enter and/or work in energized substations shall comply with the following requirements in additional to the requirements of Section 4.3.1 above.

4.3.2.2 Submit a work plan, at least seven days prior to initiating work in the substation, outlining the work to be done and identifying the circuits required to be de-energized to safely conduct operations. The plan shall include a detailed step-by-step work procedure for each phase of the work. All changes to this work plan shall be reviewed with the responsible LaRC personnel prior to initiation.

4.3.2.3 Appoint an individual responsible for the electrical safety of each work team. The safety supervisor(s) shall attend the Construction Safety Briefing. Before the work begins, the responsible individual shall provide a document to the Government establishing that the appointed safety supervisor(s) is (are) qualified and knowledgeable in OSHA and LaRC safety regulations and requirements.

4.3.2.4 Contact the Government representative at the beginning of work each day for admittance to the substation. Maintain surveillance of the substation gates to only permit authorized personnel to enter. No entrance shall be made while work is being conducted unless the contractor safety supervisor has been first contacted to verify conditions are safe.

4.4 Substation Access

4.4.1 Standard Substation Access Procedures

4.4.1.1 Doors and gates that control access to high voltage substations are secured with locks. Keys for these locks are assigned to qualified “key” holders who are electrically qualified personnel who have a need to enter the substations on a regular basis.

4.4.1.2 The issuance of substation keys shall be approved by the power distribution system Facility Safety Head and Facility Coordinator, and the Electrical Standard Practice Engineer.

4.4.1.3 Temporary keys may be assigned to other electrically qualified personnel at the discretion of the power distribution system Facility Safety Head and Facility Coordinator, and the Electrical Standard Practice Engineer.

4.4.1.4 Personnel who require access to the substations but are not a qualified “key” holder shall contact a qualified “key” holder who shall escort anyone they permit into the substation.

4.4.1.5 General requirements for substation entries are as follows:

(a) At least two people shall be involved in all entries into the substation when work is to be performed.

(b) Entry gates/doors shall be closed but shall remain unlocked while personnel are working in the substations.

(c) Entry gates/doors shall be locked when the last person exits the substation.

4.4.2 Substation Access for Non-Electrical Work

4.4.2.1 Unqualified personnel performing non-electrical work such as grounds keeping and painting in energized substations shall obtain substation access from a qualified “key” holder.

4.4.2.2 When the non-electrical work is performed around electrical hazards, the qualified “key” holder or another electrically qualified person shall act as a safety watch. If the electrical hazard can be eliminated by de-energizing circuits, or securing access to circuits by padlocks or barriers, then the work can be performed with no electrically qualified person present.

5 SPECIAL EQUIPMENT HANDLING PROCEDURES

5.1 Batteries

5.1.1 Vented batteries and battery cells, regardless of electrode type, contain dangerous electrolytes, which are subject to spillage. Overcharging or too rapid charging can cause electrolyte boiling and spewing, and the production of explosive gases. The following requirements shall be followed in these devices:

(a) Face shields and goggles, rubber gloves, and protective rubber aprons shall be worn whenever batteries or cells are being handled, filled, or charged.

(b) Ample neutralizing agent shall be present to fully neutralize any electrolyte spill, which may occur in battery operations.

(c) Battery charging shall take place in a well ventilated area.

(d) No smoking shall be permitted in the area where batteries are handled, filled, or charged.

(e) Battery charging shall comply with all of the manufacturer's recommendations.

(f) An eyewash station shall be in an accessible location that requires no more than 10 seconds to reach. This eyewash station can be in each facility or on the battery technician's truck. Eyewash devices shall comply with ANSI Z358.1-2004.

5.2 Fuses

5.2.1 Fuses shall not be removed on energized circuits above 23,000 volts. Fuses shall not be removed from loaded energized circuits with voltage ranges from 50 volts to 23,000 volts. In addition to the PPE requirements of NFPA 70E when removing or replacing fuses on unloaded energized circuits, the following shall be required:

(a) Rated 50 to 600 volts, insulated fuse tongs, extractors, or other approved methods shall be used.

(b) Rated 601 to 1000 volts, lineman's type rubber gloves in addition to either insulated fuse tongs or extractors shall be used.

(c) Rated 1001 to 23,000 volts, lineman's type rubber gloves in addition to insulated high-voltage sticks or tongs shall be used.

5.3 Experimental Equipment – General

5.3.1 Experimental electrical equipment that is under development, and therefore subject to frequent modifications, presents a particular hazard to personnel. Operating and emergency procedures may change from day to day. The following are minimum safety requirements:

5.3.2 A responsible member of the research team shall be designated to establish correct working procedures as well as proper emergency procedures for review and approval by the Electrical Standard Practice Engineer. Particular emphasis shall be placed on emergency de-energizing of the equipment.

5.3.3 Areas where high energy sources are present shall be marked and physical barriers used where practicable. Electrical and mechanical safety interlocks shall be used where practicable.

5.3.4 Persons shall not work alone on high energy equipment unless the electrical equipment has been de-energized and secured in an electrically safe work condition.

5.3.5 Before working on high voltage/high energy equipment that has been energized and then de-energized, after lockout/tagout has been implemented, the equipment shall be grounded to ensure no residual voltage remains as a potential shock hazard.

5.3.6 Use of high voltage capacitor banks on experimental equipment shall comply with the requirements of Paragraph 5.4 of this document.

5.3.7 Fail safe circuits shall be used, where practicable, in order to minimize possible hazards to personnel and equipment.

5.3.8 Temporary wiring shall meet the requirements of the NEC and Paragraphs 1.4.9 and 1.4.10 of this document. Indiscriminate use of extension cords and portable cables shall be avoided.

5.3.9 Do not use any equipment that has frayed cords or three-wire cord ends that have had the grounding prong removed. Faulty equipment and tools shall be repaired by qualified personnel.

5.3.10 The general and specific work requirements under Paragraphs 1.3 and 1.4 of this document shall apply to work under this paragraph.

5.3.11 Use of knockout boxes to house receptacles for an on-site extension cord shall not be permitted.

5.4 Experimental Equipment – High Voltage Capacitor Banks

5.4.1 Test personnel conducting experiments where capacitor banks with voltages above 600 volts are employed, shall have total knowledge of the experiment, the circuit and component layout, and be fully trained in the operating and safety procedures to be used at that facility, including procedures to be used in the event of equipment failure.

5.4.2 The high voltage test area shall be enclosed and protected through the use of gates and interlocks on the test controls. Capacitors and related high voltage component faults are a possible source of hazardous shrapnel. These components shall be isolated in a manner that precludes personnel injury or facility related hazards, such as fire.

5.4.3 High voltage warning signs shall be displayed in a conspicuous location. Flashing warning lights shall be used to indicate that tests are in progress.

5.4.4 A shorting switch or grounding device, which normally discharges the capacitor bank, shall be clearly visible to the test operator.

5.4.5 A voltmeter (VM) connected across the capacitor bank shall be clearly visible to the test operator at all times. A redundant VM shall be installed at the capacitor banks.

5.4.6 Prior to touching a high voltage component within the test area, a grounding wand approved by the LaRC Safety Manager for the particular installation shall be used to verify that the capacitor bank is fully discharged.

5.4.7 Extreme caution shall be used on capacitor banks that are operated by DC voltages since a DC capacitor bank will maintain a residual voltage for extended periods.

5.4.8 Capacitors that are connected in a series to form a bank shall be treated with great care, and prior to making any changes to a test bank or circuit, each capacitor in a series string shall be properly discharged.

5.5 PCB Hazards

5.5.1 Electrical equipment, such as transformers, capacitors, and so forth, may contain a highly toxic, noncombustible, synthetic, electrical insulating liquid known generically as “Polychlorinated Biphenyls” (PCB). PCB has been sold under various trade names including “Askeral,” “Inerteen,” “Chlorexol,” “Noflamal,” and “Pryranol.” All leaks of fluid containing PCB shall be reported immediately to the LaRC Environmental Manager.

6 HAZARDS OF ELECTRICITY

6.1 Hazards of Electric Arcs

6.1.1 Arc Flash

6.1.1.1 While the phenomena of electric arcs and their destructive forces is nothing new, their threat to the safety of exposed electrical workers has only recently come under close scrutiny. Because of the availability of high fault current levels in industrial systems, arcs from electric faults are more powerful and dangerous. An uncontrolled electric arc results in arc flash and arc blast. The severity of the hazard to the worker is determined by the amount of available energy at the fault and proximity of the worker to the fault. A dropped tool, deteriorating insulation on aging conductors, or animals are examples of situations that can create electric arc faults.

6.1.1.2 During a fault, conductive plasma is created that produces an arc flash at temperatures up to 35,000°F. The resulting radiated heat energy can create fatal burns or burns severe enough to result in long lost time recovery periods. Depending on the available short circuit current at the fault and the duration of the fault, the resulting incident energy (radiated heat energy) can exceed 40 cal/cm2. An incident energy level of 1.2 cal/cm2 will create a second degree burn causing very painful blistering of the skin, which has been deemed to be a survivable burn. A third degree burn results in complete destruction of the skin, cooking of the deeper tissues, and permanent damage and disfigurement.

6.1.1.3 Working on de-energized equipment will eliminate the arc hazard. If this is not possible, exposure to high incident energy levels while working on energized equipment can be mitigated by the use of flash rated PPE and increasing exposure distance. Flash protective PPE is designed to limit incident energy levels during an arc flash to 1.2 cal/cm2. Requirements for arc flash hazard mitigation are found in the latest edition of the NEC and NFPA 70E, Art. 130.

6.1.2 Arc Blast

6.1.2.1 Arc blast is a second consequence of electric arcs. The arc blast is produced by the rapid expansion of super-heated air surrounding the arc and vaporization of conductive metal by the arc resulting in an explosive air pressure wave. The blast energy or pressure resulting from an electric arc blast can be significant enough to cause falls or impact injuries that are more severe than burn injuries. Water turning into steam expands to 1670 times its original volume. By comparison when copper vaporizes, it expands to 67,000 times its original volume. This is the same expansion rate that is produced

when dynamite explodes. Protective clothing will not protect against impact forces resulting from this blast pressure.

6.2 Hazards of Electric Shocks

6.2.1 Effects of Electric Shocks

6.2.1.1 Some individuals who handle electrical equipment mistakenly believe their tolerance to electric shock is related to their ability to withstand the pain of the shock. Actually, the lethal incidence is a function of current passage (duration and level) through the heart region. Additionally, the onset of possibly lethal currents is only marginally higher than those ranked just painful and well within the range of industrial low-voltage power systems. While asphyxiation is the physiological result of the first zone of over-painful shock, the second zone results in heart ventricular fibrillation, or heart dysfunction. Not only is the latter not self-curing on cessation of the current, but it is generally lethal within about 3 minutes. Just as it is current, not voltage, which heats a wire, it is current which causes the physiological damage.

6.2.1.2 The values of 60 Hz current and its effects (typically) on an average man are listed in Figure 6.2.1.2 as follows:

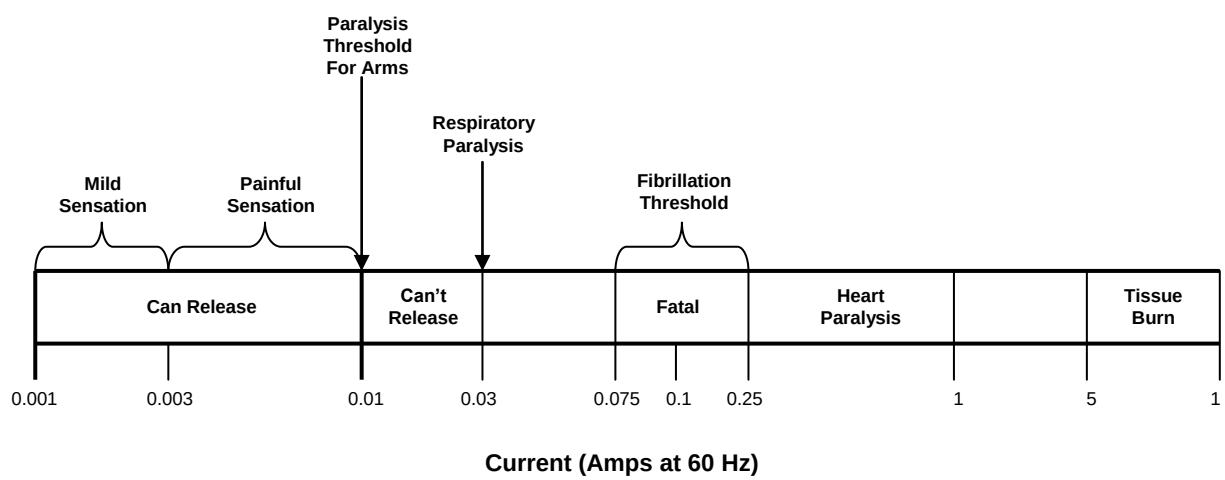

Figure 6.2.1.2 – Effects of Current on Average Human

NOTE: Most GFCI's operate at 0.005 Amps

6.2.1.3 Note that as shock current values are increased they are statistically more dangerous from burn-type damage than heart failure. This is most likely because of the shorter exposure times. When very high voltages (above

2300 V) are involved, burns may not be severe as the victim initiates an arc that retracts (by reflex) the victim's attempted grasp. In summary, humans are affected in major proportion by the duration, as well as the level of shock. When contact is made in such a manner as to retract the contracting part (such as a light finger touch when the strong muscular contractions of the arm pull the fingers away) the shock is much less dangerous than one of the same current level incurred by "freezing" to the contact with a full hand grasp.

6.2.2 Body Current Levels at 120 Volts AC

6.2.2.1 Typical body current paths are listed in the table below.

Path	Current
Dry Skin	Less than 1 mA
Wet Skin	110 mA
Hand to Foot	220 mA
Ear to Ear	1.1 A

TABLE 130.7(C)(9)(A) *Hazard/Risk Category Classifications*

Task (Assumes Equipment Is Energized, and Work Is Done Within the Flash Protection Boundary	Hazard/Risk Category	V-Rated Gloves	V-Rated Tools
Panelboards Rated 240V and Below-Notes 1 and 3			
Circuit breaker (CB) or fused switch operation with covers on	0	N	N
CB or fused switch operation with covers off	0	N	N
Work on energized parts, including voltage testing	1	Y	Y
Remove/install CBs or fused switches	1	Y	Y
Remove/install bolted covers (to expose bare, energized parts)	1	N	N
Opening hinged covers (to exposed bare, energized parts)	0	N	N
Panelboards or Switchboards Rated >240V and up to 600V (with molded case or insulated case circuit breakers)-Notes 1 and 3			
CB or fused switch operation with covers on	0	N	N
CB or fused switch operation with covers off	1	N	N
Work on energized parts, including voltage testing	2*	Y	Y
600V Class Motor Control Center (MCCs)-Notes 2 (except as indicated) and 3			
CB or fused switch or starter operation with enclosure doors closed	0	N	N
Reading a panel meter while operating a meter switch	0	N	N
CB or fused switch or starter operation with enclosure doors open	1	N	N
Work on energized parts, including voltage testing	2*	Y	Y
Work on control circuits with energized parts 120V or below, exposed	0	Y	Y
Work on control circuits with energized parts >120V, exposed	2*	Y	Y
Insertion or removal of individual starter “buckets” from MCC-Note 4	3	Y	N
Application of safety grounds, after voltage test	2*	Y	N
Removal of bolted covers (to expose bare, energized parts)-Note 4	2*	N	N
Opening hinged covers (to expose bare, energized parts)	1	N	N
600V Class Switchgear (with power circuit breakers or fused switches-Notes 5 and 6			
CB or fused switch operation with enclosure doors closed	0	N	N
Reading a panel meter while operating a meter switch	0	N	N
CB or fused switch operation with enclosure doors open	1	N	N
Work on energized parts, including voltage testing	2*	Y	Y
Work on control circuits with energized parts 120V or below, exposed	0	Y	Y
Work on control circuits with energized parts >120V exposed	2*	Y	Y
Insertion or removal (racking) of CBs from cubicles, doors open	3	N	N
Insertion or removal (racking) of CBs from cubicles, doors closed	2	N	N
Application of safety grounds, after voltage test	2*	Y	N
Removal of bolted covers (to expose bare, energized parts)	3	N	N
Opening hinged covers (to expose, bare, energized parts)	2	Y	N
Other 600V Class (277V through 600V, nominal) Equipment-Notes 2 (except as indicated) and 3			
Lighting or small power transformers (600V, maximum)	-	-	-
Removal of bolted covers (to expose bare, energized parts)	2*	N	N
Opening hinged covers (to expose bare, energized parts)	1	N	N
Work on energized parts, including voltage testing	2*	Y	Y
Application of safety grounds, after voltage test	2*	Y	N
Revenue meters (kW-hour, at primary voltage and current)	-	-	-
Insertion or removal	2*	Y	N
Cable trough or tray cover removal or installation	1	N	N
Miscellaneous equipment cover removal or installation	1	N	N
Work on energized parts, including voltage testing	2*	Y	Y
Application of safety grounds, after voltage test	2*	Y	N

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Task (Assumes Equipment Is Energized, and Work Is Done Within the Flash Protection Boundary	Hazard/Risk Category	V-Rated Gloves	V-Rated Tools
NEMA E2 (fused contactor) Motor Starters, 2.3kV Through 7.2kV			
Contactor operation with enclosure doors closed	0	N	N
Reading a panel meter while operating a meter switch	0	N	N
Contactor operation with enclosure doors open	2*	N	N
Work on energized parts, including voltage testing	3	Y	Y
Work on control circuits with energized parts 120V or below, exposed	0	Y	Y
Work on control circuits with energized parts >120V, exposed	3	Y	Y
Insertion or removal (racking) of starters from cubicles, doors open	3	N	N
Insertion or removal (racking) of starters from cubicles, doors closed	2	N	N
Application of safety grounds, after voltage test	3	Y	N
Remove of bolted covers (to expose bare, energized parts)	4	N	N
Opening hinged covers (to exposed bare, energized parts)	3	N	N
Metal Clad Switchgear, 1kV and Above			
CB or fused switch operation with enclosure doors closed	2	N	N
Reading a panel meter while operating a meter switch	0	N	N
CB or fused switch operation with enclosure doors open	4	N	N
Work on energized parts, including voltage testing	4	Y	Y
Work on control circuits with energized parts 120V or below, exposed	2	Y	Y
Work on control circuits with energized parts >120V exposed	4	Y	Y
Insertion or removal (racking) of CBs from cubicles, doors open	4	N	N
Insertion or removal (racking) of CBs from cubicles, doors closed	2	N	N
Application of safety grounds, after voltage test	4	Y	N
Removal of bolted covers (to expose bare, energized parts)	4	N	N
Opening hinged covers (to expose bare, energized parts)	3	N	N
Opening voltage transformer or control power transformer compartments	4	N	N
Other Equipment 1kV and Above			
Metal clad load interrupter switches, fused or unfused	-	-	-
Switch operation, doors closed	2	N	N
Work on energized parts, including voltage testing	4	Y	Y
Removal of bolted covers (to expose bare, energized parts)	4	N	N
Opening hinged covers (to expose bare, energized parts)	3	N	N
Outdoor disconnect switch operation (hookstick operated)	3	Y	Y
Outdoor disconnect switch operation (gang-operated, from grade)	2	N	N
Insulated cable examination, in manhole or other confined space	4	Y	N
Insulated cable examination, in open area	2	Y	N

Note: V-Rated Gloves are gloves rated and tested for the maximum line-to-line voltage upon which work will be done.

V-Rated Tools are tools rated and tested for the maximum line-to-line voltage upon which work will be done.

2* means that a double-layer switching hood and hearing protection are required for this task in addition to the other Hazard/Risk Category 2 requirements of Table 130.7(C)(10).

Y=yes (required)

N=no (not required)

Notes:

1. Maximum of 25kA short-circuit current available, 0.03 second (2 cycle) fault clearing time.
2. Maximum of 65kA short-circuit current available, 0.03 second (2 cycle) fault clearing time.
3. For <10kA short-circuit current available, the hazard/risk category required may be reduced by one number.
4. Maximum of 42kA short-circuit current available, 0.33 second (20 cycle) fault clearing time.
5. Maximum of 35kA short-circuit current available, up to 0.5 second (30 cycle) fault clearing time.
6. For <25kA short-circuit current available, the hazard/risk category required may be reduced by one

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number.

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TABLE 130.7(C)(10) *Protective Clothing and Personal Protective Equipment (PPE) Matrix*

Protective Clothing and Equipment	Protective Systems for Hazard/Risk Category					
Hazard/Risk Category Number	**-1 (Note 3)**	**0**	**1**	**2**	**3**	**4**
Non-melting (according to ASTM F 1506-00) or Untreated Natural Fiber						
a. T-shirt (short-sleeve)	X			X	X	X
b. Shirt (long-sleeve)		X				
c. Pants (long)	X	X	X (Note 4)	X (Note 6)	X	X
FR Clothing (Note 1)						
a. Long-sleeve shirt			X	X	X (Note 9)	X
b. Pants			X (Note 4)	X (Note 6)	X (Note 9)	X
c. Coverall			(Note 5)	(Note 7)	X (Note 9)	(Note 5)
Jacket, parka, or rainwear			AN	AN	AN	AN
FR Protective Equipment						
a. Flash suit jacket (multilayer)						X
b. Flash suit pants (multilayer)						X
c. Head protection		-	-	-	-	-
1. Hard hat			X	X	X	X
2. FR hard hat liner					AR	AR
d. Eye protection		-	-	-	-	-
1. Safety glasses	X	X	X	AL	AL	AL
2. Safety goggles				AL	AL	AL
e. Face and head area protection		-	-	-	-	-
1. Arc-rated face shield, or flash suit hood				X (Note 8)		
2. Flash suit hood					X	X
3. Hearing protection (ear canal inserts)				X (Note 8)	X	X
f. Hand Protection			-	-	-	-
Leather gloves (Note 2)			AN	X	X	X
g. Foot Protection						
Leather work shoes			AN	X	X	X

AN=As Needed AR=As Required

AL=Select one in group X=Minimum required

Notes:

1. See Table 130.7(C)(11). Arc rating for a garment is expressed in cal/cm^2.
2. If voltage-rated gloves are required, the leather protectors worn external to the rubber gloves satisfy this requirement.
3. Hazard/Risk Category Number "-1" is only defined if determined by Notes 3 or 6 of Table 130.7(C)(9)(A).
4. Regular weight (minimum 12 oz/yd^2 fabric weight), untreated, denim cotton blue jeans are acceptable in lieu of FR pants. The FR pants used for Hazard/Risk Category 1 shall have a minimum arc rating of 4.
5. Alternate is to use FR coveralls (minimum arc rating of 4) instead of FR shirt and FR pants.
6. If the FR pants have a minimum arc rating of 8, long pants of non-melting or untreated natural fiber are not required beneath the FR pants.
7. Alternate is to use FR coveralls (minimum arc rating of 4) over non-melting or untreated natural fiber pants and T-shirt.
8. A faceshield with a minimum arc rating of 8, with wrap-around guarding to protect not only the face, but also the forehead, ears, and neck (or alternatively, a flash suit hood), is required.
9. Alternate is to use two sets of FR coveralls (the inner with a minimum arc rating of 4 and outer coverall with a minimum arc rating of 5) over non-melting or untreated natural fiber clothing, instead of FR coveralls over FR shirt and FR pants over non-melting or untreated natural fiber clothing.

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TABLE 130.7(C)(11) *Protective Clothing Characteristics*

Hazard/Risk Category	Typical Protective Clothing Systems Clothing Description (Typical number of clothing layers is given in parentheses)	Required Minimum Arc Rating of PPE [J/cm^2 (cal/cm^2)]
0	Non-melting, flammable materials (ie. Untreated cotton, wool, rayon, or silk, or blends of these materials) with a fabric weight of at least 4.5 oz/yd^2 (1)	N/A
1	FR shirt and FR pants or FR coverall (1)	16.74 (4)
2	Cotton underwear-conventional short sleeve and brief/shorts, plus FR shirt and FR pants (1 or 2)	33.47 (8)
3	Cotton underwear plus FR shirt and FR pants plus FR coverall, or cotton underwear plus two FR coveralls (2 or 3)	104.6 (25)
4	Cotton underwear plus FR shirt and FR pants plus multilayer flash suit (3 or more)	167.36 (40)

Note: Arc rating is defined in Article 100 and can be either ATPV or E_{BT}. ATPV is defined in ASTM F 1959-99 as the incident energy on a fabric or material that results in sufficient heat transfer through the fabric or material to cause the onset of a second-degree burn based on the Stoll curve. E_{BT} is defined in ASTM F 1959-99 as the average of the five highest incident energy exposure values below the Stoll curve where the specimens do not exhibit break open. E_{BT} is reported when ATPV cannot be measured due to FR fabric break open.

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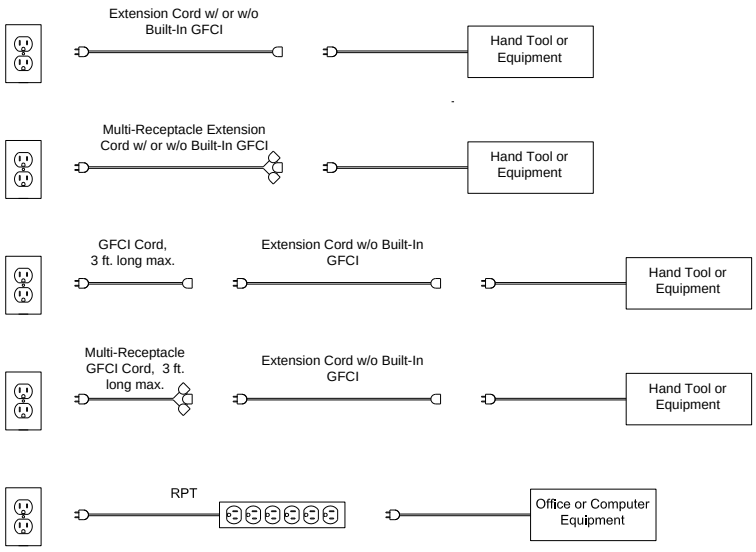
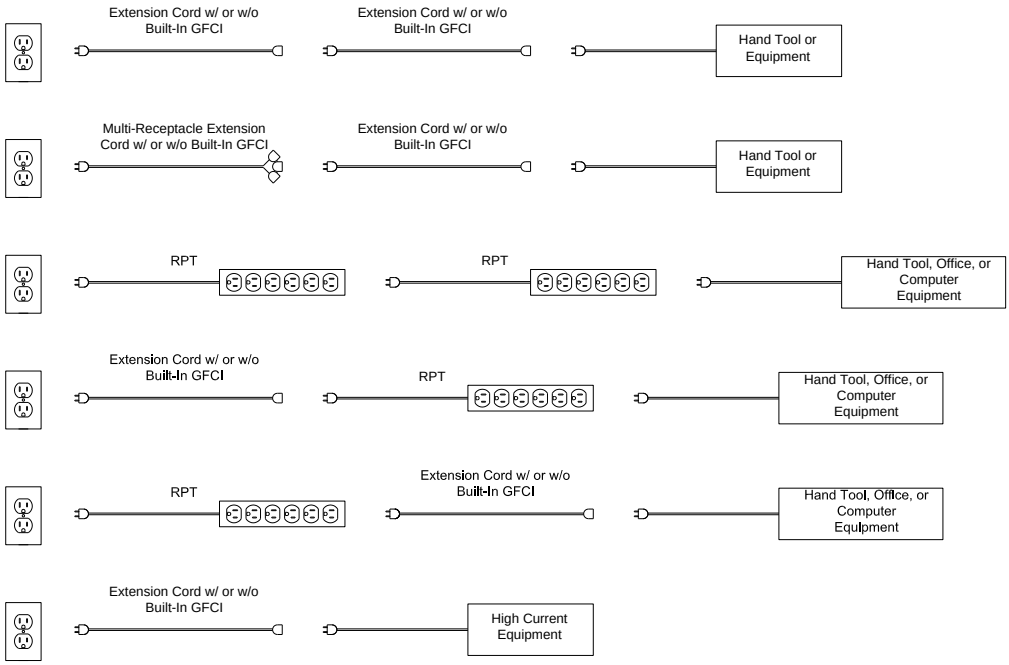
The following are examples of acceptable and unacceptable combinations of extension cords and RPTs, selected as representative of applications found at LaRC. This list is not exhaustive and acceptable and unacceptable combinations are not limited to these examples.

Acceptable combinations of extension cords and RTP's



Unacceptable (Daisy chain) combinations of extension cords and RTP's



Langley Research Center

LPR 1710.8
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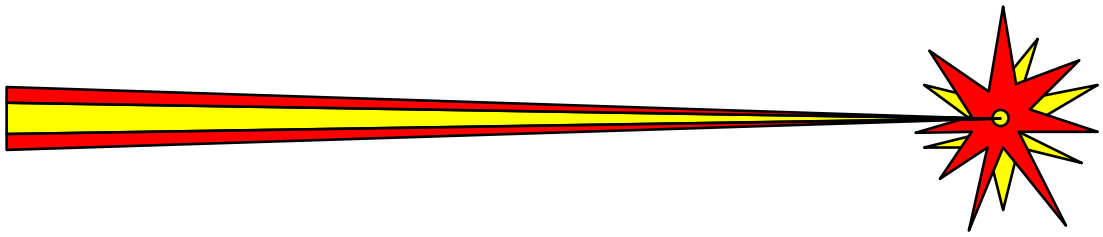
Expiration Date: August 3, 2012

NON-IONIZING RADIATION



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PREFACE

P.1 PURPOSE

a. This procedural requirement describes the organization, procedures, and requirements for the radiological health and safety activity of the Langley Research Center (LaRC), as they specifically pertain to non-ionizing radiation activities at LaRC.

b. This procedural requirement defines requirements for the procurement, use, and handling of sources of non-ionizing radiation. It also indicates sources from which more detailed information on non-ionizing radiation may be obtained when necessary.

c. This procedural requirement ensures compliance with all NASA regulations and Federal Laws applicable to non-ionizing radiation and serves to:

(1) exercise centralized control over operations involving use of hazardous radiation producing equipment.
(2) assure a safe level of exposure of personnel to non-ionizing radiation from such equipment.
(3) assure compliance with applicable Federal, state, and local regulations.

d. A Non-ionizing Radiation Committee (NIRC) is established under the authority of Langley Policy Directive (LAPD) 1700.1, “Safety Program,” and CID 1150.2, "Councils, Boards, Panels, Committees, Teams, and Groups." The committee responsibilities are presented in Chapter 1 of this LPR.

P.2 APPLICABILITY

a. These procedures apply to all persons performing work at Langley Research Center (LaRC), including civil servants, contractors (to the extent required by their contracts), research associates, and others. Non-compliance with this LPR will result in appropriate disciplinary action or exclusion from the Center for a contractor employee.

b. The procedures and radiation protection practices as set forth in this procedural requirement applies to all organizational elements of LaRC and to all personnel working in or visiting areas under the administrative control of LaRC. Although intended primarily to apply to the use of lasers or laser systems, these procedures and practices may also apply to hazardous non-coherent sources of non-ionizing radiation such as radars, solar simulators, and high-intensity arc lamps. Questions concerning details of current practices and procedures or their applicability shall be referred to the LaRC Radiation Safety Officer (RSO), Health Physicist, Safety and Facility Assurance Branch (SFAB), Safety and Mission Assurance Office (SMAO).

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c. It is the responsibility of contractors to provide and implement their own non-ionizing radiation program, to the extent required by their contracts. As a minimum, this program shall be in accordance with the LaRC program as described herein.

P.3 AUTHORITY

a. American National Standard for the Safe Use of Lasers (ANSI Z136.1-2000).
b. American National Standard for the Safe Use of Lasers Outdoors (ANSI Z136.6-2000)
c. American National Standard National Electric Code, ANSI/NFPA No. 70 1981, Articles 300 and 400.
d. American National Standard Safety Standard for Radio Receivers, Audio Systems and Accessories, ANSI/UL 127-1978.
e. Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations (CFR) 1910.97- Non-ionizing Radiation.
f. Code of Federal Regulations (CFR), Title 21 Food and Drugs, Part 1040.10 - Laser Products
g. Threshold Limit Values (TLV) and Biological Exposure Indices, American Conference of Governmental Industrial Hygienists (2006) Edition.
h. Laser Safety Reference Book, Laser Institute of America
i. Federal Aviation Administration Order 7400.2E, Procedures for Handling Airspace Matters
j. The Institute of Electrical and Electronics Engineers (IEEE) C95.1, C95.3 and C95.7

P.4 APPLICABLE DOCUMENTS

a. CID 1150.2, "Councils, Boards, Panels, Committees, Teams, and Groups."
b. LAPD 1700.1, “Safety Program."
c. LPR 1740.6, “Personnel Safety Certification.”
d. NASA Langley Form 44A, “Radiation Hazard Form.”
e. NASA Langley Form 49, “Safety Permit Request Laser/Microwave.”
f. NASA Langley Form 66, “Worker Appointment and Certification Form.”
g. NASA Langley Form 492, “Radiation Worker’s Certification Card.”

P.5 MEASUREMENT/VERIFICATION

NONE

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P.6 CANCELLATION

LPR 1710.8, dated October 3, 2004.

Original signed on file

Lesa B. Roe
Director

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Chapter 1

1. NON-IONIZING RADIATION COMMITTEE (NIRC)

1.1 COMMITTEE AUTHORITY

a. Any member of the NIRC is authorized to investigate any questionable radiation source, equipment, system, procedure, and so forth; to act in the name of the LaRC Director to stop work; to prevent the use of equipment/procedure which is considered unsafe; and, to start action to eliminate the unsafe condition. This action shall be documented within 24 hours by formal letter to the Chairperson, NIRC. However, if line management is not in agreement with the corrective action recommended by the official who stopped the work, the line manager is to submit the reasons to the Chairperson, Executive Safety Council, who shall make an appropriate review. In these cases work shall not resume without the approval of the Chairperson, Executive Safety Council.

b. Due to the need for the NIRC to maintain an overview of non-ionizing radiation activities at LaRC, a safety permit review system is established for major radiation facilities. This review system is described in Chapter 4, “Routine Procedures and Requirements.”

1.2 STRUCTURE AND ORGANIZATION

a. The NIRC functions as a committee of the Executive Safety Council. Its position in the organization for radiation safety is shown in Figure 1.1, LaRC Organization for Radiation Safety.

b. Committee members (including Chairperson and Vice Chairperson) are appointed by the Vice-Chairperson, Executive Safety Council, by virtue of their technical and/or educational expertise in the field of non-ionizing radiation. A typical committee will consist of a Chairperson, Vice Chairperson, Secretary, and eleven additional qualified members. Members serve for a three-year term with the exception of the SFAB Representative and the Radiation Safety Officer (RSO) who serve as long as the committee continues to function. Committee members may serve multiple terms. Selection of committee member should be representative of the organizations which conduct work utilizing non-ionizing radiation sources.

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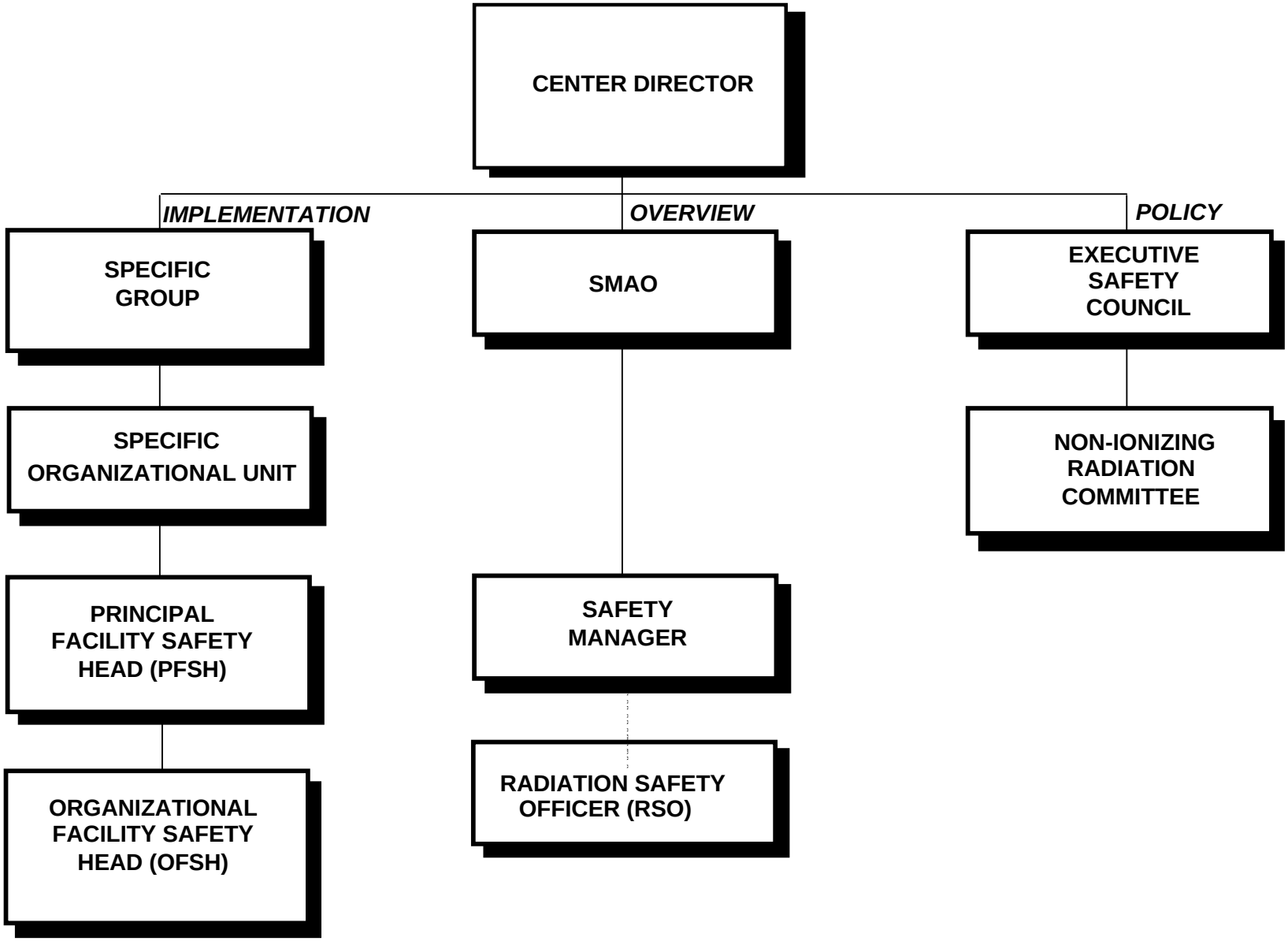

Figure 1.1, LaRC Organization for Non-ionizing Radiation Safety

1.3 DUTIES AND RESPONSIBILITIES

1.3.1 General

a. To prevent unnecessary non-ionizing radiation exposure to LaRC personnel and the surrounding populace, the NIRC shall exercise centralized control over sources of non-ionizing radiation at LaRC. This control shall be accomplished through the documented review and approval of all procurement, handling, and use of sources of hazardous non-ionizing radiation. In addition, the NIRC shall ensure that an audit is made of each facility's possession and use of sources of non-ionizing radiation no less than annually (Chapter 5).

b. The NIRC is responsible for providing oversight in the updating and modification of this procedural requirement as NASA regulations and Federal laws are implemented.

1.3.2 Specific Duties and Responsibilities

1.3.2.1 Chairperson

The duties of the committee Chairperson are to:

a. prepare agenda and call meetings as required but, at least quarterly.
b. act as the presiding officer at committee meetings.
c. act as the signature authority for actions approved by the committee.
d. be cognizant of all matters pertaining to non-ionizing radiation at LaRC.

1.3.2.2 Vice Chairperson

The duties of the committee Vice Chairperson are to:

a. assist the Chairperson whenever necessary.
b. serve as the Chairperson when the Chairperson is absent.

1.3.2.3 Secretary

The duties of the committee Secretary are to:

a. prepare and distribute minutes of committee meetings which shall contain, as a minimum, a record of persons present and a description of matters discussed and conclusions reached, including the opinions of dissenting members, and copies of all reports issued or approved by the committee.
b. distribute minutes to all members; Organizational Facility Safety Heads (OFSH's) concerned with non-ionizing radiation; the Chairperson, Executive Safety Council; and the Director, SMAO.
c. process official correspondence for the committee as needed.

1.3.2.4 Members

Member duties and responsibilities are to:

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a. be cognizant of all matters pertaining to non-ionizing radiation safety at LaRC. This is chiefly, but not entirely, achieved by attending the committee meetings and participating in the decisions made by the committee.

b. serve on ad hoc committees, appointed by the Chairperson, when necessary.

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Chapter 2

2. SAFETY AND HEALTH FUNCTIONS

2.1 GENERAL

The responsibility for implementing the policies of these procedural requirements is divided among five safety and health functions. The interface requirements of these functions and their duties and responsibilities are presented in this Chapter.

2.2 ORGANIZATIONAL FACILITY SAFETY HEAD (OFSH)

The Principal Facility Safety Head (PFSH) of each facility where non-ionizing radiation operations are performed shall appoint an OFSH for each operation, which is functionally or generically distinct. The OFSH shall, in each case, be a representative of line management who is thoroughly familiar with the non-ionizing radiation operation and its hazards. In some cases, the OFSH may also be the prime user of the source(s) of non-ionizing radiation.

2.2.1 Interfaces

The OFSH is the first point of contact for the individual who has a requirement for the procurement, use, or disposal of sources of non-ionizing radiation. The first point of contact for the OFSH is the RSO.

2.2.2 Responsibilities

Responsibilities of the OFSH of an operation involving sources of non-ionizing radiation are:

a. supervise and coordinate, in a safe manner, the procurement, use, and disposal of sources of non-ionizing radiation.
b. maintain a current inventory of all non-ionizing radiation sources used in operations. The inventory shall include locations of use, type of radiation emitted, and maximum radiation intensities produced by these sources.
c. maintain a current list of employees in the operation who are required to be certified as radiation workers. Chapter 5, “Special Procedures and Requirements,” presents the certification requirements.
d. accompany the RSO during audits of the operation and, when appropriate, attend meetings of the NIRC.

2.3 RADIATION SAFETY OFFICER (RSO)

The position of the RSO has been designated to a contractor located in the Safety and Facility Assurance Branch (SFAB). The RSO also has the title of Laser Safety Officer.

2.3.1 Interfaces

The RSO is a member of the NIRC and is responsible for reporting non-ionizing radiation information to SMAO and the Safety Manager. Recommendations to the committee for approval or disapproval of new uses of non-ionizing radiation are made

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by the RSO following pre-operational surveys and review of safety procedures. The RSO assists the radiation user as primary contact on a day-to-day basis for matters relating to radiation safety other than procurement.

2.3.2 Responsibilities

In general, the RSO provides administrative and technical guidance to LaRC personnel in the safe use of non-ionizing radiation. The RSO shall:

a. Prepare incident and overexposure reports required by the Occupational Safety and Health Administration (OSHA).
b. Perform pre-operational surveys and radiation hazard analyses of all proposed uses of facilities for non-ionizing radiation to assure conformity with applicable standards and good practice. Recommend to the NIRC approval or disapproval of these facilities.
c. Perform annual audits of non-ionizing radiation activity in each facility.
d. Perform periodic radiation protection surveys and radiation safety evaluations as an integral part of the audit function.
e. Assist line management in implementing radiation safety rules and procedures as promulgated by the NIRC.
f. Provide training and indoctrination of personnel in radiation safety.
g. Review all purchase requests for non-ionizing radiation sources for compatibility with approved policies and safety programs.
h. Review, sign and forward to the LaRC Safety Manager safety permit requests for the use of non-ionizing radiation sources (NASA Langley Form 49).
i. Regularly inform the NIRC of new developments in the field of non-ionizing radiation, as they are applicable to activities at LaRC.

2.4 SAFETY MANAGER

The Head, SFAB, SMAO, is the Safety Manager.

2.4.1 Interfaces

The Safety Manager interfaces include:

a. technically managing contractual health physics services at LaRC.
b. serving as a member of the NIRC (or assigning a designee).
c. acting as the primary contact for LaRC management on matters relating to radiation safety.
d. representing the government as the liaison between the RSO and federal regulatory authorities (e.g. OSHA, Food and Drug Administration [FDA], Federal Aviation Administration [FAA]).

2.4.2 Responsibilities

The Safety Manager shall:

a. exercise general surveillance over all uses of non-ionizing radiation at LaRC, including on-site contractor activities to assure radiation use is in conformity with

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safe practice, pertinent regulations, and with provisions approved by the NIRC for specific radiation use authorizations (that is, safety permits).

b. choose to have the RSO perform the above function.

c. serve as the final reviewing and/or certifying authority on the following documents:

(1) NASA Langley Form 66, “Worker Appointment and Certification Form.”

(2) NASA Langley Form 44A, “Radiation Hazard Form.”

(3) NASA Langley Form 49, “Safety Permit Request Laser/Microwave.”

(4) NASA Langley Form 492, “Radiation Worker’s Certification Card.”

2.5 OCCUPATIONAL HEALTH OFFICER (OHO)

The LaRC Occupational Health Officer (OHO) is a member of the Office of Human Capital Management (OHCM).

2.5.1 Interfaces

The OHO’s interfaces include:

a. Contracting Officer’s Technical Representative (COTR) for medical support services at LaRC (specifically, the LaRC Occupational Medical Center (OMC), 10 West Taylor Street, Facility 1149).

b. Center’s prime contact for matters relating to occupational illnesses or injuries.

2.5.2 Responsibilities

The OHO’s responsibilities are to:

a. determine adequacy of physical examination requirements for non-ionizing radiation workers at LaRC and review new developments in the area of medical surveillance for these workers.

b. review the medical disqualification of any LaRC employee as a non-ionizing radiation worker with the contract ophthalmologist and the LaRC Medical Director.

c. serve as a qualifying official for non-ionizing radiation worker appointment and certification on NASA Langley Form 66.

2.6 RADIATION WORKERS

The OFSH having direct involvement with sources of non-ionizing radiation shall forward recommendations for appointment of radiation workers and operators as described in Chapter 4, “Routine Procedures and Requirements.”

2.6.1 Interfaces

Radiation workers shall work under the direct authority of the OFSH.

2.6.2 Responsibilities

Radiation workers shall be:

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a. cognizant of and comply with the LaRC regulations pertaining to non-ionizing radiation safety.
b. fully aware of the limitations given in the Description of Duties block on the appointment form, and notify the OFSH when:
   (1) a change in the definition of the limitations is needed.
   (2) the need to work in restricted areas has ended.

2.7 LASER OPERATOR

The laser operator shall:

a. prevent unauthorized personnel from entering a controlled area during hazardous operations.
b. be responsible for the overall safety of all personnel in the laser work area.
c. limit access to the laser work area to all personnel not necessary for the laser research operations (Chapter 5).
d. exercise authority over the safe operation of the device to which the radiation operator is assigned.

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Chapter 3

3. ROUTINE PROCEDURES AND REQUIREMENTS

3.1 GENERAL

Clearly defined procedures and requirements are a prerequisite for the orderly processing of documents and materials for any type of organizational structure. Procedures and requirements relating to non-ionizing radiation at LaRC are included in this Chapter. Questions concerning procedures and requirements shall be directed to the RSO.

3.2 PROCUREMENT AND/OR RECEIPT

a. Prior to the procurement and receipt of any hazardous source of non-ionizing radiation, the intended user or operator of the source shall complete NASA Langley Form 44A, "Radiation Hazard Form," and route the form to the RSO as the final repository. Where an OFSH has not been appointed, the intended user submits NASA Langley Form 44A to the Principal Facility Safety Head (PFSH). The PFSH shall then appoint an OFSH for the organization, which is procuring the source of non-ionizing radiation.

b. Sources, which specifically require NASA Langley Form 44A, are:

(1) all class 3b, and 4 lasers and laser systems , which are the only lasers and laser systems that require NASA Langley Form 44A. Laser pointers and CD rom drives are not regulated and do not require a Langley Form 44A.
(2) ultraviolet light sources, radio frequency (RF) generators capable of propagating RF power into free space, and any other sources or systems that may exceed the exposure limits as outlined in this LPR.

3.2.1 Organizational Facility Safety Head (OFSH)

The OFSH is required to:

a. review and approve NASA Langley Form 44A for systems safety compatibility and/or compatibility with research objectives.
b. forward approved NASA Langley Form 44A to the RSO.

3.2.2 Radiation Safety Officer (RSO)

The RSO is responsible for:

a. scheduling a pre-operational review with the OFSH upon receipt of NASA Langley Form 44A. The purpose of this review is to provide the OFSH with guidance and assistance in the following areas:
(1) applicability of safety permit requirements.
(2) preparation of safety procedures.
(3) preparation of authorizing documents specified in this Chapter.

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b. approving or disapproving the NASA Langley Form 44A following the survey and forwarding it to the Safety Manager.

3.2.3 Safety Manager

The Safety Manager's responsibilities include:

a. On receipt of NASA Langley Form 44A, review the RSO's review and approve or disapprove the purchase of the non-ionizing radiation source.
b. If disapproved, return NASA Langley Form 44A to the OFSH with a written explanation of disapproval attached. The OFSH may appeal disapprovals, through the OFSH's Organizational Unit Manager, to the Executive Safety Council.

3.2.4 Contracting Officer, Office of Procurement

After receipt of an approved NASA Langley Form 44A, complete the information indicated in the upper right-hand corner of the form. If a contract is let for purchase of the material forward a copy to the Capital Assets and Logistics Branch (CA&LB).

3.3 AUTHORIZATION OF USE ("SAFETY PERMIT")

a. Laser/microwave sources of non-ionizing radiation require the completion and approval of a NASA Langley Form 49, "Safety Permit Request - Laser/Microwave," and a related safety plan before the source can be used or operated at any LaRC facility. (Appendix C, "Suggested Outline for NASA Langley Form 49, "Safety Permit Request - Laser/Microwave," Preparation"). This package of documents is referred to as the "safety permit." The RSO is responsible for the determination of safety permit requirements during the processing of NASA Langley Form 44A (Chapter 5).

b. As a general rule, the following sources of non-ionizing radiation shall require the issuance of a safety permit:

(1) class 3b lasers or laser systems, the use of which creates a significant possibility that its users or operators will be exposed to radiation levels in excess of the applicable maximum permissible exposure (MPE) (Chapters 5, "Special Procedures and Requirements").
(2) all class 4 lasers or laser systems.
(3) all radio frequency (RF) generators capable of propagating RF power into occupied areas in excess of those limits, which allow a whole body specific absorption rate of 0.4 w/kg in any 0.1-hour for a specific wavelength.
(4) ultraviolet light sources, as determined by the RSO, the use of which creates a significant probability that its users or operators will be exposed to ultraviolet radiation levels in excess of applicable threshold limit values (TLV) as recommended by the American Conference of Governmental Industrial Hygienists (ACGIH). (Appendix A, "Exposure Standard for Non-laser Ultraviolet Radiation," presents the determination of the MPE for non-laser ultraviolet radiation.)

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(5) magnetic field sources, as determined by the RSO, the use of which creates a significant probability that its users or operators will be exposed to magnetic flux densities in excess of the applicable TLV's as recommended by the ACGIH.

(6) static electric field sources, as determined by the RSO, with whose proposed use exists a significant probability that its users or operators will be exposed to electric flux densities in excess of the applicable TLV's as recommended by ACGIH.

(7) visible and infrared light sources, as determined by the RSO, whose use of which has the probability of exposing personnel to light levels in excess of the TLV's as recommended by the ACGIH.

c. The safety permit is a formal written designation that the particular research experiment, rig, or operation has been reviewed by technically qualified members of the LaRC staff and that all reasonable safety precautions and environmental requirements have been considered and subsequently implemented. The NASA Langley Form 49 shall describe the maximum potentially hazardous operating parameters (that is, maximum radiant power, radiant energy, kilovoltage, amperage, and so forth) expected during the life of the experiment or operation. Changes in the operational configuration which, (1) do not exceed the authorized maximum parameters, or (2) change the authorized safety features, will not require the processing of a modified NASA Langley Form 49. Other changes require additional review and approval by the NIRC. NASA Langley Form 49 is valid for a period of 1 year from date of issuance for new or modified facilities; and thereafter, for a period of 4 years.

3.3.1 Organizational Facility Safety Head (OFSH)

The OFSH shall:

a. review NASA Langley Form 49's, attached pertinent drawings, sketches, and supporting information (Appendix C, "Suggested Outline for NASA Langley Form 49, "Safety Permit Request - Laser/Microwave" Preparation.") prepared by researchers working in their facilities.

b. verify that a Worker Appointment and Certification Form (NASA Langley Form 66 for NASA employees) or its equivalent (for contractor employees) has been submitted for each radiation worker listed as a user/operator.

c. forward NASA Langley Form 49 and attachments to the RSO. Electronic media should be used whenever possible.

d. post the approved safety permit in a conspicuous place at the specified site or if more practical, in the applicable control center for the site.

e. submit a NASA Langley Form 49 for renewal to the Safety Manager at least 30 calendar days prior to its expiration date or submit a new NASA Langley Form 49 through channels anytime a change is required in the authorized maximum operating parameters.

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3.3.2 Radiation Safety Officer (RSO)

The RSO shall:

a. perform a radiation hazard analysis of the proposed operation upon receipt of NASA Langley Form 49 and attachments.
b. work closely with the OFSH during this analysis to provide guidance and assistance in the preparation and acquisition of safety procedures, protective equipment, and medical surveillance (if required).
c. forward NASA Langley Form 49, attachments, and the hazard analysis (with appropriate recommendations) to the NIRC for their review and action.
d. verify certification listings of radiation workers and laser operators.
e. review existing safety permits as part of the annual audit to ensure that they are valid (either not expired or have been reviewed before expiration date).

3.3.3 Non-ionizing Radiation Committee

The NIRC shall:

a. review NASA Langley Form 49 to determine that all reasonable precautions have been taken and whether the proposed operations can be carried out with an acceptable level of risk to personnel and equipment. Based on this review the NIRC shall:
   (1) approve issuance of the safety permit with conditions, if any.
   (2) disapprove the NASA Langley Form 49 and return to the OFSH if problem areas are evident.
   (3) withhold approval or disapproval until additional information is obtained. The OFSH shall be notified of this action.
b. review existing safety permits, that have been identified by the RSO during the annual audit, which require modification or are due for renewal.

3.3.4 Committee Chairperson

The NIRC Chairperson shall:

a. complete NASA Langley Form 49 and specify, when appropriate, any special conditions on which approval is based.
b. forward the approved NASA Langley Form 49 and attachments to the Safety Manager.

3.3.5 Safety Manager

a. The Safety Manager shall review NASA Langley Form 49 for impact on the environment or creation of safety hazards outside the scope of radiological health. Based on this review the Safety Manager will:

   (1) sign NASA Langley Form 49 and return all attached documentation to the OFSH.
   (2) return NASA Langley Form 49 and all attached documentation to the OFSH if problem areas are evident.

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3.4 USE OF LASERS IN NAVIGABLE AIRSPACE

a. The Federal Aviation Administration (FAA) is responsible for regulating the safe and efficient utilization of navigable air space and ensuring the safety of aircraft. Laser experiments or programs that will involve the propagation of laser light in navigable airspace shall be coordinated with the FAA in the planning stages to ensure control of any attendant hazard to airborne personnel and equipment.

b. FAA safety requirements for atmospheric lasers can be found in FAA Order 7400.2E. NASA LaRC complies with the requirements of this document. In addition, NASA LaRC has a written protocol agreement with Langley Air Force Base (LAFB) describing the requirements for use of lasers outdoors on Center property.

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Chapter 4

4. SPECIAL PROCEDURES AND REQUIREMENTS

4.1 SPECIAL REQUIREMENTS FOR OFF-SITE RADIATION USE AUTHORIZATION

a. Additional requirement and approvals are needed for LaRC organizations wishing to operate lasers and/or other non-ionizing radiation sources off-site. The term off-site refers to any facility not under the administrative control of LaRC, such as another NASA facility, a contractor's site, open-air operations, or air and space flights. In these circumstances, the following requirements shall be satisfied in addition to the safety permit:

(1) An OFSH from the requesting organization, having primary responsibility for all safety aspects associated with the operation of such system shall be appointed for the off-site operation. The OFSH shall be the point of contact for any issues or concerns the NIRC might have regarding the use of the source or sources for the off-site operations.

(2) Include a safety review as part of the total design review process. The OFSH is responsible for notifying the NIRC of any design review meetings.

(3) Written authorization shall be obtained from the administration or authorities for the jurisdiction or site in which the non-ionizing radiation source is to be operated. Use of the non-ionizing radiation source shall be concurred with by the safety organization for that jurisdiction.

(4) To assure minimal radiation exposure to individuals, the OFSH with the cognizance or guidance of the RSO shall perform monitoring tasks as determined necessary by the NIRC.

(5) All records of the radiation surveys shall be maintained by the OFSH and submitted to the RSO at the completion of the authorized use. Any incident involving overexposure to individuals shall be reported immediately to the RSO and the NIRC Chairperson.

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b. The RSO, in support of off-site operations, shall:

(1) act as the initial point of contact between the NIRC and the organization and/or individual wishing to operate a non-ionizing radiation source off site.
(2) maintain records of the off-site operations such as NASA Langley Form 49's, approval correspondence, safety violations or incidents, and other pertinent documentation.
(3) relay any reported incident or violation to SMAO, the Executive Safety Council, and the NIRC.
(4) assist with safety calculations.

4.1.1 Failure to Comply

Failure to comply with this LPR or any regulation cited by this LPR, may result in the suspension or termination of the non-ionizing radiation safety permit.

4.2 INTERIM APPROVALS

a. When an immediate use of non-ionizing radiation is determined necessary, the RSO, with verbal concurrence from the Chairperson, NIRC may temporarily modify the following previously approved authorizations to:

(1) extend an expiration date of a NASA Langley Form 49 for a period not to exceed 60 days.
(2) add to the sources of non-ionizing radiation named on an approved authorization.
(3) authorize a new use location and/or procedure provided the new location and/or procedure is equipped with safety features (interlocks, warning signs, area control, and so forth) which meet or exceed those authorized under the existing NASA Langley Form 49.

b. The NIRC shall evaluate these temporary modifications, and if satisfied that the RSO's action was proper, ratify the actions at the next committee meeting. However, approvals may be withdrawn at any time if safety violations occur or use of a source is found not to be in compliance with conditions of the approved authorization.

4.3 AUDITS

a. The RSO is responsible for conducting an audit of each facility possessing sources of non-ionizing radiation no less frequent than annually. The results of the audits are to be presented to the NIRC during their quarterly meetings.

b. Typical items covered during an audit are:

(1) inventories of:
  (a) lasers and laser systems.
  (b) RF sources/microwave sources.
  (c) ultraviolet sources.

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(d) magnetic sources.
(e) electric field sources.

(2) records of:
(a) worker certification and training.
(b) medical surveillance (if required).

(3) compliance with terms of the approved safety permit for the operation.
(4) selection and care of personal protective equipment (PPE).
(5) adequacy and operability of safety interlocks.
(6) area posting and signage.
(7) conduct of routine radiation protection surveys by the RSO.

4.4 TRAINING AND CERTIFICATION

All personnel who operate, manipulate, or who have any other type of physical control over the use of radiation-producing equipment or material specifically authorized by a safety permit (new or existing) are required to be trained and certified as radiation workers in accordance with LPR 1740.6, “Personnel Safety Certification.” It is the responsibility of each OFSH to ensure that personnel within the facility are trained and certified. Questions concerning this requirement should be directed to the RSO.

4.4.1 Qualifications

As a minimum, and prior to working with non-ionizing radiation, individuals shall have had experience and/or training on specific topics. NASA Langley Form 66, is used to determine and certify qualifications for worker training and safety certification described above and in accordance with LPR 1740.6. Contractor personnel shall use a form, which supplies the equivalent information contained in NASA Langley Form 66.

4.4.2 Safety Permits

All workers performing work under an approved safety permit must be certified and listed on the permit. Certified workers may be added to or removed from a permit by the OFSH or RSO without modifying the permit.

4.4.3 Certification Card

Based on the satisfactory completion of NASA Langley Form 66 and/or other documentation of the qualifying status of the worker, the RSO shall issue, revalidate, or terminate a NASA Langley Form 492, "Radiation Worker's Certification Card." The worker shall have the card on-hand or readily accessible, as proof of his/her certification, while performing applicable tasks. Contractor personnel may be issued equivalent cards by their employer.

4.5 MEDICAL SURVEILLANCE

Personnel requiring certification as laser workers shall be given a complete initial and termination eye examination by the Center’s contract ophthalmologist prior to being issued and on termination of a NASA Langley Form 492 in accordance with LPR 1740.6. These examinations are normally accomplished through routine processing of NASA Langley Form 66 and in accordance with established LaRC Occupational Medicine Examination Protocol. The examination is based upon the medical

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surveillance procedures in Appendix E of ANSI Z136.1, *Safe Use of Lasers*. A medical disqualification of any LaRC employee as a non-ionizing radiation worker shall be the result of a decision made by the ophthalmologist in consultation with the LaRC OHO and the LaRC Medical Director. Contractor companies are responsible for conducting an equivalent medical surveillance program for their employees.

4.6 INTERNAL TRANSFER

All sources of non-ionizing radiation authorized by a NASA Langley safety permit and located in a particular facility shall not be transferred to the accountability of another organization, or transferred from one location to another, either within LaRC or external to LaRC, without prior notification of the RSO and subsequent modification of the existing safety permit, as described in this chapter. This requirement is in addition to any action required for NASA property control procedures.

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Chapter 5

5. LASERS

5.1 GENERAL

The laser safety program at NASA Langley Research Center is based upon maintaining compliance with ANSI Z136.1, *Safe Use of Lasers*. The following information is provided as a brief synopsis of the safety requirements in the ANSI standard and to point out any Center–specific requirements that exist. In general, if there is a disagreement between the requirements of this document and the ANSI standard the more conservative requirement shall be adhered to. Deviations from the requirements of the ANSI standard may be granted on a case by case basis with the approval of the RSO and the NIRC.

5.2 LASER HAZARD CLASSIFICATION

The laser classification scheme is based on the accessible radiation during operation and the emission limit for that wavelength. Classification labeling which is used in conformance with the Federal Laser Product Performance Standard shall be used to satisfy this labeling requirement. Should it be necessary in the event that a laser or laser system has been modified subsequent to classification by the manufacturer, the RSO shall classify the laser or laser system following the criteria provided in the American National Standard for the Safe Use of Lasers (ANSI Z136.1-2000).

5.2.1 Class 1 or Exempt Lasers

Class 1 or Exempt lasers can be thought of as inherently safe lasers. Class 1 lasers have no accessible light in excess of the accessible emission limit (AEL). In addition, higher hazard class lasers which have been enclosed in such a manner as to prevent exposure of personnel to laser light in excess of the AEL may be classified as a Class 1 laser system.

5.2.2 Class 2 or "Low-Power" Laser Devices

Class 2 or “Low Power” laser devices are visible lasers which do not have enough power to injure a person under accidental exposure conditions (0.25 seconds or less). Class 2 lasers have a power limit of 1 mW.

5.2.3 Class 3 lasers

Class 3 lasers are sub-classified as either class 3R or class 3b. Class 3 lasers may be capable of causing injury to the eye if the laser beam is viewed either directly or by specular reflection. Class 3R lasers typically have a power limit of 5 mW. Class 3b lasers typically have a power limit of 500 mW.

5.2.4 Class 4 Lasers

Class 4 lasers are capable of causing injury to both the eye and the skin. The hazard posed by Class 4 lasers may be from directly or indirectly viewing the laser beam or its

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reflection and may come from diffusely reflected light. In addition, laser sources with an irradiance of greater than 5 W/cm2 can be capable of igniting combustible materials.

5.2.5 Class 1M and 2M lasers

These classifications are for laser whose beams would exceed the exposure limit for a Class 1 or Class 2 laser if viewed with an optical aid, such as binoculars.

5.2.6 Class 2a and 3a lasers

Laser classifications 2a and 3a are no longer utilized, although the lasers themselves are still commonly available and used. Class 2a lasers represented Class 2 lasers that were not intended for prolonged viewing such as supermarket scanners and bar code readers.

5.3 CONTROL MEASURES AND PROCEDURES

Appropriate control measures and procedures shall be used for all lasers and laser systems at LaRC to reduce the possibility of exposure of the eye and skin to hazardous laser radiation, and to other hazards associated with operation of laser devices. For all lasers and laser systems, it is mandatory that the minimum radiation level be used for the required application.

5.3.1 Laser Classifications 1, 2 and 3R

The only required control measure applicable to these lasers shall be an appropriate warning label affixed to a conspicuous place on the laser housing or control panel or both the housing and control panel (Labeling and Area Posting Requirements are described in this chapter, for label required).

Guidelines for the safe use of Class 3R (and Class 3a) laser are available from the RSO.

5.3.2 Laser Classification 3b

Those class 3b lasers which have been determined to require the issuance of an approved safety permit for their use shall comply with the following control measures and procedures. The RSO may wave some of the requirements of this section for low power Class 3b lasers on a case by case basis.

5.3.2.1 Education and Training

All persons using the laser or laser system shall be informed about the potential hazards of laser operations. All users and personnel present during use shall be certified as laser workers.

5.3.2.2 Engineering Controls

Priority shall be given to the incorporation of appropriate safety mechanisms as an integral part of the laser or laser system. Examples include beam stops, beam enlarging systems, enclosures, shutters, fail safe interlocks, and so forth.

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5.3.2.3 Laser Controlled Area

Consideration shall be given to operation of laser devices in a controlled area. Special emphasis shall be placed on control of the path of the laser beam.

5.3.2.4 Spectators

Spectators shall not be permitted into the laser-controlled area unless appropriate supervisory approval has been obtained and protective measures taken.

5.3.2.5 Beam Enclosures

The emitted laser radiation shall be contained within enclosures whenever practicable. Laser beams emitted by non-enclosed systems shall be terminated at the end of the useful beam path when the exposure level is greater than the MPE for direct irradiation of the eye and a possibility of human exposure exists.

5.3.2.6 Alignment Procedures

Alignment of laser optical systems (mirrors, lenses, beam deflectors, and so forth) shall be performed in such a manner that the primary beam, or a specular reflection of the primary beam, does not expose the eye to a level above the MPE for direct irradiation of the eye.

5.3.2.7 Optical Viewing Aids

Optical systems such as lenses, telescopes, microscopes, and so forth, may increase the hazard to the eye when viewing a laser beam; therefore, special care shall be taken in their use. Microscopes and telescopes may be used as optical instruments for viewing, but shall be provided with an interlock or filter, if necessary, to prevent ocular exposures above the appropriate MPE for irradiation of the eye.

5.3.2.8 Eye Protection

Eye protection devices, which are specifically designed for protection against radiation from the laser system, shall be used when engineering and procedural controls are inadequate to eliminate potential exposure in excess of the applicable MPE.

5.3.2.9 Equipment Labeling

Lasers shall have warning labels with the appropriate cautionary statement affixed to a conspicuous place on the laser housing or control panel, or on both the housing and control panel.

5.3.2.10 Diffusely Reflecting Materials

In addition to beam stops, shields, and enclosures, materials which will diffusely reflect any stray or incidental laser beams shall be used in laser areas whenever possible.

5.3.3 Laser Classification 4

a. The probability of injury and the extent of injury increases with increasing laser output power. High-power lasers require more rigid control measures, not only because there is a greater likelihood that specular reflections will have sufficient

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power to cause injury, but because of the greater risk of injury from hazardous diffuse reflections. The entire beam path capable of producing hazardous diffuse reflections shall be controlled. Controls shall rely primarily on more positive methods, such as enclosures and interlocks, and secondarily upon procedural safeguards.

b. Therefore, **in addition** to the control measure specified for class 3b lasers described above, the following controls shall apply to all class 4 laser systems at LaRC:

5.3.3.1 Laser Controlled Area

a. Specific laser controlled area requirements shall include:

(1) Laser devices shall be isolated in an area designated for laser operations.
(2) Access to such an area shall require appropriate authorization.
(3) Under conditions where the entire beam path is not enclosed, safety latches or interlocks shall be used to prevent unauthorized entry into laser controlled areas. Such measures shall be designed to allow both rapid egress by laser personnel at all times and admittance to the laser controlled area in an emergency condition. For such emergency conditions, a “panic button” (control disconnect switch or equivalent device) shall be available for deactivating the laser. Interlock overrides are permissible in laser controlled areas with specific approval by the RSO. If a casual passersby can gain access to an interlock bypass key, the room must have a door which requires either a separate key or a pass code to open.
(4) During tests requiring continuous operation, the person in charge of the controlled area shall be permitted to momentarily override the safety interlocks to allow access of other authorized personnel if it is clearly evident that there is no radiation hazard at the point of entry, and if the necessary protective devices are worn by the entering personnel.
(5) Should removal of the protective covers or the overriding interlocks become necessary for special training, service adjustments, or maintenance procedures, a temporary laser controlled area shall be devised following specific procedures approved by the RSO which will outline all safety requirements during the service and maintenance procedures. Such a temporary laser controlled area shall nevertheless provide for all safety requirements for all personnel, both within and without the temporary laser controlled area during the service or maintenance procedure.
(6) Under conditions where the entire beam path is not completely enclosed and the laser is capable of emission, access to the laser-controlled area shall be limited to persons wearing laser protective eyewear. In this case, all other optical paths (for example, windows) from the facility shall be covered or restricted in such a way as to reduce the transmitted intensity of the laser radiation to levels at or below the MPE for direct irradiation of

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the eye. Specularly reflecting surfaces, which are not required when using the laser, shall be removed from the beam path.

(7) The purpose of control measures is to reduce the possibility of exposure to hazardous levels of laser radiation and to associated hazards. Therefore, it may not be necessary to implement all of the control measures given. Whenever the application of any one or more control measures reduces the possible exposure to a level at or below the applicable MPE, the application of additional control measures should not be necessary.

5.3.3.2 Enclosed Beam Path

Whenever possible, the entire beam path, including the interaction area, that is, the area in which irradiation of materials by the primary or secondary beams occurs, shall be enclosed. Enclosures shall be equipped with interlocks so that the laser system will not operate unless such enclosures are installed. For pulsed systems, interlocks shall be designed so as to prevent firing of the laser, by dumping the stored energy into a dummy load. For cw lasers, the interlocks shall turn off the power supply or interrupt the beam by means of shutters. Interlocks shall not allow automatic re-energizing of the power supply, but shall be designed so that after tripping the interlock, the power supply or shutter shall be reset manually.

5.3.3.3 Remote Firing and Monitoring

Whenever possible, the laser system shall be fired and monitored from remote positions.

5.3.3.4 Warning Systems

Warning systems are required for lasers as follows:

a. An alarm system, for example, an audible sound, or a warning light visible through protective eyewear, or a verbal “countdown” command, shall be used prior to laser activation.

b. The audible system may consist of a bell or chime which commences when a pulsed laser power supply is charged for operation, for example, during the charging of capacitor banks. Systems shall be used in which a warning will sound intermittently during the charging procedure (pulsed systems) and continuously when fully charged.

5.3.3.5 Key-Switch Master Interlock

Any laser or laser system designated as class 4 shall be provided with an operative keyed master interlock or switching device. The key shall be removable and the device shall not be operable when the key is removed.

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5.4 NON-BEAM HAZARDS AND CONTROLS

5.4.1 Control of Laser Explosion Hazards

High-pressure arc lamps and filament lamps in laser equipment shall be enclosed in housings, which can withstand the maximum explosive pressures resulting from lamp disintegration. The laser target and elements of the optical train which may shatter during laser operation shall also be enclosed or equivalently protected to prevent injury to operators and observers.

5.4.2 Control of Laser Electrical Hazards

The intended application of the laser equipment determines the method of electrical installation and connection to the power supply circuit (for example, conduit versus flexible cord). All equipment shall be installed as outlined in American National Standard National Electric Code, ANSI/NFPA No. 70 1981(as updated), or the most current issue, Articles 300 and 400. (Such installed equipment is acceptable to the U. S. Department of Labor, OSHA, if accepted, certified, listed, labeled, or otherwise determined safe by a qualified testing laboratory, such as, but not limited to, Underwriters Laboratories [UL] Incorporated, and Factory Mutual Corporation.)

5.4.2.1 Shock Hazard

Controls as follows are required to avoid laser electrical shock hazards:

a. Live parts of circuits and components with peak open circuit potentials over 42.5 volts are considered hazardous, unless limited to less than 0.5 mA. Such circuits require positive protection against contact. For equipment intended for general use, interlock switches (and capacitor bleeder resistors if applicable) or their equivalent shall be installed to remove the voltage from accessible live parts to permit servicing operation. Bleeder resistors shall be of such size and rating as to carry the capacitor discharge current without burnout or mechanical injury. Circuits and components with peak open-circuit potentials of 2500 volts or more shall be adequately covered or enclosed if an appreciable capacitance is associated with the circuits.

b. If servicing of equipment requires entrance into an interlocked enclosure, a solid metal grounding rod shall be utilized to assure discharge of high voltage capacitors. The grounding rod shall be firmly attached to ground prior to contact with the potentially live point. A resistor grounding rod (for example, a large wattage ceramic resistor) may be used prior to application of the aforementioned solid conductor grounding rod to protect circuit components from overly rapid discharge, but not as a replacement.

5.4.2.2 Grounding

The frames, enclosures, and other accessible metal non-current carrying metallic parts of laser equipment shall be grounded. Grounding shall be accomplished by providing a reliable, continuous, metallic connection between the part or parts to be grounded and the grounding conductor of the power wiring system. Metal optical tables shall be bonded to the building grounding system.

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5.4.2.3 Electrical Fire Hazards

Components in electrical circuits shall be evaluated with respect to fire hazards. Circuit components of combustible material, such as transformers, that do not pass a short-circuit test without ignition (American National Standard Safety Standard for Radio Receivers, Audio Systems and Accessories, ANSI/UL 127-1978 or the most current issue) shall be provided with individual noncombustible enclosures. Power supply circuit wiring shall be completely enclosed in noncombustible material.

5.4.2.4 Electrical Hazards from Explosion

Gas laser tubes and flash lamps shall be supported to ensure that their terminals cannot make any contact which will result in a shock or fire hazard in the event of a tube or lamp failure. Components such as electrolytic capacitors may explode if subjected to voltages higher than their ratings, with the result that ejected metal may bridge live electrical parts. Such capacitors should be tested to make certain that they can withstand the highest probable potentials should other circuit components fail, unless the capacitors are adequately contained so as not to create a hazard.

5.4.3 Hazardous materials

Some types of laser systems, such as dye and excimer lasers, utilize hazardous materials in their operations. Many laser dyes have not been completely characterized and many that have been analyzed have been found to possess hazardous properties such as being carcinogenic or mutagenic. In addition, some of the solvents used to dissolve the laser dyes have hazardous properties of their own or enhance the hazardous properties of the dyes. Excimer lasers may use gases which are corrosive and/or toxic and require the appropriate ventilation systems to manage this hazard. Laser systems which use hazardous materials should have the process reviewed by the center's Industrial Hygiene staff and may require a Potentially Hazardous Materials Permit.

5.4.4 Other Forms of Radiation

Lasers may be capable of emitting other forms of non-ionizing or ionizing radiation during their operation, such as x-rays or radiofrequency waves. The RSO will review the potential for these hazards as part of the hazard analysis.

5.4.5 Laser Generated Airborne Contaminants

Laser systems which possess sufficient energy to cause material alteration or ablation have the potential to release laser generated airborne contaminants (LGAC's). These contaminants may be a respiratory hazard and shall be adequately controlled through the use of ventilation and/or enclosure of the work area. Review of these types of systems shall be coordinated with the center's Industrial Hygiene staff.

5.5 LASER PROTECTIVE EYEWEAR

Laser protective eyewear shall be worn when engineering and/or administrative controls are impractical or insufficient to reduce eye exposure to laser radiation below the applicable MPE. The RSO shall be consulted regarding the selection of eyewear. The following factors shall be considered in determining the appropriate protective eyewear:

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a. wavelength of laser output.
b. radiant exposure or irradiance.
c. MPE value.
d. optical density of eyewear at the specific laser output wavelength visible light transmission requirement.
e. minimum radiant exposure or irradiance at which damage to the laser protective eyewear might be expected to occur.
f. need for prescription glasses.
g. comfort.
h. degradation of absorbing media.
i. need for peripheral vision.

5.5.1 Specification of Optical Density, OD

a. The attenuation of Optical Density (OD) of laser protective eyewear at a specific wavelength shall be specified. Many lasers radiate at more than one wavelength; thus eyewear designed to have an adequate OD for a particular wavelength could have a completely inadequate OD at another wavelength radiated by the same laser. This problem may become particularly serious with lasers that are tunable over broad frequency bands.

b. If the Actual Eye Exposure is given by H_o, then the OD required of protective eyewear to reduce this exposure to the MPE is given by:

$$OD = \log_{10} (H_o / MPE)$$

where the units of H_o are the same as those of the appropriate MPE. It should be noted that optical densities greater than three or four (depending on exposure time) could reduce eye exposures below the ocular MPE but leave the unprotected skin surrounding the eyewear exposed to values in excess of the MPE for skin exposure. Attenuation through the protective material shall be determined from all anticipated viewing angles and at all wavelengths.

5.5.2 Visible Transmission

Adequate OD, at the laser wavelengths of interest, shall be weighed with the need for adequate visible transmission.

5.5.3 Identification of Eyewear

All laser protective eyewear shall be clearly labeled with optical density values and wavelengths for which protection is afforded.

5.5.4 Comfort and Fit

Protective eyewear shall provide a comfortable and snug fit so that laser radiation is satisfactorily attenuated before reaching the viewer's eyes. The RSO has a variety of samples which can be tried on to ensure proper fit prior to ordering.

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5.5.5 Inspection

Periodic inspections shall be made by each user of protective eyewear to ensure the maintenance of satisfactory conditions, to include:

a. inspecting the attenuator material for pitting, crazing, cracking, and so forth.
b. inspecting the goggle frame for mechanical integrity and light leaks.
c. ensuring that labeling of protective eyewear is in compliance with this Chapter.

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6. NON-COHERENT OPTICAL SOURCES

a. Non-coherent optical sources such as ultraviolet (UV), visible and infrared (IR) light are capable of causing injury to both the skin and to the eyes. All non-coherent optical sources capable of exposing workers to an irradiance level greater than the limits recommended in the Handbook of Threshold Limit Values (TLV's) and Biological Exposure Indices (BEI's) by the American Council of Government Industrial Hygienists (ACGIH) require the issuance of a safety permit by the RSO. Consult with the RSO to determine the appropriate exposure limits for these sources.

b. Types of optical radiation, the types of injury caused by them and typical sources are listed in the following table.

Source description	Emission type	Potential effects
Sunlight	Ultraviolet, visible, near infrared	Skin cancer, cataracts, sunburn, premature skin aging, retinitis
Arc lamps	Ultraviolet, visible, near infrared	Photokeratitis, erythema, skin cancer, retinal injury
Germicidal lamps	Ultraviolet	Erythema, photokeratitis, premature skin aging, skin cancer
Carbon arc lamps	Ultraviolet, blue light	Photokeratitis, erythema, retinitis
Metal halide arc lamps	Ultraviolet, blue light	Cataracts, photosensitive skin reactions, photoretinitis

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Chapter 7

7. MICROWAVE/RF RADIATION SAFETY

7.1 GENERAL INFORMATION

The Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz, is given in IEEE C95.1-1991. It covers safe levels involving both controlled and uncontrolled environments. The recommendations are listed in Appendices G and H of this LPR.

7.2 RADIATION WORKER'S RESPONSIBILITIES

The radiation workers using microwave/Rf equipment are personally responsible for compliance with the microwave/Rf standard and LaRC regulations in all operations. Operations are authorized by the NIRC. Worker responsibilities include:

a. Preparation of an initial Safety Review document for new projects or modifications of existing facilities.
b. Providing safety instructions to personnel using equipment under his direction.
c. Prohibiting use of the equipment unless there is adequate control of hazards, including warning signs and interlocks as necessary.
d. Notifying the Radiation Safety Officer, within 24 hours, when known or suspected overexposure to microwave/Rf radiation has occurred, so the individual can receive an ocular examination at their employer’s expense.
e. Adopting practices that will not intentionally expose an individual to microwave/Rf radiation in excess of the Permissible Exposure Limits (PEL’s).

7.3 MICROWAVE/RF PROJECT SAFETY REVIEW

a. Prior to installing new microwave/Rf equipment or modifying existing equipment, a Project Safety Review (NASA Langley Form 49 and associated safety plan) document must be submitted by the radiation worker to the Radiation Safety Officer (RSO) for review by the NIRC.
b. The document should include:
    (1) A description of the system and its application
    (2) A diagram showing the beam path
    (3) Operating parameters
    (4) Frequency
    (5) Antenna dimension
    (6) Power out
    (7) Antenna type
    (8) Pulse description
    (9) Antenna gain
    (10) Polarization of transmitted wave

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(11) Standard operating procedures, which will be posted near the equipment and which are designed to minimize hazards to personnel.

c. The project shall be reviewed by the RSO on an annual basis, or more frequently if the researcher's project deviated from approved standard operating procedures (SOP's).

7.4 OPERATIONAL SAFETY

a. The following rules apply when Radio Frequency Radiation (RFR) exceeding the PEL's is produced by equipment operated within NASA Langley except for household microwave ovens.

(1) Safety Permits must be posted near all operational equipment. The permit outlines suitable radiation protection procedures. A copy of the permit is on file in the SFAB.

(2) Only individuals who have been instructed in the potential hazards of microwave/Rf radiation and applicable SOP's are permitted to use the equipment.

(3) Microwave/Rf warning signs must be posted to define controlled areas.

(4) Access to areas where RFR exceeds the PEL must be restricted. When appropriate, physical barriers shall be used.

(5) Dummy loads shall be used whenever free-space radiation is not required by the mission.

(6) Free-space transmission within buildings is forbidden without prior approval from the RSO. As always, appropriate precautions must be taken to prevent overexposure to RFR.

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CHAPTER 8

8. LABELING AND AREA POSTING REQUIREMENTS

8.1 GENERAL

Labeling and area posting is required for non-ionizing radiation.

8.2 RADIO-FREQUENCY SOURCES (RF)

Those stationary RF sources determined to require an approved NASA Langley Form 49 for their use are subject to the posting requirements of the OSHA Occupational Safety and Health Standards (29 Code of Federal Regulations (CFR) 1910.97). Copies of this standard are available from the RSO.

8.3 HIGH INTENSITY ARC LAMPS OR SOLAR SIMULATORS

All high intensity arc lamps, solar simulators, or other light sources capable of producing hazardous levels of ultraviolet radiation shall have their source housings labeled and each access to the immediate work area posted with the following warning statement:

CAUTION HIGH INTENSITY ULTRA VIOLET ENERGY PROTECT EYES AND SKIN

This requirement is not applicable to those sources, which are enclosed, or when operating procedures specify the work area is to be evacuated before the source is energized.

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APPENDIX A

A. EXPOSURE STANDARD FOR NONLASER ULTRAVIOLET RADIATION

(Reference: Reprinted from the National Institute for Occupational Safety and Health recommended standard for Occupational Exposure to Ultraviolet Radiation, 1972. For more complete guidance consult the most current version of the American Conference of Governmental Industrial Hygienists, "Threshold Limit Values for Chemical Substances and Physical Agents").

RECOMMENDATIONS FOR AN ULTRAVIOLET RADIATION STANDARD

- The National Institute for Occupational Safety and Health (NIOSH) recommends that occupational exposure to ultraviolet energy in the workplace be controlled by compliance with the "Exposure Standards" below. Ultraviolet radiation (ultraviolet energy) is defined as that portion of the electromagnetic spectrum described by wavelengths from 200 to 400 nm. (Additional definitions and conversion factors are available in the referenced document.) Adherence to the recommended standards will, it is believed, prevent occupational injury from ultraviolet radiation, that is, will prevent adverse acute and chronic cutaneous and ocular changes precipitated or aggravated by occupational exposure to ultraviolet radiation.
- Sufficient technology exists to prevent adverse effects on workers, but technology to measure ultraviolet energy for compliance with the recommended standard is inadequate, so work practices are recommended for control of exposure in cases where sufficient measurement or emission data are not available.
- These criteria and the recommended standard will be reviewed and revised when relevant information warrants.

EXPOSURE STANDARDS

- For the ultraviolet spectral region of 315 to 400 nm, total irradiance incident on unprotected skin or eyes, based on either measurement data or on output data, shall not exceed 1.0 mW/cm^2 for periods greater than 1000 seconds, and for exposure times of 1000 seconds or less, the total radiant energy shall not exceed 1000 $mW.sec/cm^2$ (1.0 J/cm^2).
- For the ultraviolet spectral region of 200 to 315 nm, total irradiance incident on unprotected skin or eyes, based on either measurement data or on output data, shall not exceed the levels described below. Measurement techniques are discussed in the referenced document.
- If the ultraviolet energy is from a narrow band or monochromatic source, permissible dose levels for a daily 8 hour period can be read directly from Figure B.1, or, for selected wavelengths, from Table B.1.
- If the ultraviolet energy is from a broad band source, the effective irradiance, I_{eff}, relative to a 270 nm monochromatic source shall be calculated from the formula below. From I_{eff}, the permissible exposure time in seconds for unprotected skin or eyes shall be computed by dividing 0.003 J/cm^2, the permissible dose of 270 nm radiation, by I_{eff} W/cm^2.

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$$I_{eff} = \sum I_{\lambda} S_{\lambda} \Delta\lambda$$

where: I_{eff} = effective irradiance relative to a monochromatic source at 270 nm
I_{λ} = spectral irradiance in $W/cm^2/nm$
S_{λ} = relative spectral effectiveness (unitless); see Table B-1 for values of S_{λ} at different wavelengths
$\Delta\lambda$ = bandwidth in nm

Table B-2 lists permissible exposure times corresponding to selected values of I_{eff} in $\mu W/cm^2$.

- If radiation intensity from a point source is known at some distance from the worker, for example, from measurement at another point or from output data at a known distance from the ultraviolet source, attenuation of radiation from that point to the worker can be calculated from the principle that radiation decreases with the square of the distance it must travel. For example, an object three feet away from a radiation source receives one-ninth the energy of an object one foot away. This assumption is conservative in some instances, since ultraviolet radiation, especially at very low wave-lengths, may be absorbed by some components of the atmosphere. Where information on atmospheric absorption of ultraviolet radiation is known, further correction may be applied. The calculation of intensity of radiation at any given point by use of the inverse square formula explained above does not take into consideration reflected energy.
- The recommended standard is not proposed for application as a standard to lasers. It should be recognized that significant non-occupational exposure to ultraviolet radiation can occur from exposure to sunlight, particularly during the summer months.

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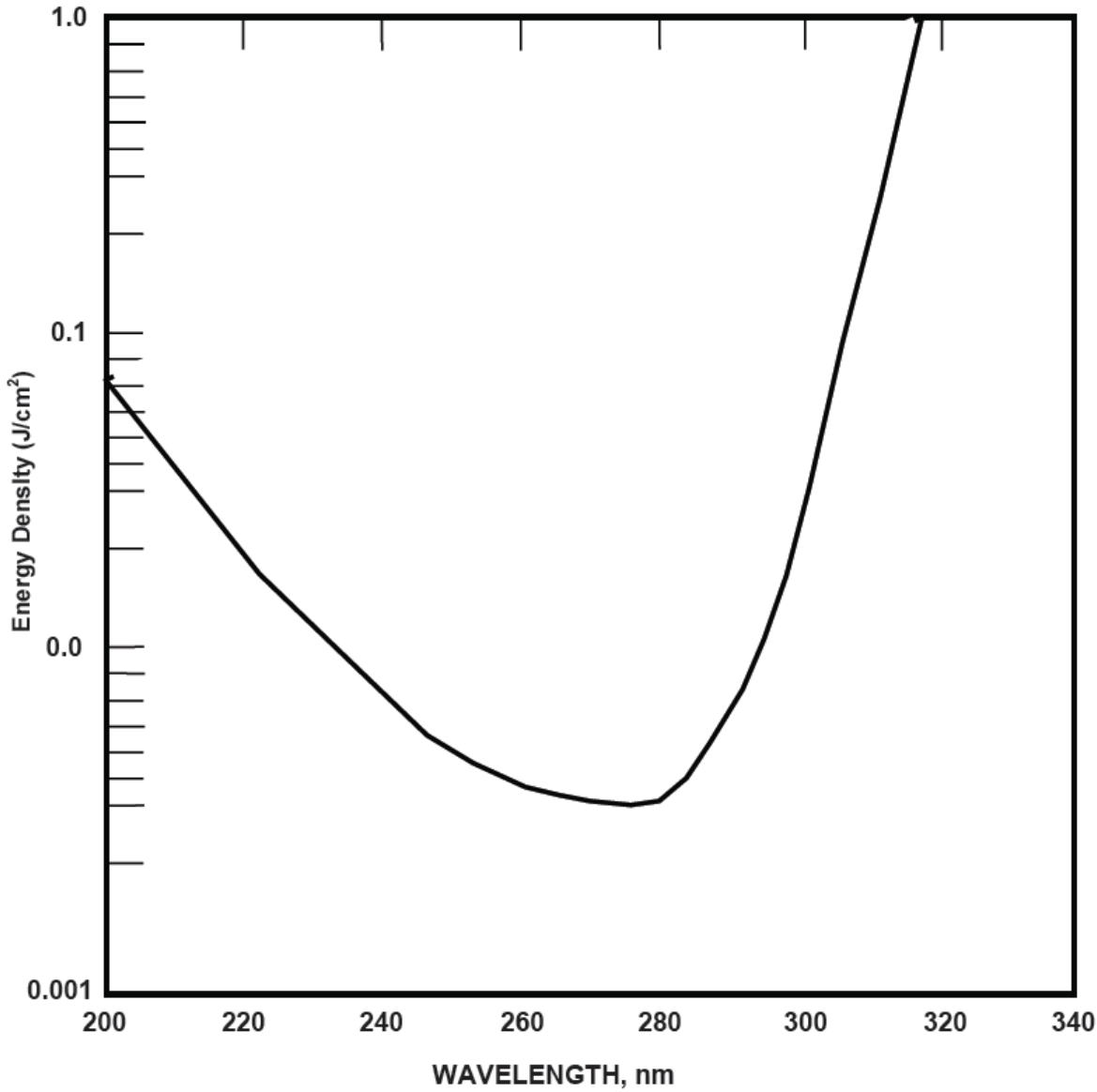

Figure B.1, Recommended Ultraviolet Radiation Exposure Standard.

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TABLE B.1, Total Permissible 8 Hour Doses and Relative Spectral Effectiveness of Some Selected Monochromatic Wavelengths.		
Wavelength (nm)	**Permissible 8-Hour Dose (mJ/cm2)**	**Relative Spectral Effectiveness (Sλ)**
200	100.0	0.03
210	40.0	0.075
220	25.0	0.12
230	16.0	0.19
240	10.0	0.30
250	7.0	0.43
254	6.0	0.50
260	4.6	0.65
270	3.0	1.00
280	3.4	0.88
290	4.7	0.64
300	10.0	0.30
305	50.0	0.06
310	200.0	0.015
315	1000.0	0.003
This table was adapted from a table developed and published by the American Conference of Governmental Industrial Hygienists		

TABLE B.2, Maximum Permissible Exposure Times for Selected Values of Ieff.	
Duration of Exposure Per Day	**Effective Irradiance Ieff (µW/cm2)**
8 hr	0.1
4 hr	0.2
1 hr	0.8
30 min	1.7
15 min	3.3
10 min	5.0
5 min	10.0
1 min	50.0
30 s	100.0
This table was adapted from a table developed and published by the American Conference of Governmental Industrial Hygienists	

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APPENDIX B

DEFINITIONS AND TERMINOLOGY

Absorption – Transformation of radiant energy to a different form of energy by interaction with matter.

Accessible Emission Limit (AEL) – The maximum accessible emission level permitted for a particular laser classification.

Antenna – An apparatus for radiating and/or receiving electromagnetic waves.

Aperture – An opening through which radiation can pass.

Attenuation – A general term used to denote a decrease in magnitude between two points of measurement.

Aversion response – The eye's natural protective response to bright light sources. The aversion response time is assumed to be an average of 0.25 seconds for visible wavelengths.

Beam – A collection of rays that may be parallel, divergent or collimated.

Beam diameter – The distance between diametrically opposed points in that cross section of the beam where the power unit area is 1/e times that of the peak power per unit area.

Beam divergence – The full angle of the beam spread between diametrically opposed 1/e points; usually expressed in milliradians (one degree = 17.5 mrad).

Class 1 laser – Class 1 lasers and laser systems include any laser, or system, that cannot emit accessible laser light in excess of the Class 1 AEL for the maximum duration of exposure inherent in the design or intended use of the laser. Class 1 laser system may contain embedded lasers of more hazardous classifications.

Class 1M laser - Class 1M lasers produce large-diameter beams, or beams that are divergent. The Maximum Permissible Exposure (MPE) for a Class 1M laser cannot normally be exceeded unless focusing or imaging optics are used to narrow down the beam. If the beam is refocused, the hazard of Class 1M lasers may be increased and the product class may be changed.

Class 2 laser – Visible light lasers that emit accessible level of laser light in excess of the Class 1 AEL but less than 1 milliwatt.

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Class 2a laser – Visible light lasers intended for a specific use (such as bar code readers) where the output is not intended to be viewed and the accessible radiant power does not exceed the Class 1 AEL for an exposure duration or less than or equal to 1000 seconds. The Class 2s designation is no longer used for newly manufactured lasers.

Class 2M laser - A Class 2M laser emits in the visible region in the form of a large diameter or divergent beam. It is presumed that the human blink reflex will be sufficient to prevent damaging exposure, but if the beam is focused down, damaging levels of radiation may be reached and may lead to a reclassification of the laser.

Class 3a laser – Class 3a lasers include lasers that emit accessible laser light in excess of the Class 2 AEL but less than 5 times the Class 2 AEL. For visible wavelength CW lasers the power limit for a Class 3a laser is 5 mW. For nonvisible wavelengths the power

Class 3R laser - A Class 3R laser is a continuous wave laser which may produce up to five times the emission limit for Class 1 or Class 2 lasers. Although the MPE can be exceeded, the risk of injury is low. The laser can produce no more than 5 mW in the visible region.

Class 3b laser - A Class 3b laser produces light of an intensity such that the MPE for eye exposure may be exceeded and direct viewing of the beam is potentially serious. Diffuse radiation (i.e., that which is scattered from a diffusing surface) should not be hazardous. CW emission from such lasers at wavelengths above 315nm must not exceed 0.5 watts.

Class 4 laser – Class 4 lasers include lasers or laser system that emit average accessible radiant power in excess of 0.5 W for exposure durations equal to or greater than 0.25 seconds, or that produce a radiant exposure of 10J/cm2 for an exposure duration of less than 0.25 seconds. Class 4 lasers are of high power (typically up to 500 mW or more if cw, or 10 J cm-2 if pulsed). These are hazardous to view at all times, may cause devastating and permanent eye damage, may have sufficient energy to ignite materials, and may cause significant skin damage. Exposure of the eye or skin to both the direct laser beam and to scattered beams, even those produced by reflection from diffusing surfaces, must be avoided at all times. In addition, they may pose a fire risk and may generate hazardous fumes.

Collimated beam - A beam with very low divergence or convergence.

Continuous wave (CW) – A term used to describe any non-ionizing radiation emitting device with a continuous output for periods of greater than or equal to 0.25 seconds.

Diffuse reflection – The change in the spatial distribution of a beam when it is reflected in many directions by a surface or by a medium.

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Electromagnetic radiation – The flow of energy consisting of orthogonally vibrating electric and magnetic fields lying in transverse to the direction of propagation. X-rays, ultraviolet, visible and infrared light and radio waves occupy various portions of the electromagnetic spectrum.

Embedded laser – A laser with an assigned classification number higher than the inherent capability of the laser system in which it is incorporated, where the systems lower classification is appropriate to the engineering features limiting the accessible emission.

Exposure (laser) – The product of irradiance and its duration.

Exposure (RF) – Generally expressed in terms of power density (mW/cm2) or equivalent electric field (V/m).

Far-field region – The region of the field from emitted from an antenna where the angular field distribution is essentially independent of the distance from the antenna. For an antennae focused at infinity, the far field region is sometimes referred to as the Fraunhofer region on the basis of analogy to optical terminology.

Fiber optics – The branch of optical technology concerned with the transmission of radiant power through fibers made of transparent materials such as glass, fused silica or plastic.

Gain – General term used to denote an increase in signal power in transmission from one point to another. Gain is usually expressed in decibels (dB).

Hertz (Hz) – The unit that expresses the frequency of oscillations in cycles per second.

Infrared (IR) – Electromagnetic radiation with wavelengths which lie within the range of 700 nanometers to 1 millimeter.

Intrabeam viewing – The viewing condition whereby the eye is directly exposed to all or part of a laser beam.

Irradiance – Quotient of the radiant flux incident on an element of the surface containing the point, by the area of that element. Unit: W/cm2.

Joule (J) – A unit of energy: 1 joule = 1 watt-second.

Laser – A device which produces an intense, coherent and direction beam of light by stimulating electronic or molecular transition to lower energy states. Acronym: **L**ight **A**mplification by **S**timulated **E**mission of **R**adiation.

Laser diode – A laser employing a forward-biased semiconductor junction as the active medium. Also called a semiconductor laser.

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Laser protective eye wear – Protective eye wear designed and rated specifically for use with lasers. Laser eyewear has protection ratings (Optical Density or OD) for specific wavelengths.

Lasing medium – A material which has the ability to emit coherent radiation by virtue of stimulated electronic or molecular transitions to lower energy states. Lasing mediums may be solids, liquids or gasses.

Light emitting diode (LED) – A p-n junction semiconductor that emits incoherent optical radiation when biased in the forward direction. LED's may be capable of emitting injurious levels of light.

Limiting aperture – The maximum diameter of a circular area over which irradiance and radiant exposure can be averaged.

Maximum permissible exposure (MPE) – The maximum level of laser radiation which a person may be exposed to with no hazardous effects or adverse biological changes in the skin or eye.

Microwave radiation – Electromagnetic radiation with frequencies that lie between 300 MHz and 300 GHz.

Modulation – The process, or result of the process, whereby some characteristic of one wave is varied in accordance with another wave or signal.

Multiple pulse laser – A laser system using recurrent pulses with a pulse repetition frequency (PRF) of more than 1 Hz.

Near-field radiation – The region of the field of an antenna between the reactive near field region and the far field region wherein radiation fields dominate and the angular field distribution is dependent upon distance from the antenna. For an antennae focuses at infinity this region is sometimes referred to as the Fresnel region.

Nominal Hazard Zone (NHZ) – The space within which the level direct, reflected or diffusely reflected laser light exceed the applicable MPE.

Nominal Ocular Hazard Distance (NOHD) - The linear distance from the point of emission of a laser beam to where the beam irradiance or radiant exposure drops below applicable ocular MPE.

Nominal Hazard Zone (NHZ) – The space within which the level of direct, reflected or diffusely reflected laser radiation during normal operation exceeds the applicable MPE. Exposure level beyond the boundary of the NHZ are below the MPE.

Non-ionizing radiation –

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1. Electromagnetic radiation which is not capable of producing ionization when interacting with matter, but is capable of producing thermal or other effects resulting in a personnel health hazard.
2. That portion of the electromagnetic spectrum which includes the frequency and wavelength characteristics associated with ultraviolet, visible, infrared, radiofrequency, and microwave radiation.

Optical Density (OD) – Logarithm to the base ten of the reciprocal of the transmittance. For laser protective eye wear it represents to magnitude of the filtration provided by the eyewear for the specified wavelength.

Pulse duration or width – The time duration of a laser or RF pulse; usually measured as the time interval between the half power points on the leading and trailing-edges of the pulse.

Pulse repetition frequency (PRF) – In a system using recurrent pulses, the number of pulses per unit of time.

Radiance – Radiant flux or power output per unit solid angle – unit area (W/sr-cm2).

Radiant exposure – Surface density of the radiant energy received (J/cm2).

Radiofrequency (RF) radiation – Electromagnetic radiation with frequencies that lie within the range of 10 kHz to 100 GHz.

Specular reflection - A mirror-like reflection of an optical beam where there is minimal alteration of the divergence.

Ultraviolet (UV) radiation – Electromagnetic radiation with wavelengths that lie within the range of 180 nanometers to 400 nanometers.

Visible radiation – Electromagnetic radiation with wavelengths that lie within the range of 400 nanometers to 700 nanometers. The frequency range is defined for safety analysis purposes rather than as an indicator of absolute barriers where visual perception of light begins and ends.

Watt (W) – The unit of power, or radiant flux. 1 Watt = 1 Joule per second.

Wavelength – The distance between two identical points in a periodic wave which have the same phase.

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APPENDIX C

SUGGESTED OUTLINE FOR NASA LANGLEY FORM 49, "SAFETY PERMIT REQUEST - LASER/MICROWAVE" PREPARATION

I. Brief description of activity objectives.

II. List of all laser operators and radiation workers to be in controlled area during hazardous source operation and their operational responsibilities (NASA Langley Form 66s for new personnel should be forwarded with NASA Langley Form 49 and currently qualified personnel listed in Item 6 of the form).

III. Planned schedule of operations and estimated frequency of operation.

IV. Safety operating plans:

A. Operational area security and control
B. Safety interlocks and overrides
C. Weather restrictions (if outside)
D. Any conditions that would preclude operations
E. Assignments of operational personnel
F. Operational countdown procedure or preparation steps
G. Safety eyewear (wavelength, density)
H. Order of action during laser operation
I. MPE calculations (if necessary)
J. Laser inventory if too numerous for cover sheet (include class, and so forth)

V. Sketches of operational area and actual experimental configuration (include map if outside)

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APPENDIX D

NON-IONIZING RADIATION AND FIELDS

STATIC MAGNETIC FIELDS

These TLV's refer to static magnetic flux densities to which it is believed that nearly all workers may be repeatedly exposed day after day without adverse health effects. These values should be used as guides in the control of exposure to static magnetic fields and should not be regarded as fine lines between safe and dangerous levels.

Routine occupational exposures should not exceed 60 millitesla (mT), equivalent to 600 gauss (G), whole body or 600 mT (6000G) to the limbs on a daily, time-weighted average basis [1 tesla (T) = 10^4 G]. Recommended ceiling values are 2 T for the whole body and 5 T for the limbs. Safety hazards may exist from the mechanical forces exerted by the magnetic field upon ferromagnetic tools and medical implants. Cardiac pacemaker and similar medical electronic device wearers should not be exposed to field levels exceeding 0.5 mT (5G). Adverse effects may also be produced at higher flux densities resulting from forces upon other implanted devices such as suture staples, aneurysm clips, prostheses, etc.

These TLV's are summarized in Table 1.

TABLE 1. TLV's for Static Magnetic Fields

	8-hour TWA	**Ceiling**
Whole body	60 mT	2 T
Limbs	600 mT	5 T
Medical electronic device wearers		.5 mT

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APPENDIX E

RECOMMENDATIONS FOR SUB-RADIO FREQUENCY STATIC MAGNETIC FIELDS STANDARDS

The ACGIH recommends that occupational exposure to static magnetic fields in the workplace be controlled by compliance with the “Exposure Standards” described below. Static magnetic fields are defined as those magnetic fields propagated from a magnetic source with frequencies at 30,000 Hertz and below. These criteria and the recommended standard will be reviewed and revised when relevant information warrants.

Exposure Standards - Sub-Radio Frequency (30 kHz and below) Magnetic Fields

These TLV’s refer to the amplitude of the magnetic flux density (B) of sub-radio frequency (sub-RF) magnetic fields in the frequency range of 30 kHz and below to which it is believed that nearly all workers may be exposed repeatedly without adverse health effects. The magnetic field strengths in these TLV’s are root mean square (rms) values. These values should be used as guides in the control of exposure to sub radio frequency magnetic fields and should not be regarded as a fine line between safe and dangerous levels.

Routine occupational exposure should not exceed:

$B_{TLVf} = 60 / f$

where: f is the frequency in Hz.

B_{TLV}= the magnetic flux density in millitesla (mT).

For frequencies in the range of 300 Hz to 30kHz (which includes the voice frequency [VF] band from 300 Hz to 3 kHz and the very-low-frequency [VLF] band from 3 to 30 kHz), occupational exposures should not exceed the ceiling value of 0.2 mT.

These ceiling values for frequencies of 300 Hz to 30 kHz are intended for both partial-body and whole-body exposures. For frequencies below 300 Hz, the TLV for exposure of the extremities can be increased by a factor of 10 for the hands and feet and by a factor of 5 for the arms and legs.

The magnetic flux density of 60 mT/f at 60 Hz corresponds to a maximum permissible flux density of 1 mT. At 30 kHz, the TLV is 0.2 mT, which corresponds to a magnetic field intensity of 160 amperes per meter (A/m).

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Contact currents from touching ungrounded objects that have acquired an induced electrical charge in a strong sub-RF magnetic field should not exceed the following point of contact levels to avoid startle responses or severe electrical shocks:

A. 1.0 milliampere (mA) at frequencies from 1 Hz to 2.5 kHz;
B. 0.4f mA at frequencies from 2.5 to 30 kHz, where f is the frequency expressed in kHz.

Notes:

1. These TLV's are based on an assessment of available data from laboratory research and human exposure studies. Modifications of the TLV's will be made if warranted by new information. At this time, there is insufficient information on human responses and possible health effects of magnetic fields in the frequency range of 1 Hz to 30 kHz to permit the establishment of a TLV for time-weighted average exposures.
2. For workers wearing cardiac pacemakers, the TLV may not protect against electromagnetic interference with pacemaker function. Some models of cardiac pacemakers have been shown to be susceptible to interference by power-frequency (50-60 Hz) magnetic flux densities as low as 0.1 mT. It is recommended that, lacking specific information on electromagnetic interference from the manufacturer, the exposure of persons wearing cardiac pacemakers or similar medical electronic devices be maintained at or below 0.1 mT at power frequencies.

TABLE 1. TLV's for Sub-Radiofrequency (30 kHz and below) Magnetic Fields

Frequency Range	**TLV**
1-300 Hz	Whole-body exposure: 60/f ceiling value in mT
1-300 Hz	Arms and legs: 300/f ceiling value in mT
1-300 Hz	Hands and feet: 600/f ceiling value in mT
300 Hz – 30 kHz	Whole-body and partial-body ceiling value: 0.2 mT
1 Hz – 2.5 kHz	Point contact current limit: 1.0 mA
2.5 – 30 kHz	Point contact current limit: 0.4 mA where f = frequency in kHz

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APPENDIX F

SUB-RADIOFREQUENCY (30 KHZ AND BELOW) AND STATIC ELECTRIC FIELDS

These TLV's refer to the maximum unprotected workplace field strengths of sub-radiofrequency electric fields (30 kHz and below) and static electric fields that represent conditions under which it is believed that nearly all workers may be exposed repeatedly without adverse health effects. The electric field intensities in these TLV's are root-mean-square (rms) values. The values should be used as guides in the control of exposure and, due to individual susceptibility, should not be regarded as a fine line between safe and dangerous levels. The electric field strengths stated in these TLV's refer to the field levels present in air, away from the surfaces of conductors (where spark discharges and contact currents may pose significant hazards).

Occupational exposures should not exceed a field strength of 25 kilovolts per meter (dV/m) form 0 hertz (Hz) (direct current [DC]) to 100 Hz. For frequencies in the range of 100 to 4 kilohertz (kHz), the ceiling value is given by:

$$E_{TLV}=2.5x10^6/f$$

Where: f = the frequency in Hz
E_{TLV} = the electric field strength in volts per meter (V/m)

A value of 625 V/m is the ceiling value for frequencies from 4 to 30 kHz. These ceiling values 0 to 30 kHz are intended for both partial-body and whole-body exposures.

Contact currents from touching ungrounded objects that have acquired an electrical charge in a strong static or sub-RF electric field should not exceed the following point contact levels to avoid startle responses or severe electrical shocks:

A. 1.0 mA at frequencies from 0 to 2.5 kHz;
B. 0.4 mA at frequencies from 2.5 to 30 kHz, where f is the frequency expressed in kHz.

Notes:

1. These TLV's are based on limiting currents on the body surface and induced internal currents to levels below those that are believed to produce adverse health effects. Certain biological effects have been demonstrated in laboratory studies at electric field strengths below those permitted in the TLV; however, there is no convincing evidence at the present time that occupational exposure to these field levels leads to adverse health effects.

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Modifications of the TLV's will be made if warranted by new information. At this time, there is insufficient information on human responses and possible health effects of electric fields in the frequency range of 0 to 30 kHz to permit the establishment of a TLV for time-weighted average exposures.

2. Field strengths greater than approximately 5 to 7 kV/m can produce a wide range of safety hazards such as startle reactions associated with spark discharges and contact currents from ungrounded conductors within the field. In addition, safety hazards associated with combustions, ignition of flammable materials, and electro-explosive devices may exist when a high-intensity electric field is present. Care should be taken to eliminate ungrounded objects, to ground such objects, or to use insulated gloves when ungrounded objects must be handled. Prudence dictates the use of protective devices (e.g., suits, gloves, and insulation) in all fields exceeding 15 kV/m.
3. For workers with cardiac pacemakers, the TLV may not protect against electromagnetic interference with pacemaker function. Some models of cardiac pacemakers have been shown to be susceptible to interference by power-frequency (50/60 Hz) electric fields as low as 2 kV/m. It is recommended that, lacking specific information on electromagnetic interference from the manufacturer, the exposure of pacemaker and medical electronic device wearers should be maintained at or below 1kV/m.

TABLE 1. TLV's for Static and Sub-Radiofrequency (30 kHz and below) Electric Fields

Frequency Range	**TLV**
0 – 100 Hz	25,000 V/m in air (ceiling value)
100 Hz – 4 kHz	2.5×10^6/f V/m in air (ceiling value) where: f – frequency in kHz
4 – 30 kHz	625 V/m in air (ceiling value)
0 – 2.5 kHz	Point of contact current limit: 1.0 mA
2.5 – 30 kHz	Point of contact current limit: 0.4 mA where: f = frequency in kHz

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APPENDIX G

MAXIMUM PERMISSIBLE EXPOSURE FOR CONTROLLED ENVIRONMENTS (3 KHZ--300 GHZ)

Table 1—Maximum permissible exposure for controlled environments

Part A: Electromagnetic fields†				
Frequency range (MHz) 1	Electric field strength (E) (V/m) 2	Magnetic field strength (H) (A/m) 3	Power density (S) E-field, H-field (mW/cm^2) 4	Averaging time $\|E\|^2$, $\|H\|^2$ or S (min) 5
0.003–0.1	614	163	(100, 1 000 000)‡	6
0.1–3.0	614	$16.3/f$	$(100, 10\,000/f^2)$‡	6
3–30	$1842/f$	$16.3/f$	$(900/f^2, 10\,000/f^2)$	6
30–100	61.4	$16.3/f$	$(1.0, 10\,000/f^2)$	6
100–300	61.4	0.163	1.0	6
300–3000	—	—	$f/300$	6
3000–15 000	—	—	10	6
15 000–300 000	—	—	10	$616\,000/f$
Note—f is the frequency in MHz.				

* The current limits given above may not adequately protect against startle reactions and burns caused by transient discharges when contacting an energized object. See IEEE 95.1 1999 for additional information.

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APPENDIX H

MAXIMUM PERMISSIBLE EXPOSURE FOR UNCONTROLLED ENVIRONMENTS (3 KHZ--300 GHZ)

Table 2—Maximum permissible exposure for uncontrolled environments

Part A: Electromagnetic Fields†					
Frequency range (MHz) 1	Electric field strength (E) (V/m) 2	Magnetic field strength (*H*) (A/m) 3	Power density (*S*) E-field, H-field (mW/cm²) 4	Averaging time $\|E\|^2$, *S* or $\|H\|^2$ (min) 5	
0.003–0.1	614	163	(100, 1 000 000)‡	6	6
0.1–1.34	614	$16.3/f$	$(100, 10\,000/f^2)$‡	6	6
1.34–3.0	$823.8/f$	$16.3/f$	$(180/f^2, 10\,000/f^2)$	$f^2/0.3$	6
3.0–30	$823.8/f$	$16.3/f$	$(180/f^2, 10\,000/f^2)$	30	6
30–100	27.5	$158.3/f^{1.668}$	$(0.2, 940\,000/f^{3.336}$	30	$0.0636 f^{1.337}$
100–300	27.5	0.0729	0.2	30	30
300–3000	—	—	$f/1500$	30	
3000–15 000	—	—	$f/1500$	$90\,000/f$	
15 000–300 000			10	$616\,000/f^{1.2}$	
NOTE—*f* is the frequency in MHz.					

- The current limits given above may not adequately protect against startle reactions and burns caused by transient discharges when contacting an energized object. See IEEE 95.1 1999 for additional information.

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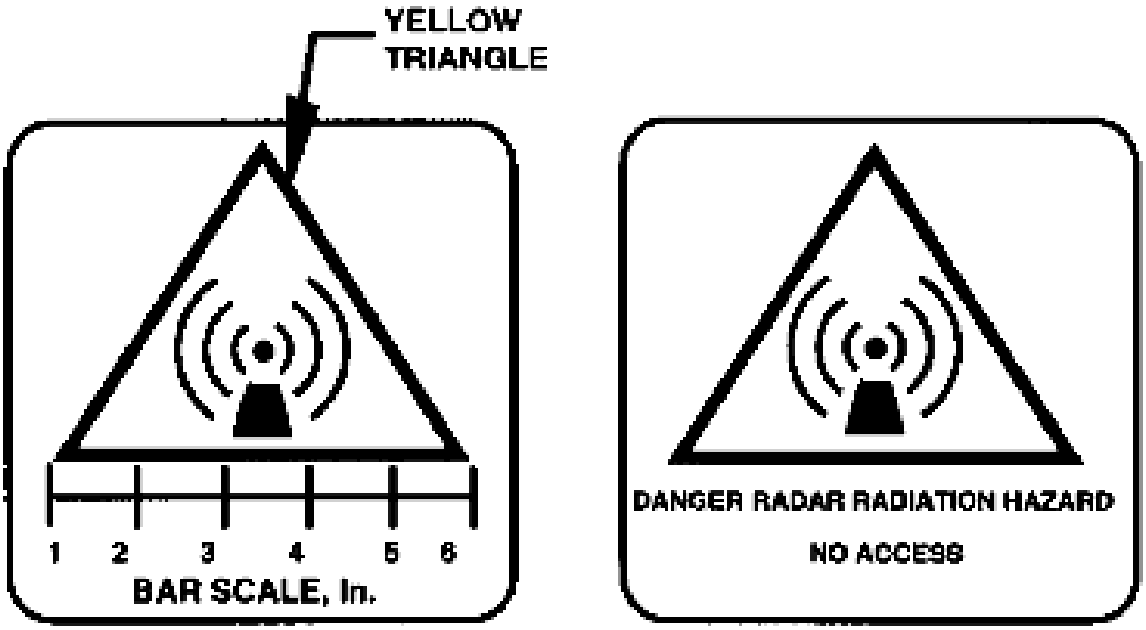
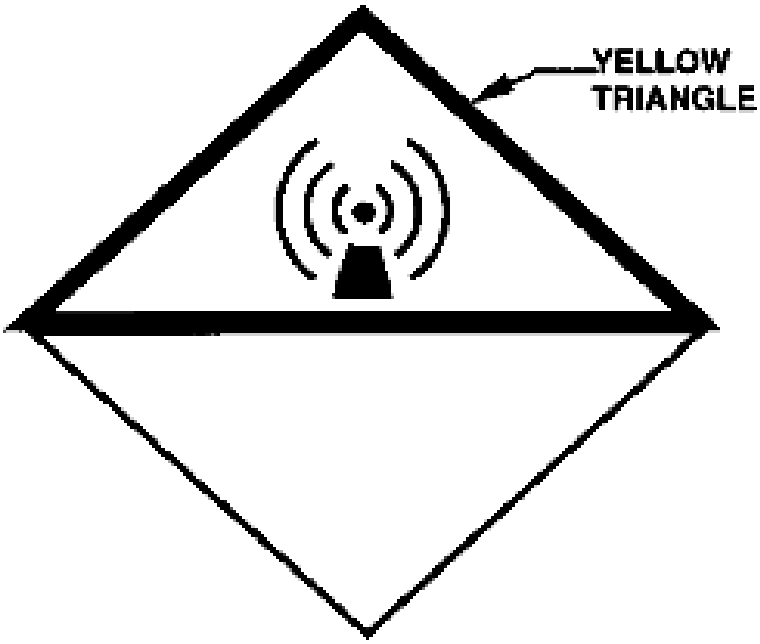
APPENDIX I

MICROWAVE/RF WARNING SIGNS

MICROWAVE/RF WARNING SIGN





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APPENDIX J

ACRONYMS

ACGIH	American Conference of Governmental Hygienists
ANSI	American National Standards Institute
CA&LB	Capital Assets and Logistics Branch, Center Operations Directorate
CFR	Code of Federal Regulations
COTR	Contracting Officer's Technical Representative
cw	Continuous wavelength
DOT	Department of Transportation
FAA	Federal Aviation Administration
FDA	Food and Drug Administration
LAPD	Langley Policy Directive
LPR	Langley Procedural Requirements
LaRC	Langley Research Center
LSO	Laser Safety Officer
MPE	Maximum Permissible Exposure
NASA	National Aeronautics and Space Administration
NFPA	National Fire Protection Association
NIOSH	National Institute for Occupational Safety and Health
NIR	Non-ionizing Radiation
NIRC	Non-ionizing Radiation Committee
NRC	Nuclear Regulatory Commission
PR/PO	purchase request/purchase order
OD	Optical Density
OFSH	Organizational Facility Safety Head
OHO	Occupational Health Officer
OHCM	Office of Human Capital Management
OMC	Occupational Medical Center
SMAO	Safety and Mission Assurance Office
SFAB	Safety and Facility Assurance Branch
OSHA	Occupational Safety and Health Administration
PEL	Permissible Exposure Limit
PFSH	Principal Facility Safety Head
rem	Roentgen equivalent man
RF	Radio Frequency
RFR	Radio Frequency Radiation
RSO	Radiation Safety Officer
SAR	Specific Absorption Rate
SDL	Standard Distribution List
TLV	Threshold Limit Value
UL	Underwriters Laboratories (Incorporated)
YAG	Yttrium Aluminum Garnet

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Langley Research Center

LPR 1740.2
Effective Date: February 12, 2008
Expiration Date: February 12, 2013

FACILITY SAFETY REQUIREMENTS

National Aeronautics and Space Administration

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Responsible Office: Safety and Mission Assurance Office

P.1 PURPOSE

The purpose of this Langley Procedural Requirements (LPR) is to set forth Langley Research Center (LaRC) procedural requirements and criteria for facility safety requirements. These procedural requirements are supported by the regulations and standards established by the American National Standards Institute (ANSI), the Occupational Safety and Health Administration (OSHA), and the National Aeronautics and Space Administration (NASA).

P.2 APPLICABILITY

This procedural requirement applies to all persons performing work at LaRC, including civil servants, contractors and subcontractors, research associates, and others. Non-compliance with this LPR may result in appropriate disciplinary action that may include termination for a civil servant employee or exclusion from the Center for a contractor employee, research associate or others.

P.3 AUTHORITY

(a) American National Standards Institute (ANSI)
(b) Occupational Safety and Health Administration (OSHA)
(c) NPD 8710.2, "NASA Safety and Health Program."
(d) NPR 8715.3, "NASA Safety Manual."
(e) NPD 8710.5, "NASA Safety Policy for Pressure Vessels and Pressurized Systems."
(f) NPD 1800.2, "NASA Occupational Health Program."
(g) NPR 8715.1, "NASA Occupational Safety and Health Programs."

P.4 REFERENCES

(a) American National Standards Institute (ANSI).
(b) OSHA 29 CFR 1926, "Construction."
(c) OSHA 29 CFR 1910, "General Industry."
(d) OSHA 29 CFR 40, "Protection of Environment."
(e) National Electrical Code (NEC).
(f) National Institute of Safety and Health (NIOSH).
(g) National Fire Protection Association (NFPA).
(h) Building Officials Code of America (BOCA) Basic Plumbing Code.
(i) American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Standard for Ventilation for Acceptable Indoor Air Quality.
(j) American Society of Mechanical Engineers (ASME).

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(k) Department of Transportation (DOT).
(l) NASA-STD-8719.9, "Standard for Lifting Devices and Equipment".
(m) NASA-STD-8719.17, "NASA Requirements for Ground Based Pressure Vessels and Pressurized Systems (PV/S)."
(n) LPR 1710.12, "Potentially Hazardous Materials - Hazard Communication Standard".
(o) LMS-CP-4760, “Reporting Injuries, Illnesses, Compensation Claims and Unsafe Working Conditions”.
(p) LAPD 1150.2, “Councils, Boards, Panels, Committees, Teams, and Groups”.
(q) LAPD 1700.2, "Safety Assignments and Responsibilities".
(r) LAPD 6000.1, "Transportation Management".
(s) LAPD 7000.2, "Review Program for Langley Research Center (LaRC) Facility Projects”.
(t) LAPD 8800.15, "Facilities Utilization Program.”
(u) LPR 1710.4, "Personnel Protection - Clothing and Equipment”.
(v) LPR 1710.6, "Electrical Safety".
(w) LPR 1710.8, “Nonionizing Radiation”.
(x) LPR 1710.10, "Safety Clearance Procedures for the Control of Hazardous Energy (Lockout/Tagout)".
(y) LPR 1710.11, “Fire Protection Program”.
(z) LPR 1710.40, "Langley Research Center Pressure Systems Handbook".
(aa) LPR 1740.4, "Facility System Safety Analysis and Configuration Management".
(bb) LPR 1740.6, “Personnel Safety Certification".
(cc) LPR 8800.1, "Environmental Program Manual".
(dd) NASA Langley Form 27, "Asbestos Safety Permit".
(ee) NASA Langley Form 44, "Hazardous Material Procurement, Inventory, and Storage Record".
(ff) NASA Langley Form 60, "Confined Space Entry Permit”.
(gg) NASA Langley Form 66, "Worker Appointment and Certification Form".
(hh) NASA Langley Form 451, "Non-personal Service (NPS) Contract Employee Safety Operator Appointment Form".
(ii) NASA Langley Form 452, "Civil Service Employee Safety Operator Appointment Form".
(jj) LAPD 1500.5, "Signs and Directory Boards."

P.5 CANCELLATION

CID 1740.2, dated September 25, 2007, is rescinded and should be destroyed.

Original signed on file

Lesa B. Roe
Center Director

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Chapter 1

1. INTRODUCTION

1.1 GENERAL

LaRC is required to provide a safe and healthful work environment for all employees. To this end, all LaRC employees shall be charged with the responsibility for ensuring a safe and healthful workplace. Every employee shall be required to notify line supervision, without fear of disciplinary action or any other form of retaliation, of any suspected hazardous condition where employee injury or equipment damage may result. When notified, a first-line supervisor shall be responsible for investigating any safety concern raised and for initiating corrective action. Reprisals or disciplinary actions against an employee for initiating a safety concern shall not be tolerated.

The Safety and Facility Assurance Branch (SFAB), Safety and Mission Assurance Office (SMAO) shall assist employees and line management with correcting deficiencies and ensuring that LaRC remains a safe and healthful place to work. SFAB, SMAO assistance may be obtained by calling 864-7233 (4-SAFE).

1.2 SCOPE

This LPR identifies potentially dangerous and hazardous situations and establishes the appropriate procedural requirements to deal with the situations.

1.3 APPLICATION AND COMPLIANCE

The procedural requirements contained in this LPR are applicable to all individuals performing work on Center and shall be complied with as stated in P.2 of this LPR.

Personnel shall be appropriately trained regarding the safety aspects of work performed.

- “Competent” means one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

- “Qualified” means one who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training, and experience, has successfully demonstrated his/her ability to solve or resolve problems related to the subject matter, the work, or the project.

Special equipment and/or supplies and procedures required to safely perform work done at LaRC shall be supplied and developed by the Government for civil service employees and by the contracting company for contractor employees.

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The following personnel as applicable shall be responsible for ensuring compliance with existing and new systems in accordance with the requirements of this LPR:

- Design Engineers
- Safety Engineers
- Technical Project Engineers (TPE's)
- Facility Safety Heads (FSH's)
- Facility Coordinators (FC's)
- Supervisors
- Employees (civil servant and contractor).

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Chapter 2

2. HAZARD IDENTIFICATION AND MARKINGS

2.1 GENERAL

All Center facilities shall receive an annual Occupational Safety and Health Audit to identify hazards. Audit findings shall be provided to the Facility Safety Head (FSH) and Facility Coordinator (FC) of the facility. A Risk Assessment Code (RAC) and associated abatement shall be assigned to each finding using the criteria in NPR 8715.1 " =NASA Occupational Safety and Health Programs with change 3," and NASA-STD-8719.7 "Facility System Safety Guidebook.". Upon discovery of imminent danger conditions, personnel shall be removed from exposure and supervisors shall be immediately contacted. The FSH and/or FC shall implement or coordinate corrective actions to ensure safe conditions are in place prior to continuing operations. Corrective/preventive action shall be tracked and implementation shall be assessed as effective prior to closure. The audit shall be posted until all findings are corrected and closed.

Supervisors shall be required to conduct monthly safety inspections of the areas occupied by their assigned employees, identifying any hazards and implementing the appropriate corrective actions. Supervisors shall communicate audit results to personnel.

2.2 UTILITY AND RESEARCH SYSTEMS

Identification of research apparatus, support equipment, and building/facility utilities shall be mandatory whenever the lines, pipes, components, or vessels are accessible during normal operations or maintenance activities. Identification shall be accomplished through the use of legends and color-coding of the system as described herein. For the purposes of this LPR, the following systems shall be excluded from the definitions of utilities:

- Electrical conduit.
- Instrumentation cables.
- Heat/air conditioning ducts.

Utility tunnels shall have markings immediately inside each entrance noting their location.

2.2.1 Sy stem Identification

System (function) identification shall be necessary in order to isolate the system, or a portion of the system, for purposes of operation and maintenance. Schematic layouts, together with condensed operating instructions, shall be prepared for each system and/or subsystem. These layouts and operating instructions shall be included in relevant facility documentation.

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2.2.2 Hazard Identification

The use of legends and colors has been determined to be the most effective means of alerting personnel to the hazards involved in the operation and maintenance of utility and research systems. Labels and legends shall be mandatory at LaRC. The use of color codes (in the form of bands) shall be desirable when and where appropriate, primarily when highly toxic or flammable media are involved. (See Appendix A for legend and color code details; see paragraph 2.4, Physical Hazards, this Chapter, where physical hazards are also involved.)

2.2.3 Legends

Tags, decals, or stencils shall be used to identify pipe or feed line media and their direction of flow. Additionally, pressures and temperatures shall be identified where appropriate. Specifically, the requirements of this section shall be supplemented when high-pressure systems are involved (see LPR 1710.40, "Langley Research Center Pressure Systems Handbook" for Center high-pressure system requirements). Banding of pipe markers now in use shall provide instant 360° location of each decal or legend. Legends shall be located approximately every 50 - 75 feet along continuous lines, on all branches at T joints, wherever lines pass through walls, and so forth. Arrows shall indicate direction of flow and point away from the legend. If flow is in both directions, double-headed arrows shall be used. The legend sizes to be used are illustrated in Figure 2.1. (Figure 2.1 also shows typical arrows and media identification.) Small tags or signs with 1/2 inch lettering may be attached to pipes or vessels under 1/2 inches in size.

All new or replacement legends shall be stenciled. If used, color bands should be painted.

2.2.4 Color Coding

The colors used to signify the various general hazards shall be based on the latest version of ANSI 53.1. Color bands, spaced at prominent locations along the pipe or device, shall be considered most appropriate. The general color scheme of the ANSI Code is shown in Figure 2.2 (see Appendix A for specific application to LaRC).

2.2.5 Responsibilities

The following personnel shall be responsible for ensuring compliance with the requirements of this section:

- Existing Systems - FSH's and/or FC's.
- New Systems - Design engineers, TPE's, and/or other personnel directly charged with the acquisition of new hardware.

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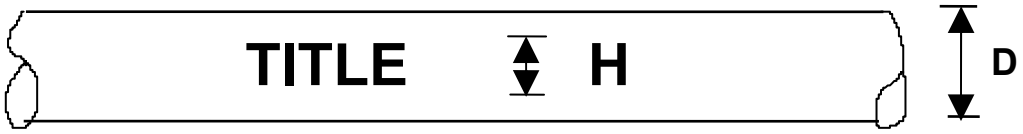
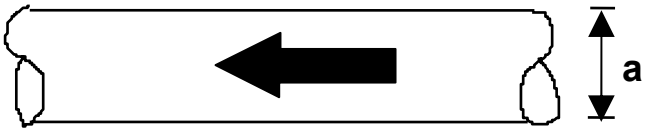
LEGENDS

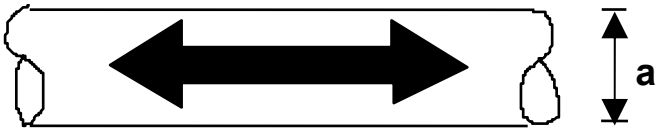


(DIAMETER	D IN INCHES)	(HEIGHT	H IN INCHES)
UNDER	1/2 "	1/2	"
1/2	" to 3 "	1-1/8	"
3	" and over	2-1/4	"

ARROWS



ONE DIRECTION



REVERSIBLE

MEDIUM AND STATE

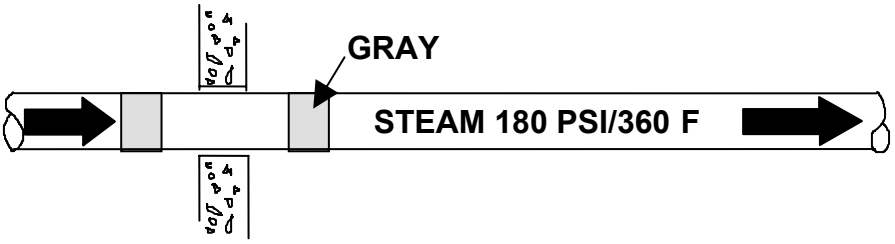


Figure 2.1, Legends

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Color Name	Hazard Identification
Yellow	Flammable materials. All materials known ordinarily as flammables or combustibles.
Brown	Toxic and poisonous materials. All materials extremely hazardous to life or health under normal conditions.
Blue	Anesthetics and harmful materials and electrical voltages. All materials productive of anesthetic vapors and all liquid chemicals and compounds hazardous to life and property but normally productive of dangerous quantities of fumes or vapors, and electrical voltage of 600 volts or greater.
Green	Oxidizing materials. All materials which readily furnish oxygen for combustion and fire producers which react explosively, or material which, when in contact with many other materials, can cause spontaneous combustion.
Red	Fire protection materials. All materials provided in piping systems or in compressed gas cylinders exclusively for use in fire protection.
Gray	Physically dangerous materials. All materials not dangerous of themselves but which are asphyxiating in confined spaces, or which are generally handled in a dangerous physical state of pressure or temperature (over 200° F and under 0° F).

Figure 2.2, General Color Scheme of the ANSI Code

2.3 UNDERGROUND UTILITIES

Mylar detectable tape or its equivalent shall be used in all installations and maintenance tasks for buried underground facilities at LaRC, to include laying detectable tape approximately 6 inches below the surface of the ground directly above buried utility lines. This procedural requirement is consistent with OSHA regulations, which stipulates that personnel shall be protected from hazards created by excavating or trenching in the vicinity of dangerous underground facilities.

Excavation or other surface penetration activity (including landscaping) performed on LaRC premises either by in-house or contractor personnel, presents a potential safety hazard. Accordingly, a "Digging Permit" system has been developed to control actual or potential disturbance of existing surfaces to a depth in excess of 6 inches. The Underground Utilities Coordinator, Center Operations Directorate, has been designated as the focal point for control of the buried/underground utility systems at this Center. The Underground Utilities Coordinator shall issue a NASA Langley Form 511, "Digging Permit," upon request. Early identification of excavation/penetration requirements will

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assist the Underground Utilities Coordinator in planning drawings and survey support efforts.

It shall be the responsibility of the designated Contracting Officer's Technical Representative (COTR) or the designated inspector to ensure the following steps are performed in connection with actual "digging" operations of contractors at LaRC:

- Notify the Underground Utilities Coordinator at least 24 hours in advance with the specific details.
- Coordinate a specific time prior to the start of excavation operations to meet with the contractor and LaRC survey personnel at the work site. Survey personnel shall mark all existing utilities, provide the contractor with current work site utility drawings, and issue the NASA Langley Form 511, "Digging Permit".
- Verify that the contractor conforms to all published requirements during the excavation/penetration process (including appropriate barricades and warnings) and prominently displays this authorization.
- Notify the Underground Utilities Coordinator (or agents) prior to back fill so that affected documents can be verified and/or red lined.
- Remove and return the sign and NASA Langley Form 511, "Digging Permit" to the Center Operations Directorate, at the completion of the operation if the Underground Utilities Coordinator (or agents) has not already done so.

2.4 PHYSICAL HAZARDS

This section recognizes the dangers resulting from people being too close to physical hazards, and provides LaRC procedural requirements for marking and color-coding.

2.4.1 Color Coding

For each type of hazard identified, a specific color shall be required as specified:

Color	Hazard Identification
Red	Fire protection equipment and apparatus. Containers for flammable liquids having a flashpoint below 100° F. Emergency stop bars or buttons on hazardous machines.
Orange	Dangerous parts of machinery or energized equipment, which may cut, crush, shock, or otherwise injure, such as when enclosure doors are open or when gear belts or other guards around the moving equipment are open or removed, exposing unguarded hazards.
Yellow	Caution and for marking physical hazards such as falling, stumbling, striking against, tripping, or getting caught in between objects. Solid yellow, yellow and black stripes, yellow and black checkers (or yellow with suitable contrasting background) should be used interchangeably, and using a combination which will attract the most attention in the particular environment.

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Green	"Safety" and the location of First Aid equipment, if any, (except fire fighting equipment).
Blue	Warning against the starting, the use of, or the movement of equipment under repair or being worked on.
Magenta (Purple and Yellow)	Radiation hazards.
Black, White, or a Combination	Traffic and household markings. Solid black, solid white, single color striping, stripes of black and white or black and white checkers shall be used in accordance with local conditions.

2.4.2 Identificati on Clarification

In general, the use of color-coding shall be intended to identify the immediate area where the physical hazard exists. Consequently, excessive use of warning color defeats the identification of the specific hazard and tends to make the program ineffective. Further, multiple hazard identification requirements shall have a criteria for determining precedents. The LaRC procedural requirement is that the most serious hazard determines the appropriate color-coding, as shown by the following examples:

- Where no physical hazard exists, black and white shall be used for housekeeping walkways and work areas. However, when physical hazards intrude into these spaces, yellow or combination yellow and black shall be used for marking.
- When a utility or research system also represents a physical hazard, the physical hazard color-coding represents the overriding requirement. The piping or device shall have a legend and shall be painted yellow or yellow and black. Also, utility color bands at appropriate intervals may be added to the basic physical hazard color where appropriate.

2.5 POTENTIALLY HAZARDOUS MATERIALS

Communications concerning hazardous chemicals and their safe use are extremely important. Hazard awareness shall be increased through the use of warning labels. The use of color codes reduces the danger to the individual by enabling the person to immediately identify and evaluate the hazard/risk posed by the various materials stored or being used. Therefore, personnel engaged in tasks requiring the use of potentially hazardous materials shall have a good working knowledge and understanding of the criteria and requirements outlined in LPR 1710.12, "Potentially Hazardous Materials - Hazard Communication Standard." OSHA mandated Hazard Communication and Chemical Laboratory Safety Standards are also outlined in LPR 1710.12 as well as requirements for permits for the use of hazardous materials.

The type of risk shall be identified by color (blue--health; red--flammability; yellow--reactivity; and white--other hazards). The degree of danger shall be determined on a scale of 0 to 4; with 0 representing minimal danger and 4 indicating extreme danger, possibly death. This identification system is further described in LPR 1710.12 and in

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National Fire Protection Association (NFPA) 704, “Standard System for the Identification of the Hazards of Materials for Emergency Response.” Additional information and assistance shall be provided by SFAB, SMAO, particularly for instances involving contractor activities.

2.6 ALLOWABLE FLOOR LOADS

The annual Occupational Safety and Health Audit shall determine the need for allowable floor load identifications. Thereafter, each FSH and/or the FC shall be responsible for ensuring that appropriate floor loading signs are displayed and the design loading is not exceeded.

The use and marking of these signs shall be in accordance with the following criteria:

- Markings shall not be required on concrete slabs constructed directly on earth/fill.
- All floor areas shall be marked in accordance with engineering design criteria as to the loads approved for the area by the COD.
- SFAB, SMAO shall furnish the signs upon request or as a part of the facilities annual Occupational Safety and Health Audit, or when otherwise requested.
- Areas with an allowable load of 300 pounds per square foot (psf) and above shall be marked with notice signs; below 300 psf shall be marked with caution signs. In both cases, the signs shall display the actual approved load in psf.
- Sufficient signs shall be placed in the space to which they relate so that building occupants will be aware of the loading limitations.
- All drawings and specifications involving new construction shall indicate allowable floor loadings and provide for the appropriate signs.

2.7 SIGNS--INDUSTRIAL, TRAFFIC SAFETY, AND INFORMATION

All industrial safety and health, traffic, and other facility informational signs shall be fabricated and installed in accordance with the requirements of LAPD 1500.5, “Signs and Directory Boards”.

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Chapter 3

3. SPECIAL SYSTEMS REQUIREMENTS

3.1 PRESSURE SYSTEMS

NASA policy applicable to these systems is set forth in NPD 8710.5, "NASA Safety Policy for Pressure Vessels and Pressurized Systems." Requirements for the application of this LPR to ground based systems is contained in NASA-STD-8719.17, "NASA Requirements for Ground Based Pressure Vessels and Pressurized Systems (PV/S)."

3.1.1 Sy stems Requirements

LaRC implementation of the Agency procedural requirements is contained in LPR 1710.40, "Langley Research Center Pressure Systems Handbook."

3.1.2 "Witnessing" Policy

Hydrostatic or pneumatic testing of pressure systems shall be a basic requirement of LPR 1710.40. It shall be required that the acceptance testing of pressure systems used on LaRC experimental equipment, or being procured for use at LaRC, be witnessed as follows:

- Pressure tests conducted elsewhere for systems to be used at LaRC shall be witnessed by a representative, such as the LaRC Resident Engineer, or other selected NASA personnel.
- Testing of pressure systems (at or away from LaRC), which are not destined to become a part of a LaRC facility system, shall be witnessed as determined by the responsible LaRC Project Manager.

3.2 MECHANICAL SYSTEMS

3.2.1 Machine Guarding

As a minimum, new and existing machinery shall meet the requirements of the latest OSHA 29 CFR 1910, Subpart O, "Machinery and Machine Guarding," requirements. LaRC mechanical requirements applicable to machinery are:

- Machines (manual or powered) shall be properly anchored to prevent walking or moving. Specifically, any machine shall be anchored that might move or walk because of unbalanced operation (tipping) or because it is located so that passing heavy equipment could impact or upset the machine. Excluded from this requirement are tools and machines explicitly designed for portable use.
- Existing machinery shall be brought into compliance with OSHA standards, which require the machine operator and other employees to be protected from rotating and moving parts. The annual Occupational Safety and Health Audit shall identify those machines requiring corrective action.

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- All purchase requisitions and contractual commitments, which include machinery shall contain in the specifications a requirement that machine guarding is in compliance with OSHA 29 CFR 1910, Subpart O. All such specifications shall be reviewed and approved by the LaRC Safety Manager or his/her designee.

3.2.2 Preventive Maintenance (PM) Review

SFAB shall participate in Maintenance Configuration Control Board (MCCB) reviews and shall evaluate facility hardware for single point failures that can cause death or injury and assure appropriate PM's are in place. Reviews include "end of life" considerations, etc., and are applicable to such items as roll-up/overhead doors with chain cable or other single point failure drive systems, etc."

3.3 ELECTRICAL SYSTEMS

The basic LaRC procedural requirement for electrical systems shall be the OSHA recognized National Electric Code (NEC). Specific LaRC procedural requirements and interpretations of the NEC are contained in LPR 1710.6, "Electrical Safety."

3.3.1 Working Clearances

Working clearances shall be in accordance with the NEC, Section 110-16, "Working Space about Electrical Equipment (600 Volts or Less)."

3.3.2 "Hot Stick" Safety Procedures

Due to the extremely hazardous potential of discharging high voltage electrical storage, special requirements are specified. LaRC "Hot Stick" procedural requirements for each High Voltage Test Facility shall be required to be written as a detailed step by step outline of how to safely de-energize capacitor banks prior to making changes or adjustments. Each facility "Hot Stick" procedure shall conform to the requirements of LPR 1710.6.

3.4 WATER CONNECTIONS

Contamination of the potable water supply is prohibited. LaRC procedural requirements have established safeguards against possible contamination of the fresh water supply caused by backflow or back siphonage. These safeguards are:

- Where the possibility of a cross connection may exist, backflow prevention devices, or the equivalent, shall be installed and tested periodically.
- Any suspect cross connection or suspect contamination of fresh water shall immediately be reported to the FSH.

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4. FACILITIES AND STRUCTURES SAFETY

4.1 SCAFFOLDING/STAGING

This chapter establishes the procedural requirements for ensuring compliance with the minimum safety requirements/standards in the design, construction, erection, and use of metal and wood scaffolding/staging/staging platforms. These include varieties of fixed and mobile self-supporting, suspension, and special types of scaffolding/staging. The requirements/standards applicable to these devices, when utilized by civil servant employees or contractors, shall be OSHA 29 CFR 1910.28 and/or 29 CFR 1926.451.

4.1.1 Responsibilities

It shall be the responsibility of qualified (SFAB, SMAO, facility, other civil servant, contractor, or sub-contractor) personnel to certify all scaffolding at LaRC to be in conformance with OSHA and LaRC requirements. All scaffolding/staging systems shall be certified as safe prior to use. Personnel authorized to approve scaffolding/staging systems shall be appropriately designated/listed in writing as “Qualified”. Ongoing scaffolding/staging operational support shall include close monitoring by competent personnel to ensure a continued state of scaffolding/staging system conformance. Those ensuring continued conformance shall be appropriately designated in writing as “Competent”. Prior to scaffold/staging usage, the users shall examine the “posted” scaffold/staging certification for the presence of a “qualified” signature showing current approval. If scaffold/staging conditions cannot be determined to be in “safety” conformance, a competent individual shall remove the “posted” certification from the scaffold/staging. Competent individuals are authorized to “re-post” the certification when it has been re-certified by a “qualified’ person.

4.1.2 Facility and Line Management/Supervisors and Support Personnel

Facility Coordinators, Facility Safety Heads, and construction inspectors, or designated Contracting Officer's Technical Representatives (COTR)/Contract Monitors shall ensure that:

- When working from suspension-type scaffolding/staging, each worker shall be protected by an approved full body harness and lanyard attached to a lifeline. The lifeline shall be securely attached to substantial members of the structure (not the scaffolding/staging), or to securely rigged lines that will safely suspend the worker in the event of a fall.
- Any scaffold/staging, including accessories such as braces, trusses, screw legs, ladders, and so forth, damaged or weakened from any cause, shall immediately be repaired or replaced.

These personnel shall also be responsible for ensuring the prompt and safe dismantling of scaffolding/staging when no longer required.

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4.1.3 General Requirements

Personnel using scaffolding/staging at LaRC shall observe the following requirements:

- Scaffold/staging "use" shall be authorized by a current certification posted conspicuously on or in the immediate vicinity of the scaffold/staging. The scaffold/staging system shall not be used without the approval/authorization of a qualified person.
- Scaffolds/staging shall not be modified without the approval of the qualified personnel.
- Scaffolds/staging shall not be erected, modified, or dismantled except under the supervision of competent personnel.
- During erection, modification, or disassembly "incomplete" scaffolding/staging structural support sections shall not be depended upon for safe support of personnel.
- Scaffolds/staging shall not be moved while occupied.
- Scaffolding/staging shall not be modified while occupied.
- The footing or anchorage for scaffolds/staging shall be sound, rigid, and capable of carrying the maximum intended load without settling or displacement. Unstable objects such as barrels, boxes, loose brick, or concrete blocks shall not be used to support scaffolds or planks.
- Guardrails and toe-boards (minimum height of four inches) shall be installed on all open sides and ends of platforms more than 10 feet above the ground. Hand rails, 2 inches by 4 inches or the equivalent, shall be installed no less than 36 inches or not more than 42 inches high, with a mid-rail, when required, of 1 inch by 4 inch lumber or equivalent.
- "C-clamps" shall not be used in-lieu of properly designed mechanisms (brakes, wheel turning mechanisms, etc.)
- Supports for guardrails and toe-boards shall be at intervals not to exceed eight feet.
- Scaffolds/staging and their components shall be capable of supporting, without failure, at least four times the maximum intended load. To ensure that the working load is not exceeded, the maximum capacity shall be displayed on a tag or plate firmly affixed to the scaffolding/staging.
- An access ladder or equivalent (approved by a qualified individual) shall be provided.
- Scaffolds/staging shall be secured to permanent structures through the use of an approved anchor system or other equivalent means. Window cleaner anchor bolts shall not be used.
- The use of shore scaffolds/staging or lean-to scaffolds/staging shall be prohibited.
- Wooden scaffolding/staging requirements shall also specify that:
  - Planking lumber grade, maximum permissible span, and nail or bolt requirements shall be as specified in the appropriate sections of OSHA 29 CFR 1910.28 and 1926.451.

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  - Planking or platforms shall be overlapped a minimum of 12 inches, secured from movement, and extended over their supports not less than six inches or more than 12 inches.
  - Poles, legs, and uprights of scaffolds/staging shall be plumb and securely/rigidly braced to prevent swaying and displacement.
- Special considerations that are required to be tailored to the individual application shall be constructed in accordance with the applicable OSHA standards, and shall include such items as:
  - Tag lines and tie-offs
  - Overhead protection
  - Underneath protection
  - No work conditions
  - Rope protection
  - Fire prevention
  - Uplift locks
  - Maximum occupancy
  - Adjacent heat sources

4.2 UNPROTECTED ELEVATED WORK

Requirements for assigning employees tasks that involve personnel presence at unprotected elevated levels shall be referred to as elevated work.

4.2.1 Elevated Work

There are four height categories for elevated work that is unprotected. Each has its own personnel protection requirements.

- General safety ≥ four feet
- Construction safety ≥ six feet
- Scaffold ≥ ten feet
- High Work ≥ twenty-five feet outside protective enclosures, catwalks etc. Bucket work at any elevated level is considered high work.

Elevated high work shall meet the requirements of ANSI and OSHA 29 CFR 1926 standards, including substations, gantries, stacks, and certain hazardous roofs. Bucket truck occupants shall have special medical qualifications and certification. For any individuals (visitors, etc.) temporarily exposed to elevated levels> 25 feet inside protective enclosures, catwalks, etc. the individual and the supervisor must be comfortable that the exposed individual is physically and mentally capable of performing the task. All safety requirements shall be adhered to by visitors.

4.2.2 Safety Requirements for Personnel Exposed to Elevated Levels that are Unprotected

Before assigning employees to work at elevated levels, supervisors shall ensure that the following safety requirements and precautions are observed:

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- Provide adequate safety measures, equipment and/or devices to minimize any potential hazard that could be encountered while working at the elevated levels. These devices shall include, but are not be limited to, full body harnesses and lanyards, guardrails, lifelines, and/or scaffolds/staging.
- Instruct employees regarding the specific tasks that are to be performed including actions to reduce the potential for occurrences of falling material and to adequately prevent injury or equipment damage from falling objects. Paramount to such instruction shall be the pre-use inspection of all safety equipment prior to each usage. Inclement weather restrictions shall be identified and briefed.
- Workers shall be certified and demonstrate the proper use of all safety related equipment.
- Employees shall obtain medical examinations to ensure that they are physically qualified to perform assigned tasks at high work.
- Make certain that the employee is physically and mentally capable of performing each specific elevated level work task. If there is any doubt or reservation as to the employee's capabilities (even though the employee may have previously been medically certified to perform at high work levels), the assignment shall be deferred. Be alert to any indications of the effects of alcohol, drug consumption, or mental stress.

4.2.3 Responsibilities

Civil servant and contractor supervisors shall be responsible for complying with the requirements of this section. Supervisors shall refer all questions relative to working at elevated levels to the LaRC Safety Manager, or the Occupational Health Officer (OHO), Office of Human Capital Management (OHCM) or their designee or qualified contractor personnel for advice and guidance.

Upon receipt of a completed NASA Langley Form 66, "Worker Appointment and Certification Form," the Occupational Health Services (OHS) shall arrange for physical examinations of high worker employees. Examinations shall specifically include consideration of physical defects or conditions that could create a potential hazard while working at high work levels or in a bucket truck (for example, vertigo, epilepsy, fainting spells, and so forth).

The OHS shall be responsible for certifying, on NASA Langley Form 66, that employees examined have been found medically qualified to perform high work. This certification shall be made prior to initiation of work.

The certifying official shall be the LaRC Safety Manager or his/her designee, who shall verify the proper completion of NASA Langley Form 66, maintain certification records, and provide authorizing documentation.

SFAB, or contractors shall counsel supervisors regarding appropriate safety precautions and approved safety devices to be used when working at elevated levels.

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4.3 ELEVATED WORK – (ROOF TOPS)

LaRC roof areas are not generally designated as work areas. However, tasks such as equipment maintenance, roof repair, and various types of construction projects are occasionally performed on these surfaces. The following establishes the minimum requirements for these activities.

4.3.1 Access Control

It shall be the responsibility of the FC to control access to these potentially hazardous roof areas. To support the FC in this function, the following procedural requirements are established:

- All accesses to hazardous roof areas shall be identified by appropriate warning signs.
- When working on a low slope roof or any similar structure at height (slope less than or equal to 4:12, vertical rise: horizontal run) and using the safety monitoring system, the safety monitor shall not have other responsibilities which could take the monitor's attention from the monitoring function" (OSHA 29 CFR 1926.502 (h) (1) (v)).
- All personnel requiring access to roof areas shall notify the FC and obtain approval prior to performing any roof activity.
- Where structural integrity or permanent safety devices do not provide sufficient protection to confine the risk to the simple "high work" category (see paragraph 4.2.1 Elevated Levels), special security, safety equipment and/or procedures, and temporary structural requirements shall be specified and conspicuously documented and posted by the facility. The COD, in conjunction with the LaRC Safety Manager or his/her designee, shall assist in developing these specifications.

4.3.2 Equipment Access

Where access to roof-located equipment (for example, heating, ventilation, and air-conditioning, aircraft warning lights, pressure systems, instrumentation stations, and so forth) is required, the following shall apply:

- Permanent working platforms, associated walkways or ladders, and appropriate rails and guards or personal harness safety equipment shall be provided in accordance with OSHA, 29 CFR 1910 standards.
- Those workers requiring access shall be identified and certified as "high workers." (See paragraph 4.2.1 Elevated Levels).
- Approved safety equipment and procedures shall be used for these operations.

For buildings with adequate structural integrity, the same requirements described in paragraph 4.3.1 of this chapter shall apply to roof repairs or modifications. Roof activities on surfaces that are structurally inadequate, or which are not permanently configured for such work, shall have the following additional requirements (all cement-asbestos paneled roofs shall automatically be in this category):

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- Internal building access to these roofs shall be secured by locks and the keys maintained by the FC or alternate.
- Roof prime load-carrying members (or alternatively the minimum spans that guarantee load support), including allowable loads, shall be identified and documented in the facility files.
- Prior to initiation of roof repair or modification, the affected parties (NASA, contractor or subcontractor) shall be briefed on both the potential hazards and recommended minimum safety considerations associated with the performance of the specific roof task. The responsibility for this coordination shall depend upon the personnel performing the task:

Worker	**Responsibility**
NASA/LaRC	FSH/FC
Support Service Contractor	COTR and/or Technical Monitor
Construction	Assigned Inspector Contractor

4.3.3 RESPONSIBILITIES

All prime and sub contractors shall provide seamless conformance to OSHA requirements (or LaRC's requirements, if more restrictive) for fall protection. In particular, when working on a low slope roof or any similar structure of height (slope less than or equal to 4:12, vertical rise: horizontal run) and using the safety monitoring system, the safety monitor shall not have other responsibilities, which could take the monitor's attention away from the monitoring function" (Reference OSHA 29 CFR 1926.502 (h) (1) (v)).

4.4 CONFINED SPACES

Any space not intended for continuous employee occupancy, having a limited means of egress, and which is also subject to either the accumulation of an actual or potentially hazardous atmosphere or a potential for engulfment is considered to be a confined space. Confined spaces generally include, but are not limited to, storage tanks, process vessels, bins, boilers, ventilation or exhaust ducts, sewers, manholes, underground utility vaults, acid tanks, digesters, ovens, kiers, pulpers, tunnels, furnaces, degreasers, test chambers, compartments, vats, certain locations within aircraft and spacecraft when not in flight, and pipelines. Open top spaces more than four feet in depth, such as pits, tubs, vaults, and vessels, may also be confined spaces.

This LPR establishes the procedural requirements applicable to all personnel, contractors, and operations at NASA, to prevent exposure to dangerous air contamination when entering into and working within confined spaces. Dangerous air contamination is any atmosphere presenting increased risk of health impairment, injury, disablement, or death, such as:

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- Combustible or flammable gases and vapors at concentrations in excess of 10 percent of their lower explosive limit.
- An oxygen concentration less than 19.5 percent or greater than 23.5 percent by volume.
- Toxic substances present at concentrations in excess of their permissible exposure limits or threshold limit values (TLV's).

NOTE: OSHA exposure standards (29 Code of Federal Regulations (CFR) 1910) will be used unless the American Conference of Governmental Industrial Hygienists (ACGIH) TLV's are more restrictive; in which case ACGIH guides will be used.

4.4.1 Responsibilities

Supervisors shall have overall responsibility for entry and work in confined spaces and for ensuring that the requirements of this procedural requirement are implemented. The LaRC fire department is trained and equipped to conduct confined space rescue, therefore the fire department (864-5600) shall receive prior notification that there will be a confined space entry. Supervisors shall request assistance from the SFAB Industrial Hygiene staff, if there is any doubt about whether a location meets the criteria of a confined space. The SFAB Industrial Hygiene staff shall be responsible for civil servants and the contracting company's industrial hygiene staff shall be responsible for contractor personnel and shall:

- Evaluate and approve entry by permit and/or operating procedures.
- Review equipment to be used.
- Ensure that atmospheric measuring equipment is installed, maintained, calibrated, and used properly.
- Assist supervisors in identifying and posting areas to be considered confined spaces and in training or approving training programs for personnel entering confined spaces.
- Test the atmosphere, or as deemed appropriate, certify other personnel to perform this task.

4.4.2 Permit/Procedure System

NASA Langley Form 60, "Confined Space Entry Permit," or approved procedure where entry is on a routine basis and hazards are well known, shall be required. Attention to detail similar to that of the Confined Space Entry Permit shall be required for an approved procedure. An approved procedure shall be updated and reviewed at least annually.

4.4.3 Posting

Confined spaces shall be posted at all times with the sign shown in Figure 4.1. During periods when work is scheduled within the confined space, a copy of the permit or procedure shall also be posted.

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Figure 4.1, Confined Space Warning

4.4.4 Training

All employees who participate in the entry of confined spaces shall be trained regarding the nature of the hazards involved as mandated in LPR 1740.6, Chapter 10. This includes operating and rescue procedures, precautions to be taken, and the proper use of required personal protective and emergency equipment. Procedures shall be thoroughly explained so that each person is aware of the proper action to take under varying circumstances. All persons shall be totally familiar with the system of communication used during confined space work.

4.4.5 Atmospheric Testing

Prior to entry into a confined space, atmospheric tests shall be conducted to determine the presence of dangerous air contamination. Subsequent atmospheric testing with hourly recording shall be required.

4.4.6 Ventilation

In all cases of dangerous air contamination, ventilation shall be recommended as the primary means of control. Continuous general dilution or local exhaust ventilation shall be maintained where dangerous air contamination is produced as part of a work procedure (for example, cleaning with solvents, welding, or painting), or where dangerous air contamination may develop due to the nature of the confined space (for example, desorption from walls or evaporation of residual chemicals). Ventilating a confined space does not eliminate the need for atmospheric testing.

Ventilation equipment used to prevent situations that are immediately dangerous to life and health shall have an audible warning device to signal ventilation system failure.

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It is good practice to ventilate all confined spaces before entry and during occupancy even though no dangerous air contamination is present.

4.4.7 Prevention of Dangerous Air Contamination

Accidental introduction of dangerous air contamination into the confined space through interconnecting equipment such as piping, ducts, vents, drains, and so forth, shall be prevented by positive means such as lock-out and tagging, disconnection of pipes, blind flanges, and two block valves with an open vent between them, or other procedures.

4.4.8 Electrical Equipment

Since tanks, damp manholes, and so forth, often constitute "massive electrical grounds," electrical circuits in confined spaces shall be de-energized and locked/tagged out as warranted due to the potential for electrical shock. Any electrical equipment used inside confined spaces shall be properly insulated and grounded. Only explosive-proof electrical equipment, in accordance with Article 500 of the NEC, and non-sparking hand tools shall be used in confined spaces subject to contamination by combustible/ flammable vapors, gases, or particulates. Where possible, it is desirable to use pneumatically driven power tools equipped with conductive air supply hoses. Nitrogen or other inert gas pressure shall not be used as a substitute for air pressure unless specifically approved by the confined space monitor. All hand-held electrical equipment shall have a ground fault interrupter circuit breaker (4 to 6 mA where possible) at the power source unless the power source is an ungrounded portable generator, an ungrounded battery source less than 28 volts, or an ungrounded isolation transformer of less than 28 volts.

4.4.9 Personal Protective Equipment

Protective equipment shall be used by all personnel as follows:

- Suitable goggles or full-coverage face shields with goggles, impervious outer clothing, gloves, hood, and boots shall be worn, as necessary, to protect against irritating, corrosive, or toxic contaminants.
- Hard hats shall be worn in confined spaces when circumstances so warrant. Hard hats shall meet the requirements specified in OSHA 29 CFR 1910.135.
- Depending on the extent of the hazard, lifelines and safety harnesses may also be required. Safety harnesses shall be certified according to Section 4 of ANSI A10.14-1975. Lifelines shall not be less than 1/2-inch nylon (5/8-inch preferred) or 3/4-inch manila rope of good quality without splices. Lines shall be inspected periodically to ensure that they are free from defects. A line shall be securely attached to the harness, and the free end of the line shall be secured outside the entry opening, checked prior to entry, and shall not be removed while inside the confined space. The safety harness shall be of the type that permits easy rescue of persons from the confined space during emergency conditions. In cases where the size of the entry/exit opening is less than 19 inches, a wrist-type harness shall be used. A hoisting device or other effective means shall be

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provided by SFAB, SMAO for civil servants and by the Contracting Company for contractors for lifting personnel out of the confined space.

- Respiratory protection requirements for civil servants shall be determined by SFAB Industrial Hygiene staff and by the Contracting Company Industrial Hygienist for contractors as defined by the applicable contractor. Needs are based upon conditions and test results of the confined space and the work activity to be performed. All respirators shall be NASA or contractor, and National Institute of Safety and Health (NIOSH)-approved devices and shall be fitted, used, and maintained in accordance with OSHA respiratory protection, air contaminant, and other applicable standards. The quality of air used in supplied-air respirators shall meet OSHA requirements (Compressed Gas Association Grade D). Contractors shall be responsible for supplying their own respirators. Annual physical examinations to determine ability to use respiratory protective devices and perform the work that may be required shall be administered to all personnel who work in confined spaces, including standby personnel. Only when ventilation has been found to be impractical or ineffective shall personal respiratory protective equipment be required as a primary means of control.

4.4.10 Standby Personnel

Standby personnel shall be positioned outside confined spaces to give assistance in cases of emergency. Standby personnel shall have no assigned duties to perform other than to observe and communicate with persons inside the confined space. Audible voice, radio/telephone, constant visual, or other suitable forms of communication between the persons in confined spaces and standby personnel shall be continuously maintained. The system shall be tested immediately upon entry to confirm its effectiveness. Also, standby personnel shall have a communication link with additional persons who can render help in emergencies. The LaRC fire department that is trained and equipped for confined space rescue shall be contacted by dialing 911 from any LaRC telephone or 864-2222 from a cellular telephone, if rescue should become necessary.

4.5 ASBESTOS

Asbestos is a generic term for a number of naturally occurring, hydrated mineral silicates, incombustible in air and separable into filaments, such as chrysotile, amosite, crocidolite, and other forms as described by OSHA.

These procedural requirements are established to prevent exposing personnel or the environment to friable asbestos in accordance with federal, state, and local regulations applicable to asbestos. This applies to all personnel and operations at LaRC, including contractors. Present Commonwealth of Virginia regulations exempt federal facilities from having a Project Monitor on site for asbestos abatement projects unless the abatement is greater than or equal to 1600 square feet or 2500 linear feet. According to 40 CFR 763, Subpart E, Appendix C6, Project Monitors observe abatement activities performed by contractors and generally serve as a building owner's representative to ensure that abatement work is completed according to specifications and in compliance with all relevant statutes and regulations. It is a conflict of interest under present

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Commonwealth of Virginia regulations for a contractor to have an employee/employer relationship with or a financial interest in asbestos monitoring work performed by a Project Monitor. Regulations also require that an asbestos contractor shall not have any financial interests in the firm of which the Project Monitor is an employee. This section shall in no way relieve the abatement contractor of the OSHA requirements for personnel monitoring requirements.

In the past, the SFAB, SMAO has provided all project monitoring services for asbestos abatement jobs performed by the Research, Operations, Maintenance, and Engineering (ROME) Contractor removal team. For all future projects, the following information applies:

- SFAB, SMAO shall provide Project Monitors and personnel sampling for all asbestos work being performed at LaRC that is ≤ 10 square feet or 10 linear feet. This information shall be taken to ensure Government employees' protection and shall be provided to the ROME Contractor for informational purposes only. This support shall in no way relieve the abatement contractor of the OSHA requirements or personnel monitoring requirements.
- SFAB, SMAO shall monitor all glove bag removal operations and small containment jobs (≤ 10 square feet or 10 linear feet) at no additional cost. Additionally, SFAB, SMAO shall spot check areas exterior to the containment area and at the clearance inspection to protect civil service employees adjacent to the regulated areas.
- Personnel monitoring of all other jobs (≤ >10 square feet or 10 linear feet) shall be the responsibility of the asbestos abatement contractor only.
- The ROME Contractor shall assume responsibility for personnel monitoring of its employees for regulatory compliance as required by Federal Law (OSHA 29 CFR 1926.1101) on all jobs ≥ 10 square feet or 10 linear feet.
- Contract Services, COD shall notify the ROME Contractor and SFAB, SMAO in advance of any asbestos removal work requiring a 20-day notification to the Commonwealth of Virginia. A 20-day notification shall be required on all work that involves removal of more than 10 linear feet or 10 square feet of asbestos containing material (ACM). Additionally, notification to SMAO shall include the total amount of ACM to be removed and anticipated start dates for monitoring and for clearance sampling to be conducted.

Operational considerations for asbestos-related activities shall be as follows:

- Prior to any operation involving removal, repair, or any other procedure, which may result in release of airborne asbestos, an inspection shall be conducted to evaluate the potential hazard and to recommend appropriate controls.
- The inspection team shall consist of an individual from the SFAB Industrial Hygiene staff, the contractor safety official, the contractor operational supervisor ("competent person" as defined by OSHA regulations), and a facility representative, either the FSH or FC. The inspection team shall establish

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operational and control procedures, which are documented through issuance of NASA Langley Form 27, "Asbestos Safety Permit."

- Applicable portions of 29 CFR 1926.1101, "Asbestos," shall be incorporated as appropriate into all asbestos operations.
- Asbestos Configuration Management reporting shall be coordinated in accordance with LPR 1740.4, "Facility System Safety Analysis and Configuration Management," Chapter 8.
- Asbestos materials will be disposed of in accordance with federal, state, and local rules and regulations. Implementation shall be the contractor's responsibility in coordination with the Capital Assets and Logistics Branch (CA&LB), COD environmental personnel.
- Asbestos removal operations shall be conducted in accordance with LPR 8800.1, "Environmental Program Manual," Chapter 9, "Asbestos."
- Replacement insulation shall be asbestos-free and identified with stickers, which say **"Non-Asbestos"** or **"Asbestos Free."**

4.6 SECURITY (SECURE) AREAS

Design, operational, and emergency access procedural requirements for secure areas are established in this section.

4.6.1 Design Safety

All requests for "security areas" which require facility modification shall generally be accomplished by submitting a work request via the ROME Integrator with a sketch or drawing. The security and safety representatives shall physically review and approve the requested areas to ensure compliance with security and life safety regulations. Specific security hardware, hardware locations, facility access/egress routes, and so forth, shall be annotated on the sketch/drawing and signed by the FSH. The approval document (copy) shall be posted at the entrance with the authorized entry personnel roster.

For areas where modification is not required, the SFAB, SMAO shall be informed by the requester and/or the SMST, COD and a safety review shall be performed. (See LAPD 7000.2, "Review Program for Langley Research Center (LaRC) Facility Projects.")

4.6.2 Operational Safety

The FSH shall post at the main entrance door(s) a roster of two or more persons who can be contacted for after duty-hours entry. If the FSH is not on the approved access list, an organizational FSH shall be appointed to exercise safety responsibilities within the security area. All security area operations shall be reviewed by the SFAB, SMAO to determine if a buddy system shall be required during operations in the secure areas.

During the annual Occupational Safety and Health audit, the SFAB, SMAO representative shall review "security areas" for procedural requirement compliance. Appropriate access authorization shall be obtained through security channels by the safety personnel involved.

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4.6.3 Emergency Access

Facility personnel shall be aware that in the event of a mishap, safety personnel shall have access to the security area after showing their badges and identifying themselves. SMST, COD shall maintain a list of safety personnel for cross-reference and identification.

4.6.4 Health/Injury Emergency

- City of Hampton emergency response personnel shall respond.
- Emergency response personnel shall obtain immediate entry to the area (forced entry if access doors cannot be immediately unlocked).
- SMST, COD shall respond to the request and, after response activities are complete, debrief all involved parties who gained access.
- After affected personnel obtain medical treatment, the employee shall report the incident in accordance withLMS-CP-4760, “Reporting Injuries, Illnesses, Compensation Claims and Unsafe Working Conditions.”

4.6.5 Fire Alarm

The Fire Department shall respond to a fire alarm as follows:

- Obtain immediate entry (forcing doors if doors are not immediately unlocked).
- Locate and extinguish the fire.
- After the fire is extinguished, relinquish control of the area to SMST, who shall debrief all response personnel when the emergency response is completed.

4.7 PROBLEM/FAILURE REPORTING

Facilities shall report problems/failures through the computerized maintenance management system with SFAB, SMAO being informed of the problem/failure in accordance with LMS-CP-4760, “Reporting Injuries, Illnesses, Compensation Claims and Unsafe Working Conditions,” on the appropriate methods to report a safety hazard or concern. Problem failure reports may be used internally for system reporting.

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Chapter 5

5. MECHANICAL EQUIPMENT ROOMS

5.1 HOUSEKEEPING

All LaRC mechanical equipment (M.E.) rooms shall be kept clean and clear of excessive combustible materials.

5.2 ELEVATOR M.E. ROOM ACCESS DOORS

Access doors for LaRC elevator M.E. rooms shall meet the requirements of ANSI A17.1. This shall require doors to be self-closing with a spring-type lock arranged to permit the doors to be opened from inside without a key.

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Chapter 6

6. EQUIPMENT SAFETY

6.1 FORKLIFT TRUCKS

LaRC forklift procedural requirements are consistent with OSHA, Section 29 CFR 1910.178 and are established in this section.

6.1.1 New Equipment Requirements

All new powered industrial forklifts acquired and used by LaRC shall meet the design and construction requirements established in the latest revision of ANSI B56.1, except for vehicles intended primarily for earth moving and over the road hauling.

The user shall ensure that all capacity, operation, and maintenance instruction plates, nameplates, required decals, and markings are in place and maintained in a legible condition.

6.1.2 Overhead Guards

Safeguards, which protect the operator from physical injury shall be required on all new or existing forklifts.

High lift forklifts shall be fitted with an overhead guard manufactured in accordance with the latest revision of ANSI B56.1. Where operating conditions do not permit use of this guard, approval for noncompliance shall be obtained from the LaRC Safety Manager or his/her designee.

An overhead guard shall be used as protection against falling objects. An overhead guard shall be intended for protection from the impact of small items such as packages, boxes, bagged material, and so forth. It shall not be intended to withstand the impact of a falling capacity load.

If the type of load presents a hazard, the user shall equip forklifts with a vertical load backrest extension manufactured in accordance with the latest revision of ANSI B56.1.

6.1.3 Personnel Safeguards

Forklift operators shall be certified (see LPR 1740.6, “Personnel Safety Certification”). Whenever a forklift is used for lifting personnel, the following additional precautions shall be taken (see LPR 1740.6, “Personnel Safety Certification”):

- Only trained and authorized operators shall be permitted to operate the forklift.
- The platform shall be certified for personnel use and firmly secured to the lifting carriage and/or forks.
- Falling object protection shall be provided when warranted.

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6.1.4 Safe Loads and Loading Practices

Handle only stable or safely arranged loads and do not exceed the rated capacity of the forklift.

Modifications to increase a forklift's load capacity shall be permitted only when approved by the forklift manufacturer.

6.1.5 Vehicle Maintenance

Forklifts covered by these requirements shall have their load life capability verified every five years and as required due to major repair. The rated load shall be centered on the lifting forks during the load test with the test being conducted in accordance with ANSI B 56.1, as amended. The date of the next load test shall be stenciled on the right vertical boom. Load tests shall be the responsibility of the COD, through the ROME contractor.

Normal vehicle maintenance and roadworthiness shall remain the responsibility of the Transportation and Motor Vehicle Operations Officer (TMVOO). (See LAPD 6000.1, "Transportation Management").

6.2 LIFTING DEVICES, EQUIPMENT, AND OPERATIONS

LaRC-owned, LaRC-contractor owned and/or leased or other lifting devices or equipment operated at LaRC shall conform to the requirements of NPR 8715.3, "NASA Safety Manual" and NASA-STD-8719.9, "Standard for Lifting Devices and Equipment". 1). Responsibility of the Lifting Device (LD) Operator to ensure that the crane and associated hardware being used has current certifications with no overdue maintenance. LD & Equipment (e) certification documentation shall provide traceable objective evidence of conformance to requirement elements. The LDE will have a legible certification tag made of "permanent" material attached to it showing pertinent equipment certification data. The LD Operator, on a daily basis, prior to using the lifting device, is to sign-off performance of and conformance to the inspection/operational checklist items. The checklist items shall be approved by the LDE Manager. 2). A Center wide committee shall be established to communicated and exchange LDE information. The LDE Manger will lead the committee. All lifting device operations shall be formally assessed for "critical lifting" criteria and be classified as critical or non critical. The LDE Manager shall review/approve all lifting classifications. The application and use of this equipment is divided into two categories:

- Critical Lifting/Rigging Operations
- General Lifting/Rigging Operations

The LaRC procedural requirement is that at no time shall personnel or any extremity (e.g., arm, hand, leg, etc.) be located under a suspended load (e.g., a load only on the hook). A deviation from this policy shall be processed in accordance with NASA-STD-8719.9. After assuring that the deviation satisfies the OSHA approved NASA Alternate Standard, the LDE Manager shall consult with NASA Headquarters Office of Safety and Mission Assurance internal standards prior to any person working under a suspended

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load operation at LaRC.

6.2.1 Critical Lifting/Rigging Operations

Lifts where failure/loss of control could result in damage of high dollar items (e.g., NASA spaceflight hardware, etc., or a total combined damage/replacement cost in excess of 5 million dollars), or mission essential items, unique one-of-a kind test articles, major facility items, or personnel are considered critical lifts. Also, if the potential for loss of life is greater than that associated with a “normal” lifting operation, for example the use of a man-basket, the operation shall be defined as a critical lift. When failure/loss of control could result in damage to a one-of-a-kind article or major facility component that will result in serious programmatic mission essential or institutional impact (e.g., termination of the research program, critical schedule impacts, or facility closure) the LaRC Lifting Device and Equipment Manager, SFAB, SMAO Safety Engineer, and the appropriate Organizational Unit Manager shall determine if the lift shall be defined as critical. Examples of lifts that have been defined as critical at LaRC are: the National Transonic Facility (NTF) and 14x22 Foot Tunnel replacement drive motors, lifting unique/costly flight hardware, and moving the Cockpit Motion Facility simulators.

Critical lifting/rigging equipment and operations shall meet the requirements outlined in this document and the requirements in NASA-STD-8719.9, “Standard for Lifting Devices and Equipment.” Critical lifts with safety deficiencies shall be prohibited until all safety items have been corrected. The more restrictive requirement shall be used if any conflicts between the two documents arise.

6.2.2 General Lifting/Rigging Operations

LaRC general lifting/rigging operations shall be controlled by the criteria which meets the requirements of NASA-STD-8719.9. Variances, when requested, shall be submitted to the LaRC Lifting Device and Equipment Manager for review and analysis before being forwarded to the LaRC Safety Manager and then the Center Director for final approval.

6.2.3 Maintenance of Lifting Devices and Equipment

The maintenance of all lifting devices and equipment shall be the responsibility of the COD through the ROME contractor. Maintenance shall include periodic inspections and load tests. All maintenance, tests, and inspections shall be performed in accordance with applicable ANSI standards using the schedule in NASA-STD-8719.9.

The LaRC Computerized Maintenance Management System (CMMS) shall serve as the auditable documentation to track maintenance effectiveness. Each item, as a minimum, shall be identified, indicate last load test amount, and indicate next inspection and load test due dates. All permanent maintenance records shall be maintained by the COD.

It shall be the responsibility of the FSH's and FC's to ensure lifting equipment under

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their control are included in the LaRC CMMS.

6.2.4 Overhead Cranes

This section establishes minimum procedural requirements for the design, testing, inspection, maintenance, and operation for overhead and gantry cranes, including under hung, monorail, and jib cranes. As a minimum all overhead cranes shall be designed, tested, inspected, maintained, and operated in accordance with NASA-STD-8719.9, the appropriate codes and standards.

Additional requirements for all overhead cranes, including cab-operated, are listed below.

- All cranes shall be equipped with emergency disconnect switches located in the immediate vicinity of the crane operation. Each cut off switch shall be plainly identified and personnel operating the crane shall know the exact location of the switch. Pneumatic cranes shall have their cut-off valves identified and located in the same manner.

- Only authorized personnel, qualified in the safe operation of cranes and hoists, shall be permitted to operate such equipment. They shall be qualified/certified in accordance with the requirements of LPR 1740.6.

- Inspections shall be performed by the operator daily, or prior to each use for equipment not used daily. It is the responsibility of the crane operator to ensure that the crane and associated hardware being used have current inspections with no overdue maintenance needed.

Additional operational considerations for cab-operated overhead cranes are listed below.

- The general arrangement of the cab and the location of the control and protective equipment shall be so that all operating handles are within convenient reach of the operator.

- A suitable fire extinguisher and cab lighting shall be provided for safe operation.

- All cab-operated cranes equipped with a power traveling mechanism shall be equipped with an audible warning device.

- These cranes may be modified only if such modifications and the supporting structure is analyzed by either a qualified person or the crane manufacturer. A crane whose load supporting components have been modified shall be tested and the new rated load shall be displayed in accordance with ANSI B30.2, as amended.

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- Only individuals who have been trained and certified in the operation of the crane, thereby being considered qualified operators, shall enter a crane cab or pulpit with the exception of competent persons whose duties required them to do so. Operations shall assure these persons are aware of emergency egress and fire extinguisher equipment.

6.2.5 Mobile Cranes and Derricks, Hoists and Winches, Hooks, Jacks/Shop Lifts, Slings and Associated Lifting Hardware, Vehicle and Self-Propelled Platforms

Mobile Cranes and Derricks, Hoists and Winches, Hooks, Jacks/Shop Lifts, Slings and Associated Lifting Hardware, Vehicle and Self-Propelled Platforms etc. shall be in conformance with the requirements of NASA-STD-8719.9.

6.2.6 Responsibilities

The responsibilities for lifting equipment at LaRC are as follows:

- The LaRC Safety Manager or his/her designee shall be responsible for auditing all lifting equipment programs for compliance.
- The COD shall be responsible for the roadworthiness and vehicle maintenance of mobile lifting equipment.
- The COD shall be responsible for maintaining the lift integrity of lifting equipment and devices center-wide.
- The lifting operator shall be responsible for the daily equipment inspection to ensure safe operation. This includes operator certification update as necessary.
- The LaRC Lifting Device and Equipment Manager (LD&EM) shall serve as the Center's point of contact with other Agency and Center personnel in reviewing proposed changes to NASA-STD-8719.9. The LD&EM shall also be responsible for maintaining programmatic oversight of operations, maintenance and repair of lifting devices and equipment at the Center and working with functional organizations to correct program deficiencies.
- The FSH and FC shall ensure any lifting equipment under their control is included in the LaRC CMMS. They shall also ensure that personnel using lifting equipment within their facility have the proper certifications.

6.3 LADDERS

This section establishes the minimum procedural requirements for ladders (metal, wood and fiberglass) to ensure they conform to the specifications outlined in ANSI A14.1 and A14.2 and A14.5. Only ladders meeting these standards shall be purchased or used at LaRC.

6.3.1 Procurement and Selection

Ladders are categorized as follows:

- Type IA - Extra Heavy Duty.

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- Type I - Heavy Duty.
- Type II - Medium Duty.
- Type III - Light Duty (Household).

Purchase requisitions for ladders shall specify the appropriate ANSI code and type. The Type III ladder is prohibited from use at LaRC.

6.3.2 Care and Maintenance

Ladders shall be maintained in good usable condition at all times. Hardware fittings and accessories shall be checked frequently and kept in good working order. Additionally, ladders shall be inspected frequently for general stability and worthiness, and those found to be defective or unsafe shall immediately be withdrawn from service and destroyed. Ladders shall be stored in places which will afford protection and where they will not be hazardous when not in use.

6.3.3 Fixed or Permanently Installed Ladders

Fixed ladders shall be designed, constructed, and installed to conform to the requirements of ANSI A14.3, and OSHA 29 CFR 1910.27.

The following considerations apply to rungs and cleats:

- The distance between rungs, cleats, and steps shall not exceed 12 inches, shall be uniform throughout the length of the ladder, and shall be free of sharp edges, burrs, or projections which may be a hazard.
- All metal rungs shall have a minimum diameter of 3/4 inch. The minimum clear length of rungs and cleats shall be 16 inches.
- The rungs of an individual rung ladder shall be designed so that the foot cannot slide off the end.
- Rails to top landings shall extend a distance of at least 42 inches above the landing. Rungs above the landing shall be omitted when it is necessary to pass through the rails. Landing platforms shall be provided where a person must step a distance greater than 14 inches from ladder to roof, tank, or so forth.
- Metal cages extending from a point 7 feet above the base to the top shall be provided for all permanently fixed ladders 20 feet or more in height.
- The distance from the centerline of rungs, cleats, or steps to the nearest permanent object in back of the ladder shall be not less than seven inches.
- It shall be required that a clear area be maintained at the base of any fixed ladder which is 18 inches from the centerline of the ladder along the wall and 36 inches from the rungs on the climbing side. This area shall be marked on the floor to assist in keeping the area clear of obstructions.

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6.4 BATTERY PROCESSING

This section establishes the minimum procedural requirements for battery rooms and battery installations to ensure they are in compliance with OSHA 29 CFR 1910.178(g) and NEC Article 480. Each FSH and FC shall be responsible for ensuring that each battery installation is in compliance with these procedural requirements. Additional requirements for electrical personnel are addressed in LPR 1710.6, "Electrical Safety."

6.4.1 Battery Charging

Battery charging installations shall be located in areas designated for that purpose. Special procedural requirements for these areas shall include:

- Facilities to be provided with flushing and neutralizing spilled electrolyte, for fire protection, and for adequate ventilation for dispersal of fumes from gassing batteries.
- When racks are used for support of batteries, they shall be made of or be coated with materials not conducive to spark generation.
- When charging batteries, acid shall be poured into water; never water poured into acid. Additionally, the battery vent caps shall be kept in place to avoid electrolyte spray. Care shall be taken to ensure that vent caps are functioning. The battery (or compartment) cover(s) shall be open to dissipate heat.
- Smoking shall be prohibited in the charging area.
- Precautions shall be taken to prevent open flames, sparks, or electric arcs in battery-charging areas. Further, tools and other metallic objects shall be kept away from the top of uncovered batteries.

  NOTE: Storage batteries (wet type secondary cell) may be either acid or alkali type; both types produce hydrogen during charge or discharge period.

6.4.2 Battery Rooms

In addition to the above procedural requirements, LaRC interprets OSHA requirements as follows:

- Adequate ventilation means not only to remove the corrosive fumes, but also to prevent the buildup of explosive mixtures of hydrogen and oxygen during periods of charging and discharging.
- Smoking and open flames shall be prohibited in battery rooms, battery installation areas, and battery charging areas.

LaRC procedures require that all charging devices or loads be removed from the batteries in a battery room, battery installation, or battery charging area before the batteries are either connected or disconnected.

LaRC procedural requirements for battery room personnel protection are:

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- Battery maintenance shall be restricted to trained personnel.
- Face shield, apron, and gloves shall be the minimum required personnel protection to be worn by battery maintenance personnel. (See LPR 1710.4, "Personnel Protection - Clothing and Equipment.")
- Battery rooms shall also be equipped with appropriate eyewash capability as prescribed in ANSI Z358.1-1990 (the use of eyewash bottles with limited shelf life is prohibited).

6.5 KIRK KEY CONTROL

The following procedural requirements have been established to ensure safe operations where duplicate Kirk keys exist:

- Duplicate keys shall be kept under lock and key and color-coded red for field identification.
- Duplicate keys shall be issued by the responsible FSH, or alternate, or to the FC, or alternate.
- Issuance logs shall be maintained and a FSH approved procedure developed for key usage. An information copy of the procedure and date of key issuance shall be given to the LaRC Safety Manager or his/her designee, Mail Stop 305.
- All duplicate keys shall be logged in before initiation of research operations. If a duplicate key is issued because of a broken primary key, it shall no longer be considered a duplicate key and it shall be included in the log.

6.6 PRESSURIZED LAMPS

Pressurized lamps in use at LaRC include mercury, high-pressure sodium, metal halide, and short arc. To ensure that safe handling and disposal requirements are met, LaRC procedural requirements are outlined below:

- Potential personnel exposure to excessive ultraviolet radiation levels is possible when the lamp's outer globe is broken or punctured and lamp operation is continued.
- Extreme care shall be exercised when handling pressurized lamps, especially short arc types, as the lamps can present an explosion hazard if not handled properly. These short arc type lamps shall not be used extensively at LaRC except in solar simulator applications.
- Special gloves and face shields shall be required for handling pressurized lamps, especially short arc lamps.

Manufacturer's instructions for the handling and use of pressurized lamps shall be strictly adhered to at LaRC. Disposal information concerning pressurized lamps is available from the CA&LB, COD environmental personnel at 864-3500.

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Chapter 7

7. MATERIALS SAFETY

7.1 PYROTECHNICS AND EXPLOSIVES OPERATIONS

This section establishes the minimum procedural requirements for all pyrotechnic and explosive material, including residual quantities, controlled throughout the procurement, storage, and usage stages. Research, design verification testing, and operations involving pyrotechnic devices shall be coordinated with the FSH (see LAPD 1700.2, "Safety Assignments and Responsibilities"; the Pyrotechnic Support Engineer [PSE]; and LAPD 1150.2, “Councils, Boards, Panels, Committees, Teams, and Groups,” The Executive Safety Council).

7.1.1 A Guide and Checklist of the Key Items to be Observed

LPR 1710.7, "Use and Handling of Explosives and Pyrotechnics," and LPR 1710.12, "Potentially Hazardous Materials - Hazardous Communication Standard," contain criteria for day-to-day operations. All design and research operations employing pyrotechnics or quantities of hazardous materials shall require special approval of the PSE and the LaRC Safety Manager or his/her designees.

Only authorized or certified personnel shall ship, receive, withdraw, or otherwise utilize pyrotechnics at LaRC. Acquisition and disposal of pyrotechnics shall be controlled by using the LaRC Safety Permit process and NASA Langley Form 44, "Hazardous Material Procurement, Inventory, and Storage Record."

Off Center shipment of explosives and hazardous materials shall be the responsibility of the LaRC Transportation Officer, LMT, COD. Shipments shall be governed by Department of Transportation (DOT) regulations.

Drivers of vehicles transporting explosive materials shall be required to have a commercial driver's license.

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8. GENERAL SAFETY

8.1 DISABLED PERSONS

This section establishes the minimum procedural requirements to ensure compliance with the Americans with Disabilities Act. These procedural requirements include designs of new facilities and modifications to existing facilities to ensure the appropriate considerations are taken to ensure the safety, accessibility, and convenience of disabled persons.

8.2 SANITATION FACILITIES

LaRC design personnel shall be responsible for reviewing all plumbing installations (including lavatories, showers, fountains, and toilets) for compliance with OSHA 29 CFR 1910.141, ANSI requirements, and local codes.

8.3 OFFICE SAFETY

LaRC office safety is a very important objective, particularly since safety data indicates that a significant number of injuries occur in the office environment. Some of the causes of office injuries, treated in detail in the following paragraphs, are:

- Lack of familiarity with office equipment and procedures.
- Shortcutting established procedures, for example, failing to call for trained and experienced movers to move office furniture or materials.
- Needless hurry which causes falls or slipping on walkway surfaces, stairs, and steps; striking against objects such as doors, desks, file cabinets, open drawers, and other people; and from improper use of chairs to gain elevation for high reaching.
- Improperly installed office furniture, which may fall or overturn and strike a worker.

8.3.1 Requirements for Office Safety

The procedural requirements for office safety include the following:

- Contact the FC to act as the focal point to correct any hazardous conditions found.
- File cabinets and storage cabinets shall be bolted together or fastened to the wall or floor if their loading, location, or style represents a tipping hazard.
- Bookcase units shall not be stacked higher than four units without additional safeguards.
- All new stairways, aisles, and exits shall comply with NFPA Standards 101, Life Safety Code, and OSHA requirements. Existing units shall conform to the intent of these procedural requirements by using operational constraints.
- File drawers shall not open into aisles unless sufficient space for a free and unobstructed aisle way remains with the drawer open.

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- Telephone or electric cords shall not be permitted on the floor in the chair area or in walkways around desks.
- Electrical power strips shall be turned on their sides to avoid electrical shorts due to spills and shall be placed out of walkways.
- Self-adhesive rubber ramps, which serve to cover or permit walking over telephone or electric cords, shall not be permanently used at LaRC in walkways or access paths. When electric or telephone service is needed in the center of an office area, overhead service and power poles from ceiling to floor shall be installed beside the desk or table.

8.3.2 Maintenance of Furniture

Office furniture shall be kept in good condition. Furniture in need of repair shall be removed from service for repair or replacement.

In general, glass tops shall not be used on desks and furniture. Where currently in use, these tops can be retained until deterioration is evident (cracks, burred edges, and so forth), at which point they shall be replaced with an approved surface material.

8.3.3 Safety Practices

The use of thin masonite/plastic sheets under chairs with rollers shall be prohibited due to the curl that may develop at the edges of the sheet, causing a tripping hazard for both the chair and the occupant. Oversize rollers shall be fitted on chairs, which are used on rugs.

At least three feet shall be allowed as chair space between the back of one desk and any obstruction behind the chair.

Flammable or toxic office chemical supplies shall be stored in metal cabinets. Flammable or toxic chemicals, when stored, shall be limited to minimum quantities necessary for the operation conducted in the office, neatly arranged, and properly marked. The amount stored shall be limited to a one-week supply.

Heavy equipment and files shall be placed against walls or columns.

8.3.4 Proper Disposal of Material

Bulk computer/recyclable paper and bulk paper/trash, such as books, loose leaf binders, telephone books, and discarded bond paper thicker than 1/2 inches shall be packed in 18”x12”x12” boxes, FSN 8115-00-179-0579, available from stock.

The Center has a contractor lighting crew to replace bulbs/tubes and this service shall be used. When such items are replaced by NASA personnel, the bulbs/tubes shall be placed in identified special containers and set aside for appropriate pickup. Do not dispose of this glass in regular waste paper receptacles.

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Broken glass, small pieces of metal, razor blades or medical treatment items (insulin needles) shall not be disposed of in regular waste paper receptacles.

To prevent occupational dermatitis, materials remaining after servicing copying machines shall be put into containers. Material spills on carpets or floors shall be immediately be cleaned up by the vendor in order to eliminate slip hazards.

8.4 PERSONNEL CERTIFICATION AND QUALIFICATION REQUIREMENTS

The minimum procedural requirements to certify civil servant and contractor workers performing tasks, which could be potentially hazardous to either the individual or coworkers if applicable safety precautions are not observed. These procedural requirements vary with the type of activity being performed, and are described in LPR 1740.6 “Personnel Safety Certification”.

8.4.1 Certification Requests

It shall be the responsibility of each first line supervisor to initiate the certification process. All certifications shall be requested on NASA Langley Form 66, " Worker Appointment and Certification Form," except for safety operators which shall be requested on NASA Langley Form 451, "Non-personal Service (NPS) Contract Employee Safety Operator Appointment Form" or NASA Langley Form 452, "Civil Service Employee Safety Operator Appointment Form" (see LPR 1710.10, "Safety Clearance Procedures for the Control of Hazardous Energy (Lockout/Tagout)"). If any employee suspects a particular task requires worker certification, the employee shall bring it to the attention of the line supervisor, the LaRC Safety Manager or his/her designee. The contractor shall use “as equal” certification requests.

8.4.2 Qualification Requirements

The requesting initiator shall indicate prior education, training, or experience directly related to the activity involved. This information shall assist the qualifying official to determine the need for new training prior to issuance of the certification. Training requirements and arrangements shall be verified through the LaRC Safety Manager or personnel within the SFAB, SMAO, if not prescribed in the indicated LPR's. The contractor shall use “as equal” qualification requirements.

8.4.3 Record of Certification

Each certified worker shall be issued a certification card which shall be on the person whenever performing the function requiring certification. Special equipment operators shall have their certification typed on their Government vehicle licenses. In all cases, the certifying or authorizing official shall be the LaRC Safety Manager or his/her designee, assisted in this process by designated line managers, qualifying officials, and the SFAB Industrial Hygiene staff, as appropriate. Further, the LaRC Safety Manager shall ensure a listing of certified personnel is maintained and notification of line management of extension or recertification due dates is done. The contractor shall use “as equal” records of certification.

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8.4.4 Certification Requirements

Current work activities requiring certification are listed on the next page. Questions on certification status, or need for other types, shall be addressed to the LaRC Safety Manager or his/her designee or contractor management as applicable.

Table 8.1

Work Activities Requiring Certification

Type Work	Prescribing Document	Request Form
Safety Operator	LPR 1710.10	NASA Langley Forms 451 and 452
Ionizing Radiation	LPR 1710.5	NASA Langley Form 66
Nonionizing Radiation	LPR 1710.8	NASA Langley Form 66
Chemical	LPR 1710.12	NASA Langley Form 66
Pyrotechnic	LPR 1710.7	NASA Langley Form 66
High Worker	LPR 1740.2	NASA Langley Form 66
Hardware Handlers	LPR 1740.6	NASA Langley Form 66
Aerial Man Lift Operator	LPR 1740.6	NASA Langley Form 66
Confined Space Monitor	LPR 1740.2	NASA Langley Form 66
Commercial Driver's License	Virginia State Law	State Permit Required

8.5 EARPHONES, PORTABLE RADIOS, AND TAPE PLAYERS

Radios or players with a single headphone shall be acceptable in office or non-hazardous locations. Use discretion when using dual headphones with player units

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while jogging, operating a vehicle, or in the workplace. One ear shall remain uncovered so that warning noises, conversation, etc., can be received. The single and the dual headphone devices can both be dangerous as the unsecured cords may become entangled in rotating machinery or caught on objects and projections, leading to a mishap and possible injury.

8.6 PORTABLE ELECTRIC HEATERS

Portable electric heaters shall be permitted at LaRC for emergency use during major heating failures, facility rehabilitations, or for health reasons with the written approval of the LaRC Fire Chief. All unapproved portable heaters shall be disposed of appropriately.

8.7 PHYSICAL LIFTING REQUIREMENTS

Back and muscular injuries comprise a major part of the injuries occurring on Center. Reference weights for moderate lifting provided by the Department of Labor and Office of Personnel Management are 20 to 50 lbs. and 15 to 44 lbs., respectively. A normal lifting requirement of 15 to 40 lbs. has been established for LaRC.

Personal physical requirements may lower this requirement as individuals shall never lift more than their own capability. When lifting loads greater than 40 lbs., extreme caution shall be taken. Additional manpower or mechanical advantage shall be used whenever possible.

Safe lifting is another critical element of injury prevention. Awareness material and training is available through SFAB, SMAO.

8.7.1 Lifting

Observe the following safe lifting practices:

- Stand as close as possible to the load.
- Bend at the knees, keeping the back straight.
- Firmly grasp the load.
- Lift with the legs.
- Hold the load as close as possible to the body.

8.7.2 Moving or Carrying

When moving/carrying items:

- Don’t change grips unless the weight is supported.
- Avoid twisting the body.
- Assure clear vision, particularly when ascending or descending stairs.
- Push, don’t pull, loads.
- Shoulder carry bags/sacks, braced by hand.
- Roll barrels when manually moving them.

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8.7.3 Unloading

When unloading items:

- Bend the knees to lower the load.
- Make sure all body parts are clear when lowering a load.
- Lower the load then slide it into tight places.
- Lower the load by resting it on its edge and pushing it forward.
- Make sure the load is secure before leaving it.

8.8 FIRST AID KITS

To ensure that all LaRC and support contractor personnel have access to first aid treatment, the LaRC clinic and medical personnel are available daily from 7:00 a.m. to 3:30 p.m. During the remainder of each workday, advanced-life-support certified paramedics are on duty and available at Facility 1248, the Fire Station.

First aid kits shall not be authorized in LaRC facilities and shall be forwarded to SFAB, SMAO. All personnel requiring first aid treatment shall report to Facility 1149, "First Aid," from 7:00 a.m. to 3:30 p.m. during the day shift and to Facility 1248 at all other times. It is very important that all incidents are reported and treated professionally. Individuals treated by paramedics in Facility 1248 should report to the Medical Center, Facility 1149, at their earliest convenience to assure that medical records are annotated.

8.9 EMERGENCY LIGHT REQUIREMENTS

Emergency lights shall be defined and placed according to the Fire and Life Safety Code. Section 6.3 of LPR 1710.11, “Fire Protection Program,” contains detailed discussion of battery powered emergency lighting.

Installation, removal, or relocation of emergency lights shall be approved by SFAB, SMAO. All FC's shall be aware of the routine preventive maintenance cycle for these critical systems.

8.10 OCCUPANCY PERMITS

Section 6.4 of LPR 1710.11, “Fire Protection Program,” contains detailed discussion of occupancy permits.

8.11 ADMINISTRATIVE LOCKS

Red, yellow, and blue locks are hardware that shall be used as part of LaRC lockout/tagout procedures as identified in LPR 1710.10 "Safety Clearance Procedures for the Control of Hazardous Energy (Lockout/Tagout)". They shall not be used for administrative or operational purposes that do not involve the servicing or maintenance of equipment or systems as indicated in LPR 1710.10. Instead, such equipment shall be locked with something other than a red, yellow, or blue lock and their associated

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identification tags. The designation of other locking and tagging processes is collectively referred to as administrative locking and tagging in lieu of the lockout process described in LPR 1710.10.

Administrative locking and tagging is distinguished from the lockout/tagout process detailed in this LPR 1710.10 in both practice and purpose. An administrative lock may be controlled by a group or organization, rather than an individual, and the locks and identification tags required by LPR 1710.10 shall not be used in administrative locking and tagging.

8.11.1 Administrative Lock Use

Administrative locking and tagging may be performed for various reasons, including equipment security, programmatic purposes or general safety. Administrative examples are:

- A locked fence around high-voltage switching station.
- A lock on an overhead crane disconnect switch.
- A locked door to a laser or chemical laboratory.
- Locked equipment that is out of use for an indefinite period of time.
- A locked facility or a system that is deactivated or moth balled.
- A locked door or gate to roof access.

8.11.2 Administrative Locking Responsibility

Administrative locking is the responsibility of the facility or organization responsible for the equipment/system or area. Best practice dictates that a sign or tag shall communicate the reason for the lock and the person or organization controlling the lock. Examples are:

- Equipment Controlled Area - See (list name and telephone extension) for access.
- System Deactivated - do not remove without concurrence from (list name and telephone extension).
- Use limited to certified operators - See (list name and telephone extension) for additional information

8.11.3 Administrative Locking for General Safety Purposes

Anytime a lock is used for safety purposes an identification tag or sign shall be affixed to communicate a warning, safety concern or hazard, and responsible organization or individual. Examples are:

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- CAUTION- High Voltage Keep Out - Access controlled by (list name and telephone extension).
- WARNING - Fall Hazard - Limited access controlled by (list organization, name, and telephone extension).
- DANGER - Nitrogen Asphyxiation - Limited access controlled by (list organization, name, and telephone extension).

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Chapter 9

9. TRAILER SAFETY PROGRAM

9.1 GENERAL

This Chapter establishes the procedural requirements for the LaRC Trailer Safety Program. All trailers, except office and/or laboratory, shall be under the control of the LaRC Transportation Officer.

The four classifications of trailers included in this program are:

- Compressed Gas (Tube).
- Liquid Storage (Tank).
- Office and/or Laboratory.
- Other (Van Type, Instrument, Cargo Containers, etc.).

Tractors supporting the movement of these trailers shall comply with Virginia State roadworthiness requirements. Notification of planned trailer movement shall be provided to the Transportation Officer and the SFAB, SMAO, 30 days prior to the expected date of trailer movement.

9.2 COMPRESSED GAS TRAILERS

Permanent and mobile compressed gas trailers at LaRC may be used in support of various research activities. Necessary recertification and roadworthiness procedural requirements are defined in this Chapter.

All permanent trailers at LaRC shall be configured in accordance with criteria specified in Appendix C.

9.2.1 Mobile Compressed Gas Trailers

Mobile compressed gas trailers shall be included in the LaRC roadworthiness program, which provides for inspection according to Virginia State requirements. Inspection shall be coordinated by the trailer loanee through the Transportation Officer, 864-3440.

9.2.2 Gaseous Tube Trailers

Gaseous tube trailers shall be fabricated in accordance with the American Society of Mechanical Engineers (ASME) or DOT design criteria. Trailers shall be fabricated in accordance with DOT criteria and shall require recertification every five years. At LaRC, DOT type permanent and mobile nitrogen storage trailers shall also require recertification every five years and no trailer shall be filled with gas if it has exceeded the five year recertification period. Recertification information shall be maintained by SFAB, SMAO, who shall notify the trailer loanee three months prior to required certification. The loanee shall be required to submit a work request via the ROME Integrator for funding for recertification and major roadworthiness repairs. Recertification information and records relating to recertification shall be maintained by

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the COD. Roadworthiness repairs shall be performed by the office of the Transportation Officer.

9.3 LIQUID STORAGE TRAILERS

Permanent and mobile liquid storage trailers used in support of research activities at LaRC shall have the same configuration and roadworthiness requirements as those defined for compressed gas trailers.

The structural integrity of liquid storage trailers for cryogenics shall be provided through inspection as defined in LPR 1710.40, "Langley Research Center Pressure Systems Handbook," Appendix A. These trailers and all other liquid storage trailers shall have the required vessel inspection criteria included in the LaRC computerized maintenance program.

9.4 OFFICE AND/OR LABORATORY TRAILERS

Trailers used for office and/or labs at LaRC shall be controlled by CA&LB, COD as set forth in LAPD 8800.15, "Facilities Utilization Program." The Facility Utilization Manager, CA&LB, COD, shall be responsible for the configuration and movement of these trailers. Each trailer unit shall have a Facility Coordinator designated for normal daily management. These units shall be subject to the annual safety and health audits, fire inspection, and evacuation drills performed by SFAB, SMAO. Office and laboratory trailer installation shall comply with policy presented in Appendix C of this LPR.

A number of trailers have been modified to function as temporary restrooms. These trailers shall be controlled by CA&LB, COD and shall comply with Appendix C requirements.

Section 8.4 of LPR 1710.11, “Fire Protection Program,” contains detailed discussion concerning use of trailers.

9.5 OTHER TRAILERS

Van type, flat bed, instrument, and other trailers, which are mobile shall be included in the LaRC roadworthiness program. Permanent trailers of this type shall require roadworthiness inspection prior to movement. This inspection shall be coordinated with the Transportation Officer, CA&LB, COD.

Cargo trailers and conex containers that have been made immobile by configuration shall require SFAB, SMAO, approval before installation. Present trailer siting requirements shall be used as appropriate. This shall be determined by SFAB, SMAO.

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CHAPTER 10

10. COMPRESSED GASES

10.1 GENERAL

Any material that is under pressure can be dangerous if it is not handled properly. If the material is a compressed-gas it may be flammable, explosive, reactive, toxic or a combination of these characteristics. Because of the hazards associated with compressed gases, it is important to know their hazardous properties and how to safely handle their containers (the gas cylinder).

10.2 IDENTIFICATION

Before handling any compressed-gas cylinder, identify the cylinder by its identification and hazard labels, not its color (different manufacturers use different color codes). Check the label for hazards, and read the Material Safety Data Sheet instructions on handling and protective equipment. Each cylinder shall have a label showing its maximum approved pressure and a current test date. Cylinders missing this information shall not be handled.

10.3 HANDLING CYLINDERS

Only trained persons shall unload cylinders. Before accepting compressed-gas cylinders, inspect them for damage or leaks and continue inspecting them at regular intervals. Move damaged or leaking cylinders to a safe, isolated storage area since a ruptured cylinder can literally become a rocket with the force to blast through a concrete wall. When moving cylinders, use special cylinder hand trucks with the cylinder lashed to the cradle and standing as upright as possible. Avoid dropping, banging or rolling cylinders and keep them away from fire, heat and sparks.

When using cylinders, open the valve slowly with the discharge end of the cylinder pointed away from personnel. Ensure the hoses and connections are clean and are in good condition before the cylinder is used. When cylinders are not in use, screw down the protective metal cap to the last thread. Empty cylinders shall be labeled as such and kept separate from full ones.

10.4 STORAGE

Compressed-gas cylinders shall not be stored in temperatures above 125 °F(51.7 °C), in direct sunlight, or subjected to artificially created low temperatures. Keep cylinders upright, secured with a chain or cable, in a safe, fire-resistant, well-ventilated area, and away from heat sources, combustible materials and electrical wiring.

Group cylinders with others of the same contents, and store empty cylinders separately. Avoid using cylinders in confined spaces. Rotate stock, using older cylinders first.

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10.5 COMPRESSED GASES REQUIRING SPECIAL HANDLING

The following compressed gases procedural requirements are for their special handling:

- Oxygen, while not flammable in itself, increases the tendency of combustible materials to burn or explode. Keep oxygen cylinders away from combustible or flammable materials and fire hazards, including oil or grease on your hands, clothes and work area. Oxygen shall not be used in place of compressed air.
- Chlorine and fluorine are highly corrosive and irritating gases, and will attack many materials. When mixed with acetylene and exposed to light, they may explode. Chlorine will form corrosive hydrochloric acid in water, eating into iron or steel equipment. A gas mask and other protective equipment shall be available for use in case of a leak.
- Ammonia is also highly corrosive. When using it, ensure a gas mask and other protective equipment is readily available.
- Acetylene and hydrogen are both highly explosive gases that shall be handled with extreme caution. Hydrogen escapes easily from threaded fittings that are not completely tight, and such leaks can ignite spontaneously from the friction of the escaping gas. Hydrogen has no odor to warn of a leak. Acetylene bottles shall always remain upright in order to prevent the possibility of gas leakage and/or explosion.

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CHAPTER 11

11. LASERS

Lasers are commonplace today. As with all electronic equipment in use, microchips and other components have made these items much smaller, lighter, and more powerful. In the past, diode lasers were considered relatively safe to the eye due to their low power output. However, these devices are now being manufactured with power outputs that are extremely hazardous to the eye and workers should remain alert to this hazard when using these very small and seemingly harmless laser devices. Eye protection devices specifically designed for protection against radiation from Class 3b and Class 4 laser systems shall be administratively required. Their use shall be enforced when engineering or procedural and administrative controls are inadequate to eliminate potential exposure in excess of the applicable maximum permissible exposure.

Contact the LaRC Radiation Officer at 864-3210 for answers to questions concerning lasers, laser operations, laser safety training, and laser eye protection. More information regarding laser use at LaRC may be found in LPR 1710.8, “Nonionizing Radiation”.

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LPR 1740.2 APPENDICES

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Appendix A

COLOR CODING FOR HAZARD/RISK IDENTIFICATION

SYSTEM	LEGEND	COLOR WARNING	REMARKS
1. ENVIRONMENTAL CONTROL SYSTEMS			
Air Conditioning Ducts			
Supply	A/C SPLY		
Return	A/C RTN		
Fresh Air	FR AIR		
Exhaust	EXH AIR		
Heating Ducts			
Supply	HTG SPLY		
Return	HTG RTN		
Fresh Air	FR AIR		
Exhaust	EXH AIR		
Dual Temperature Ducts			
Supply	DUAL TEMP SPLY		
Return	DUAL TEMP RTN		
Fresh Air	FR AIR		
Mechanical Ventilation			
Supply	MECH VENT SPLY		Color warning shall be applied as applicable.
Exhaust	MECH VENT EXH		Color warning shall be applied as applicable.
Hot Water Heating (Low & Med. Temp.)			
Supply	HTG SPLY_____F		Gray color warning for temperature above 200^0 F.
Return	HTG RTN_____F		Gray color warning for temperature above 200^0 F.

Appendix A

COLOR CODING FOR HAZARD/RISK IDENTIFICATION - Continued

SYSTEM	LEGEND	COLOR WARNING	REMARKS
Chilled Water Cooling			
Supply	CH WTR SPLY_____F		
Return	CH WTR RTN_____F		
Cryogenic Piping			Gray color warning for temperature over 200^0 F and under 0^0 F.
Hot Water Heating (High Temp.)			
Supply	HI TEMP SPLY_____F	Gray	Identify over 200^0 F.
Return	HI TEMP RTN_____F	Gray	
Steam Piping, Heating & Process			
Steam	STEAM_____PSI_____F	Gray	Identify if above 200^0 F.
Condensate	COND RTN	Gray	Identify if above 200^0 F.
Miscellaneous Piping			
Boiler Feed Water	BLR FD WTR_____PSI		Gray color warning for temperature above 200^0 F.
Boiler Make-up Water	BLR MK WTR		
Condenser Water In	COND WTR IN		
Condenser Water Out	COND WTR OUT		
2. Plumbing Systems			Drainage, Waste, and vent piping are used as defined in the National Planning Code.
Acid Line	ACID_____%	Blue	Insert chemical formula and concentration in percent.
Acid Waste	ACID WST		
Drinking Water, Chilled	CH DKG WTR		
Domestic Hot Water	DOM HT WTR		
Non-Potable Water	NON-POT WTR	Brown	
Sanitary Drain	SANI DRN	Brown	

Appendix A

COLOR CODING FOR HAZARD/RISK IDENTIFICATION - Continued

SYSTEM	LEGEND	COLOR WARNING	REMARKS
Stack Vent	STK VNT		
Industrial Waste	IND WSTE		Color warning shall be applied as applicable.
Water Main	WTR MAIN_____PSI		
3. Drainage Systems			
Sanitary Sewer	SANI SWR	Brown	
Storm Sewer	STRM SWR		
Combined Sewer	COMB SWR	Brown	
4. Fire Protection System			
Fire Main	FIRE MAIN_____PSI	Red	Color warning and legend not applicable to fire hydrants.
Sprinkler Piping	SPKLR SYST	Red	
Carbon Dioxide	CO_2 FIRE PROT	Red	
Alternative Gas Agents	FM 200/Inergen	Red	
5. Electrical Systems			
Lighting	ELECT LTG_____V		Indication of voltage and blue color warning for voltages 600V and above.
Power	ELEC PWR_____V		Indication of voltage and blue color warning for voltages 600V and above. All 220V and above panels shall be identified as such.

Appendix A

COLOR CODING FOR HAZARD/RISK IDENTIFICATION - Continued

SYSTEM	LEGEND	COLOR WARNING	REMARKS
6. Compressed Gas Systems			Gray color warning for line pressures of 150 PSI and above.
Compressed Air			
Shop	AIR SHOP_____PSI		
Breathing	AIR BRTHG_____PSI		
Instrument	AIR INSTR_____PSI		
Diesel Starting	AIR DSL STG_____PSI		
Oxygen	COMP GAS O_2_____PSI	Green	
Liquid Oxygen	LOX_____F_____PSI	Green	
Carbon Dioxide	COMP GAS CO_2	Gray	
Nitrogen Gas	COMP GAS N_2_____PSI	Gray	
7. REFRIGERANT SYSTEMS			
Ammonia	REFRG NH_3 No. 17	Brown	
Carbon Dioxide	REFRG CO_2 No. 744	Gray	
Methyl Chloride	REFRG CH_3Cl No. 40	Yellow	
Halocarbons	REFRG No.____	Gray	Insert refrigerant number.
Sulfur Dioxide	REFRG SO_2 No. 764	Gray	
8. SECONDARY COOLANTS			
Brines			
Sodium Chloride	BRINE NaCl___%		Insert concentration in percent.
Calcium Chloride	BRINE CaCl___%		Insert concentration in percent.
Inhibited Glycols			
Ethylene	INH ETHY GLY	Yellow	
Propylene	INH PROPY GLY	Yellow	

Appendix A

COLOR CODING FOR HAZARD/RISK IDENTIFICATION - Concluded

SYSTEM	LEGEND	COLOR WARNING	REMARKS
Halocarbons			
Refrigerant No. 11	BRINE R-11	Gray	
Refrigerant No. 12	BRINE R-12	Gray	
Refrigerant No. 30	BRINE R-30	Gray	
Refrigerant No. 1120	BRINE R-1120	Gray	
9. FUEL SYSTEMS			
Aviation Gasoline	AV GAS___OCT	Yellow	Insert API Octane No.
Diesel Fuel	DIESEL FUEL	Yellow	
Jet Fuel	JET FUEL JP___	Yellow	Insert API Identification No.
Heating Fuel	FUEL OIL NO___	Yellow	Insert API Identification No.
Navy Special Oil	NAV SPCL FUEL	Yellow	
Natural Gas	NAT GAS___PSI	Yellow	
Motor Gasoline	MO GAS___OCT	Yellow	Insert API Octane No.
10. MISCELLANEOUS SYSTEMS			
Dust Collection	DUST COLL		
Laboratory Gas	LAB GAS___PSI		
Snow Melting	SNO MLTG		
Vacuum	VAC	Gray	
Lab Exhaust Systems	LAB EXH SYST		Color warning shall be applied as applicable

Appendix B

CRITERIA FOR SECURING PERMANENT STORAGE TRAILERS (GASEOUS AND LIQUID)

1. Support piers should be eight-inch by 16-inch masonry blocks, resting on a 16-inch by 16-inch concrete slab that is at least four inches thick. Pier spacing will be at four locations (two front and two back).

2. *Provide at least six 1/2-inch diameter sod-screws in soil anchor tie downs with four near the corners and augured at least three feet in the ground. In locations where concrete exists, 3/4-inch concrete anchor bolts will be used. (Contact the COD for details.) Turnbuckles will be used at each hold down location. In locations where asphalt exists, the material will be removed to earth level and sod-screws installed as described above.

3. A minimum spacing of at least six feet should be maintained between adjacent structures.

* This requirement is applied where the trailer size and configuration provides an unacceptable risk. This risk assessment is provided by the SFAB, SMAO.

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Appendix C

OFFICE AND/OR LABORATORY TRAILER INSTALLATION GUIDELINES

SITING REQUIREMENTS

1. Footings and piers will be installed on solid ground. This may require removal of topsoil to provide a firm and level surface.

2. Support piers will be eight-inch by 16-inch masonry blocks, doublewide. Pier spacing will be 10 feet or less, center to center. Blocks will be placed on 16-inch by 16-inch by four-inch concrete slabs. Slabs are not required on asphalt or concrete surfaces four inches or greater in thickness.

3. Place trailer on piers and shim so floor is level. Shims will be wood or metal with care being taken so as not to damage masonry blocks.

4. Skirt enclosure will be provided on all trailers with exposed plumbing. Skirts on all other units are desirable but optional.

5. Provide three-foot wide landing equipped with stairs and handrails at exits. Appropriate sidewalks will be installed to provide safe walkways.

6. A minimum spacing of 25 feet will be maintained between adjacent trailer units or complexes. (A trailer unit is defined as a single trailer. A trailer complex is defined as two or more units that are designed to be tied together.) A minimum spacing of 25 feet is required between a trailer unit/complex and permanent facilities.

7. Trailer tongues will be removed or adequately covered to protect employees from walking or tripping hazards.

8. Digging Permits:

   Digging permits are required for all digging to include:

   - All tie-down penetrations.
   - All underground utility installations.
   - Topsoil removal.

   Digging permits are obtained by calling the Underground Utilities Coordinator.

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OFFICE AND/OR LABORATORY TRAILER INSTALLATION GUIDELINES- Continued

9. Tie-downs:

   - Soil anchor tie-downs will be provided on all single trailer units. Tie-downs will be located at each corner and at the midpoint of the sides.
   - Soil anchor tie-downs will be used on complexes (two or more units) in a manner to protect the units from high winds. Tie-downs will be provided at each corner of the unit and on the sides at midpoints. Tie-downs should not exceed 20 feet between anchor points.
   - All penetrations for tie-downs require a LaRC "Digging Permit." (See Chapter 2, Figure 2-2.)

INTERIOR MODIFICATION

1. Walls, ceilings, and new partitions will be of noncombustible construction, that is, steel studs and sheetrock.

2. Exterior door locks will be modified to be compatible with the LaRC key system.

3. Double exits with clear access routes will be provided for each trailer unit.

4. Fire extinguisher(s) will be installed in accordance with appropriate National Fire Protection Association (NFPA) Standards.

5. Laboratory trailers shall have smoke detectors.

HEATING SYSTEMS

No trailer unit or complex will be installed with gas or fuel oil heating systems. Only electrical resistant or compressor-type heat will be used.

WATER AND SANITARY CONNECTIONS

Water and sanitary connections for LaRC trailers will be installed in accordance with the Building Officials Code of America (BOCA) Basic Plumbing Code, most recent edition.

FRESH AIR REQUIREMENTS

Fresh air requirements shall comply with the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Standard for Ventilation for Acceptable Indoor Air Quality, most recent edition.

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OFFICE AND/OR LABORATORY TRAILER INSTALLATION GUIDELINES-Concluded

RESTROOMS

1. Restrooms will be provided with not less than a 60 cfm exhaust fan.

2. Water heaters will be equipped with thermal and pressure relief devices.

ELECTRICAL INSTALLATION

The electrical utilities and the telephone service for all trailer installations will be installed in accordance with the National Electric Code (NEC), most recent edition.

Specific Requirements

1. All exposed wiring will be installed in conduit.

2. All wire will be 12-gage copper or larger.

3. All electrical fixtures and equipment will be grounded.

4. The metal shell and frame of all trailers will be bonded to a common ground.

5. Direct burial cable will not be installed above ground.

6. A fused disconnect or circuit breaker located outside the trailer will be used as a main disconnect for each trailer.

7. A local protective signaling system will be installed in all office/laboratory trailers in accordance with NFPA. The signaling system will be connected directly to the Central Fire Alarm Panel in Facility 1248. This system will be operational before the trailers are occupied.

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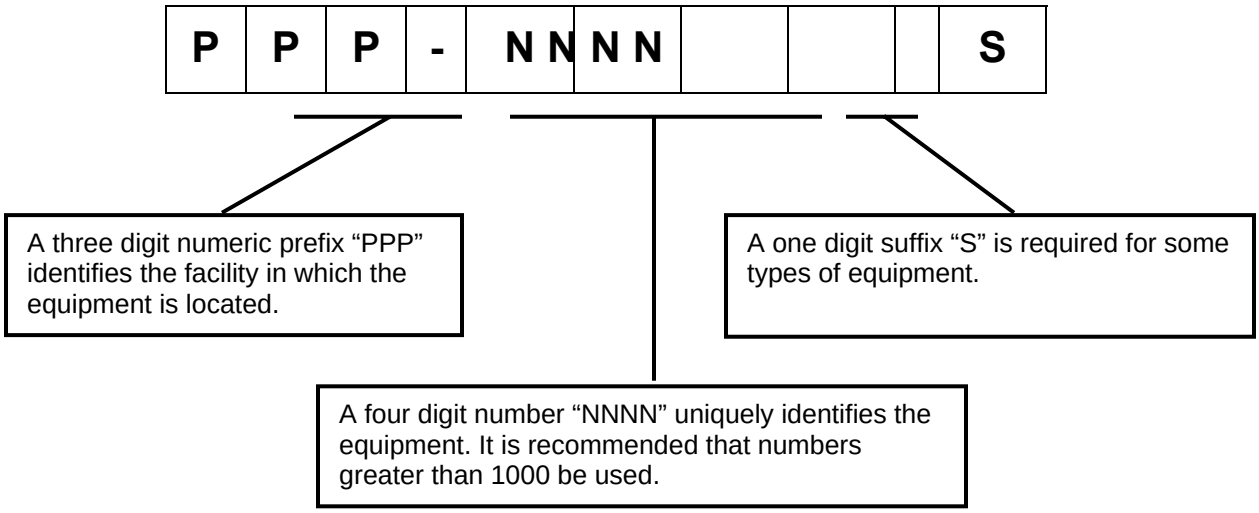
Appendix D

EQUIPMENT NUMBERING SYSTEM

1. General

This Appendix describes a numbering system for equipment in LaRC facilities. The purpose of this numbering system is to provide an identification number for each piece of equipment such that it can be uniquely identified in facility configuration controlled documents, e.g., Drawings, Standard Operating Procedures (SOP), and Safety Analysis Reports (SAR's). This number is also utilized in the Computerized Maintenance Management System (CMMS) database as a secondary identification number, where it is known as the “LaRC Location ID” number.

The equipment numbering system uses at most eight (8) digits. A typical equipment number is in the format:



- The three-digit prefixes (PPP) identifying LaRC buildings are shown in Table 1.
- The unique four-digit number (NNNN) is assigned by the equipment owner or his/her designated representative.
- The requirement for use of a suffix (S) in an equipment’s number is generally found in other prescribing Langley Management System (LMS) documents. For example, in the case of pressure system components, such as valves, filters, heaters, steam traps, etc., the prescribing document is LPR 1710.40, “Pressure Systems Handbook.”

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Thus, typical equipment numbers would be:

- 067-0155 for an electrical breaker located in Building 1247E, or
- 040-3025N for a nitrogen system valve in Building 1221, or
- 144-25101 for a parking lot light

2. Implementing the Equipment Numbering System

It shall be the responsibility of the system's owner to maintain a master equipment list to prevent the issuance of duplicate equipment numbers. For new facilities, or the addition or modification to existing facilities, engineering design personnel shall estimate the total equipment numbers required, and request a block of numbers from the owner or his/her designated representative to assign to the new equipment being installed.

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Table 1. Equipment Numbering Prefixes

Building No. or Infrastructure Item	Prefix
581	001
582	002
582A	003
641	010
642	021
644	015
645 & 645A	014
647	012
648, 648A & 648B	019
650	020
1000	300
1101	301
1122	179
1130T	107
1133B & 1133D	156
1145	167
1146 & 1146 A,B,D,E,F,H,I &K	022
1147	082
1148	023
1149	024
1151	035
1152	026
1153	079
1154 & 1154A	083
1156	112
1157	113
1158 & 1158A	114
1159	115
1166	162
1167	163
1169	132
1170	133
1171	134
1172	135
1173	136
1174	182
1175	166
1176	177
1177	178

Building No. or Infrastructure Item	Prefix
1181	180
1186	176
1187	181
1188	173
1189	174
1190	170
1191	172
1194/1194A	030
1195A, 1195B & 1195C	033
1196	185
1197	168
1198	160
1199	085
1200 & 1200A	074
1201	039
1202 & 1202A	075
1203	120
1205	076
1206	081
1208 & 1028A	097
1209	125
1211	155
1212, 1212B & 1212C	043
1213	042
1214	165
1215	041
1216	169
1218 & 1218A	036
1219	037
1220	049
1221, 1221A,B,C,D&E	040
1222 & 1222B	054
1223	029
1223A	123
1224T	171
1225	044
1227	086
1228	056
1229, 1229A & 1229B	045
1230, 1230A & 1230B	047

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Building No. or Infrastructure Item	Prefix
1231, 1231A & 1231B	046
1232	055
1232A	053
1233	034
1234	022
1235	058
1236, 1236A, B, C, & D	059
1237A, 1237B & 1237C	093
1238, 1238A & 1238B	027
1239	087
1240	081
1241	061
1242, 1242A & 1242B	122
1243	088
1244	060
1244A, B, C & D	060
1245	081
1246	081
1247B & 1247H	064
1247A,1247C & 1247F	065
1247D & 1247G	066
1247E	067
1248	080
1250 & 1250A	077
1251	050
1251A, B, C, D, & E	150
1253 & 1253A	089
1254	158
1255	137
1256 & 1256A, & 1256B	063
1257 & 1257N & S	051
1258	051
1260	051
1261, 1261A & B	124
1262	068
1264	151
1265A-E	028
1266	090
1267	031
1267A & 1267B	031
1268A & 1268B	070
1265A-E	028

Building No. or Infrastructure Item	Prefix
1265A-H	028
1266	090
1267	031
1267A & 1267B	031
1268, 1268A, B, C, & D	070
1273 & 1273A	106
1274B	069
1275	069
1277	145
1285	139
1286	110
1287	126
1289	096
1290	084
1292, 1292A & B	038
1293A, B, C, D	062
1294	111
1295, 1295 A-E	250
1296	031
1297, 1297A-G	071
1298	072
1299	073
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Langley Research Center

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FACILITY SAFETY HEAD AND FACILITY COORDINATOR GUIDE

National Aeronautics and Space Administration

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Responsible Office: Safety and Mission Assurance Office

PREFACE

Langley Policy Directive (LAPD) 1700.1, "Safety Program," provides the guidance and foundation for the LaRC Safety Program and the Facility Safety Head and Facility Coordinator Program. A staff of full-time safety professionals assigned to the Safety and Facility Assurance Branch (SFAB), Safety and Mission Assurance Office (SMAO), is available to assist Principal Facility Safety Heads (FSH), Organizational Facility Safety Heads (OFSH) and Facility Coordinators (FC) in carrying out their responsibilities. This Langley Procedural Requirements (LPR) provides information to FSH's and FC's relative to the LaRC Safety Program.

CID 1740.3, dated September 25, 2007, is rescinded and should be destroyed.

Original signed on file

Lesa B. Roe
Center Director

DISTRIBUTION:
SDL 040, SDL 043, SDL 410, SDL 411, and SDL 412 (LaRC Safety Manual Holders)
429/SFAB, SMAO (200 copies)

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REFERENCES

Office of Safety and Health Administration (OSHA), Part 1910.178G

National Electrical Code Article 480

GSA Federal Standard 313A, Materials Safety Data Sheets

National Fire Prevention Association Standards 101, Life Safety Code

CID 1150.2, “Boards, Panels, Committees, Councils, and Teams.”

LAPD 1700.1, “Safety Program.”

LAPD 1700.2, “Safety Assignments.”

LPR 1710.5, “Ionizing Radiation.”

LPR 1710.7, “Use and Handling of Explosives and Pyrotechnics.”

LPR 1710.8, “Nonionizing Radiation.”

LPR 1710.12, “Potentially Hazardous Materials.”

LPR 1740.4, “Facility Systems Safety and Configuration Management.”

LPR 1740.6, “Personnel Safety Certification.”

LMS-CP-4760, “Reporting Injuries, Illnesses, Compensation Claims, and Unsafe Working Conditions.”

Langley Form 44, “Hazardous Materials.”

Langley Form 44B, “Hazardous Material Reissue Card.”

Langley Form 69, “Work Request.”

Langley Form 95, “Supervisor’s Report of Accident.”

Langley Form 495, “Safety Operators Clearance Procedures.”

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Chapter 1

1. GENERAL

1.1 SAFETY RESPONSIBILITY AND AUTHORITY

Safety responsibilities cannot be separated from the other management and operational activities which continually occur in Center facilities and research apparatus. This inseparability demands that safety management become an integral part of facility and research management. Understanding this premise, Langley Research Center (LaRC) has established a safety process, which establishes responsibility and authority for safety at the line level of management. This is accomplished through a system that designates key personnel as Principal Facility Safety Heads (FSH's), Organizational Facility Safety Heads (OFSH's), and Facility Coordinators (FC's) at all facilities and research apparatus located on the Center. The primary responsibility of the FSH is the safe operation of the research apparatus assigned to them and/or for the maintenance of a safe working environment for their staff. The scope of this responsibility encompasses such elements as the establishment and use of normal and emergency operating procedures, configuration control, safety training and coordination, preventative maintenance, and the traditional institutional safety considerations such as fire prevention, hazard identification and removal, machine guarding, and the resolution of other workplace hazards.

In this regard, designated FSH's are responsible to ensure that operations within their facilities, or changes initiated to their facility and/or to their research equipment, are properly reviewed. Reviews ensure that safety considerations and requirements have been incorporated into requested and approved changes to the resources under their control.

1.2 LANGLEY RESEARCH CENTER SAFETY PHILOSOPHY

LaRC safety philosophy centers around five key elements, which provide guidance to OFSH when establishing and maintaining a safe work environment. The five elements of the LaRC Safety Philosophy are:

- Safety is a process which is designed and planned into all facilities and research apparatus,
- Safety design reviews and facility pre-operational reviews are essential elements in safety planning,
- Successful safety practices require that research operations be managed by standard operating procedures and configuration management processes,
- The use of trained safety operators is essential to facility safety, and

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- The use of a comprehensive audits and surveys system must include the following:

  - Annual Facility Safety and Health Audits, and
  - Regular surveys of operations which ensure compliance and facility self-discipline, accomplished accurately and on schedule.

Safety is a comprehensive process which, to be successful, requires the active support of all Center managers and employees. The OFSH's and FC's have a wide range of duties that require this level of support. Leadership is a key requirement for the individuals who serve as safety officials, since not all organizational elements that they must evaluate are in their chain of command or span of control. Accordingly, the Center has established, either by policy directive or LaRC Safety Manual procedures, the mechanisms discussed in the following paragraphs to assist each OFSH and FC in meeting their responsibilities.

1.2.1 Safety Design/Design Review and Pre-Operational Reviews of Facilities and Research Apparatus

The design of safety into a facility or research apparatus is essential to the long-term operational safety of any Center project. The design process is usually accomplished by line engineering organizations who have direct responsibility for the particular project.

Center policy directives specifically stipulate that a design review system will be incorporated into major efforts conducted on LaRC. One additional responsibility of the FSH is to ensure that mandated safety and health audits are accomplished on schedule and in accordance with policy directives.

Minor modifications to facilities and apparatus are often initiated during ongoing research efforts, but these changes are still subject to review and require proper evaluation. Since these modifications usually go unaddressed by the formal design review system, they must be reviewed under a separate assurance process, i.e., by either being presented to the Standard Practice Engineers or the Systems Operations Committee for concurrence (See CID 1150.2 - Boards, Panels, Committees, Councils, and Teams.")

1.2.2 Control by Procedures and Configuration Management

LaRC has issued comprehensive, written policy directives, guidelines, and procedures to manage and control the operations on the Center in a safe and healthful manner. LaRC's written procedures specify methods and requirements for the safe operations of Center facilities and research activities. These procedures (designed as a risk management technique to improve operational safety) are one of several safety initiatives promulgated by Center Management.

Additionally, LaRC high-risk facilities are included in a Configuration Management (CM) Program managed by SFAB. Each high-risk facility has a managed procedure for

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maintaining specified documentation associated with its operation. The CM process documents the pedigree, standard operating procedures, and checklists of Center research facilities and apparatus. To support the CM process, the OFSH must accomplish the following:

- Ensure that documents are maintained and implemented,
- Ensure that controlled documents are current, and
- Request necessary assistance from SFAB and SMAO.

1.2.3 The Use of Trained Safety Operators

The use of certified Safety Operators is a component of the LaRC Safety Program. Each facility that requires equipment/devices to be maintained in a certain configuration for the protection of personnel or equipment shall assign a certified Safety Operator and use the NASA Lockout/Tagout system. Each Safety Operator is required to be safety certified and to maintain a current Safety Operator's Permit. More specifically, the Safety Operator's Permit will indicate the exact equipment/system upon which the Safety Operator is currently certified. The responsibility for training and certification of facility Safety Operators rests with the Center Operations Directorate (COD) and SMAO.

It is the responsibility of the OFSH to ensure that the facility Safety Operators are cognizant of their duties and responsibilities. If the OFSH has any reservations about the certification or training of a Safety Operator, these concerns are to be immediately brought to the attention of the COD and/or SMAO. For more information on this process, see LPR 1740.6, "Personnel Safety Certification."

1.2.4 Regular Audit and Survey of Operations

At a minimum, all LaRC facilities and research apparatus will receive an annual safety survey/audit. However, LaRC operations that require a review by the industrial hygienists or health physicists may be audited more frequently. Regardless of frequency, the results of all audits and surveys will be reported to the cognizant OFSH. When deficiencies are cited in the audits, the OFSH shall initiate corrective action. These actions will address all noted deficiencies, ensuring the required changes are implemented.

1.3 ACCESS TO BUILDINGS AND RESEARCH APPARATUS

One method of maintaining safety and security in the workplace is by implementing comprehensive security strategies. Proven strategies that improve security and safety include controlling and restricting access. In support of strict security standards, access to the Center, Center buildings, and research apparatus should be strictly controlled. In support of security standards, the OFSH and the FC play a key role in ensuring that authorized access controls to their resources are properly established and maintained.

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1.3.1 After-Hours

After-hours access to buildings and facilities is strictly controlled by security procedures promulgated by the Security & Program Protection Services (SPPS) Individuals accessing buildings after normal duty hours are required to possess the proper security badge and have the need for access. If security areas exist within the facility or research apparatus, access and notification requirements shall be governed by secure area access procedures.

Occasionally, a situation will arise where a facility representative will need to be contacted after-hours. To facilitate the after-hours emergency contact process, the OFSH will post the names of two or more individuals at the main entrance door(s) of the building or facility. These individuals will respond to on-call emergencies and other after-hours facility requirements.

1.3.2 Kirk Key Controls

The Kirk Key control system requires that a succession of actions be initiated in sequential order to ensure the safe operation of critical systems on LaRC. The following Kirk Key System controls and procedures have been established to assure the safe operation of Center resources:

- Duplicate keys are properly secured until they are required to be issued.
- Duplicate keys are color-coded “red” for the purpose of identifying them as duplicates when they are issued for field use.
- Duplicate keys will be issued to the FC, or alternate FC, by the responsible OFSH or alternate.
- Each FSH shall develop and approve a procedure governing the issuance and usage of Kirk Keys in their facility.
- A Kirk Key Issuance Log, which has been approved by the OFSH, will be maintained for each facility.
- An information copy of the facility Kirk Key procedure and date of key issuance log will be forwarded the LaRC Safety Manager.

1.3.3 Access to Roof Areas

It is the responsibility of the FC to control access to potentially hazardous roof areas. To support the FC in this function, the following access procedures are established:

- All access to hazardous roof areas will be identified by appropriate warning signs.
- All personal requiring access to roof areas will notify the FC and obtain approval prior to performing any roof activity.
- When structural integrity or permanent safety devices do not provide sufficient protection to confine the risk to the simple “high work” category, special security, safety equipment/procedures, and temporary structural requirements will be specified and conspicuously documented by the Facility.

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- All Center personnel will assist the FC in identifying unauthorized interior and exterior roof access locations, which would allow unauthorized access to roof areas.
- Internal access to roofs will be secured by locks and keys, which will be controlled by the FC or alternate FC.

1.3.4 Posting of Facility Safety Personnel

Each Center facility shall have the name of the Facility Safety Head and Facility Coordinator posted at all entrances to the facility to include the individuals name, telephone number, facility number (if not located in the facility), and room number. If so designated, the names of all Alternate Facility Safety Heads, Alternate Facility Coordinators, Organizational Facility Safety Heads, Organizational Facility Coordinators, Alternate Organizational Facility Safety Heads, and Organizational Facility Coordinators shall be included on the posted list.

1.4 SAFETY MEETINGS

The LaRC Safety Program is supported by a comprehensive system of safety meetings, which are conducted at all organizational levels. Safety meetings establish two-way communication between line and staff personnel on critical safety issues, ensuring the LaRC Safety Program functions properly. The following paragraphs summarize the safety meetings required to be coordinated by the OFSH.

1.4.1 Employee Safety Meetings

The objective of employee safety meetings is to maintain a high level of safety consciousness among the employees. These meetings shall be held annually for employees working in administrative facilities and monthly for those employees working in laboratory, tunnel or other high-exposure research facilities. Since the evaluation of employee attitudes cannot be made wholly on the basis of accident and injury records, the FSH's and FC's should observe the performances of individuals and groups in work areas. These observations provide indications of the general attitudes of the employees toward safety and also provide a basis for establishing safety discussions in employee safety meetings.

The content, format, and frequency of employee safety meetings depends upon the following workplace variables:

- The size of the work force,
- The categories of work performed by the work force,
- The environmental conditions present in the workplace, and
- The current safety record of the facility.

However, as a minimum, topics to be covered shall include a review of all mishap and close-calls occurring within the facility since the last safety meeting, and relevant

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prevention techniques. Minutes of the safety meetings shall be kept and are subject to audit review.

SFAB maintains an extensive inventory of safety awareness material and training aids, which are available for employee safety meetings. Also, safety personnel from SFAB are available to conduct Safety Programs requiring specific areas of expertise.

1.4.2 Facility Safety Head and Facility Coordinator Meetings

The Safety Manager encourages meetings between the FSH's and FC's to discuss safety problems encountered in their facility. These meetings should be scheduled between them to discuss and review appropriate safety topics affecting their operation.

1.5 SPECIFIC SAFETY TRAINING SESSIONS

There are specified work areas where mechanical devices or special environmental conditions require workers to perform tasks in the presence of hazards. The Safety Manager will assist each FSH in providing training, which will address the specific work operations that are conducted in these areas. The objective of this training is to provide the employees with safe procedures.

1.6 ENFORCEMENT OF SAFETY REGULATIONS

The FSH and FC are required to be familiar with all pertinent safety regulations and remain alert for safety violations or the careless operation of equipment in their areas of responsibility. The LaRC Safety Manual contains the information necessary to perform these responsibilities. FSH's and FC should review the LaRC Safety Manual and become familiar with the Center safety regulations applicable to their positions.

1.7 HUMAN FACTORS

FSHs and FCs are required to be continually cognizant of worker's attitudes toward safety issues. In evaluating these attitudes, safety officials must appraise a variety of work actions taken by employees who function in various positions along the entire spectrum of the work force. In supporting the Center's mission, LaRC workers perform a variety of work tasks that range from simple to complex. For this reason, safety officials must be vigilant in the research environment, recognize this phenomenon, and proactively initiate safety measures to prevent research mishaps.

1.7.1 Horseplay

The term horseplay covers a complete spectrum of ill-advised physical misbehavior, which is banned in the workplace. Employees are prohibited from engaging in any unruly behavior such as rough-housing, scuffling, or practical jokes. Common sense dictates that these actions disrupt any work environment and are especially disruptive in the LaRC high-risk research environment. OFSH's will be alert to stop any such behavior in all facilities or research apparatus that function under their safety requirements.

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1.7.2 Carelessness and Preoccupation

The OFSH ensures that all newly assigned employees are given a safety awareness briefing and cautioned concerning all known hazards in their work areas. FSHs should remain alert for the emergence of new hazards that could present a danger to careless or preoccupied employees. Also, safety officials shall observe employees for continued patterns of careless behavior that can be isolated, identified, and remedied. Once unsafe behavior is identified, the first step in improving safety is to make the employee(s) aware of their behavior. If undesirable behavior has been identified, the OFSH is authorized to use corrective measures or authorized sanctions.

Preoccupied employees in a research environment are dangerous and unpredictable. Their inattentiveness can lead directly to accidents or injury. Compounding this safety issue is the fact that accidents caused by preoccupation are difficult to predict and prevent. The best policy to prevent accidents due to preoccupation is to continually remind personnel to watch out for the well-being of their fellow workers by being constantly vigilant for obvious hazards. For example, hazards such as slippery walkways and trip hazards should be posted with warning signs and observed hazards should be reported and corrected as quickly as possible.

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Chapter 2

2. IDENTIFICATION OF TYPICAL SAFETY HAZARDS

2.1 SLIP, TRIP, AND FALL HAZARDS

The loss of productive work time is frequently the result of employees suffering an injury from some type of fall. A major cause of employee falls is unsafe or hazardous surfaces. For this reason, all underfoot surfaces such as floors, ramps, stairways, ladders, and vehicle beds should be constantly monitored for the presence of hazards. Once unsafe floor conditions are discovered, they shall be immediately rectified. Additionally, the proactive strategy of issuing periodic reminders and cautions to employees during wet weather is always recommended. These reminders should outline the dangers of wet footwear and wet walking surfaces. As an added precaution, "WET FLOOR" signs should be displayed whenever conditions warrant.

The elimination of trip hazards is a primary responsibility of facility safety officials. Facilities must be continually monitored to identify and eliminate the following trip hazards:

- Electrical extension cords on the floor,
- Floor duct covers that are loose or improperly fitted,
- Floor electrical and telephone outlets in walkways or aisles, and
- Materials, cartons, and equipment left in hallways.

2.2 OTHER FALL HAZARDS

Safety officials will be alert for all fall hazards that exist in their facility and ensure that the following types of fall hazards are addressed:

- Unguarded openings in flooring,
- Stairs that lack handrails,
- Faulty ladders,
- Missing or inadequate guardrails in lofts, towers, and balconies, and
- Using chairs, boxes, or other improper makeshift means for reaching high shelves and fixtures.

2.3 LIFTING HAZARDS

FSH’s and FC shall provide guidance to workers on procedures to reduce injuries due to lifting hazards. The following two paragraphs summarize the methods available to safety officials to accomplish the objective of reducing lifting hazards.

2.3.1 Incorrect Methods and Habits

Safety officials shall provide guidance on techniques that will reduce the probability of workers suffering back injuries due to improper lifting. This guidance is important since

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back injury and pain in the lumbar region is one of the more frequent causes of workers losing time from their jobs. With very few exceptions, back trauma is the result of behavioral errors on the part of the injured person rather than the result of hazardous working conditions. For this reason, personnel should be frequently cautioned to follow safe lifting procedures.

Trauma to the back of an employee is generally caused by improperly lifting an object or by attempting to lift a load that is too heavy or awkward. SFAB can provide a number of awareness programs addressing these issues by providing instruction on proper lifting methods and other techniques to avoid back injury.

2.3.2 Planning Ahead to Avoid Twists and Jerks

FSH's and FC should frequently remind personnel of the dangers of bending and twisting their backs. Back injuries do not always occur as a result of lifting heavy loads. They often result from relatively minor back stress, which might occur while stooping to pick up small items. Twisting the body while stooping or straightening can likely cause an injury, if the movement is too sudden or too strenuous. It is important for workers to understand that most back injuries can be avoided if they remember to bend their knees rather than their back, and to be careful when twisting.

2.4 PERSONAL SAFETY HAZARDS

FSH's and FC's shall be alert to observe employee's personal items, such as clothing, footwear, and the grooming of hair, as safety concerns requiring safety management. When these personal items present a safety concern, the appropriate corrective action will be initiated by safety officials to alleviate unnecessary risks.

2.4.1 Clothing

The FSH shall implement standards that restrict certain employees from wearing loosely fitting clothing. Employees who operate or are exposed to fixed machine tools, hand tools, or rotating/reciprocating machinery shall be monitored for loosely fitting clothing. Closely fitted clothing should always be worn to optimize the safety of workers who operate machinery. Also, specific restrictions apply to wearing neckties, loose shirt sleeves, or other clothing susceptible to being caught in a belt, pulley, between gears, in a revolving shaft, or in a revolving chuck. Likewise, jewelry such as wristwatches, bracelets, necklaces, and rings will not be worn while operating this type of equipment or while working in proximity to energized electrical circuits. This policy is imperative, since many serious injuries and/or fatalities have resulted in workplaces when these procedures were not subscribed to by management or complied with by workers.

2.4.2 Footwear

Safety officials will ensure that employees wear approved footwear that is appropriate for the type of work being performed and the work environment of the employee. For example, open-toe or high-heel shoes, sandals, or thongs are not suitable for machine and repair shops, fabrication areas, laboratories, construction sites, or any work area in which supplies or equipment are handled or stored.

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2.4.3 Hair

Safety officials will ensure that the following safeguards are in place regarding the manner in which employees maintain their hair. Employees who operate machining tools or other equipment, and who wear their hair long enough to become entangled in the equipment, are required to wear a safety cap completely covering their hair. This policy is intended to prevent situations where workers become partially or entirely scalped when their hair becomes entangled in machinery.

Male employees who work in areas where they may be required or expected to use respiratory protection will be expected to trim their facial hair. Facial hair should be trimmed to ensure that the face mask will fit properly with a tight seal.

2.5 PERSONAL PROTECTIVE EQUIPMENT

LaRC safety policy requires that specified workers wear personal protective equipment while performing specific functions in the workplace. The following paragraphs (2.5.1 through 2.5.6) include a summary of these requirements.

2.5.1 Hard Hats

Protective headgear shall be worn in any environment where there is a reasonable possibility of people receiving head injuries as a result of falling objects, laterally moving materials and equipment, or personnel striking their heads against protrusions.

2.5.2 Goggles, Safety Glasses, and Face Shields

The appropriate protection shall be worn wherever eye or face hazards exist in the work environment. Examples of these hazards are:

- Flash or glare hazards that exist in the vicinity of welding and cutting operations, arc lights, or other light sources,
- When working with or near tools and operations (i.e., grinding wheels, hammers, drills, and sandblasting tools) that have the potential to propel particles,
- When working in an open-air environment where wind or moving air may cause dust or other foreign matter to become a hazard,
- When working with high-pressure fluid (gas or liquid) systems where the potential exists for an inadvertently released stream or blast of fluid, and
- Where hazardous chemicals may be splashed or injected into the eyes or face.

2.5.3 Gloves

Gloves shall be worn whenever the task exposes the hands to injurious textures, materials, or temperatures. The following are typical tasks that require workers who perform such duties to wear gloves for protection:

- Chemical laboratory operations,
- Metals fabrication operations,
- Cryogenic operations, and

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- Operations where workers handle bulky, rough materials.

2.5.4 Safety Shoes

Safety officials will ensure that safety shoes are worn by all employees who perform tasks that expose their feet to hazards. The typical areas where safety shoes will be required are:

- Construction sites,
- Fabrication workshops,
- Warehouses,
- Loading docks, and
- Locations where gas bottles are handled and/or stored.

2.5.5 Respiratory Protection Devices

Respiratory protection devices should be worn whenever needed to eliminate the inhalation of hazardous levels of airborne contaminants. Safety officials shall coordinate with the LaRC Industrial Hygienist who will assist in selection of the proper equipment and the training of personnel.

2.5.6 Specialized Protective Needs

When a work hazard develops that may require the use of specialized protective gear or equipment, safety officials shall take the appropriate actions to solve the problem. If new or specialized protective gear or equipment is needed, contact SFAB for help in evaluating the situation and obtaining the necessary items to eliminate the hazard.

2.6 STRIKE AND COLLISION HAZARDS

Safety officials should be vigilant for the development of strike and collision hazards in the workplace. These hazards develop as workers accomplish the day-to-day activities of their work responsibilities. For this reason safety officials should be observant for the development of the hazards discussed in paragraphs 2.6.1 through 2.6.4.

2.6.1 Worn or Improperly Used Tools

Tools that become worn in the course of normal operations can become workplace hazards. For this reason, all tools should be routinely checked for wear that could cause them to contribute to a workplace accident. For example, worn wrenches, loose hammerheads, worn ratchets and jacks, or other mechanisms that have exceeded their life span should be considered workplace hazards. Additionally, tools or other mechanisms that are misused by workers can cause workplace accidents. Workers should not subject tools to excessive stresses, such as using tools for purposes for which they were not designed.

Safety officials should be observant for worn or misused tools and they should issue necessary reminders reinforcing the requirement of using the proper tools for the job being performed.

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2.6.2 Overhead Hazards

Wherever equipment is suspended above the workplace, personnel working in the area should be made aware of the hazard. Also, warning signs should be placed in conspicuous locations informing personnel of overhead hazards.

Safety standards will be instituted to prevent accidents from occurring when objects are stored overhead or work is being performed at elevated levels. Material and equipment kept in overhead storage or work areas will be secured, preventing it from falling to lower levels. Personnel working in overhead areas should be frequently reminded of their responsibility to safeguard individuals who are passing beneath. When work is being performed in overhead areas, personnel will use the following equipment as required:

- Safety harnesses,
- Lifelines while working on open beams or framing, and
- Tool lanyards.

2.6.3 Missing and Improperly Installed Mechanical Guards

Safety officials shall be observant for hazards caused by unguarded machinery or other equipment that could contribute to the injury of an employee. Corrective action should be implemented when this type of hazard exists. The following are examples of this type of hazard:

- Improperly adjusted tool rests on grinders,
- Blade guards on circular and band saws moved out of service, and
- Belt and pulley guards removed on air compressors, air handlers, and other rotating machinery.

2.6.4 Collision Hazards

Collision hazards are caused by low overheads or objects that protrude into work-areas and passageways. Examples of collision hazards are piping, wiring conduits, and other structural components such as lower-than-normal doorways. These hazards should be removed or altered when possible to eliminate the possibility of employees injuring themselves. Most importantly, objects that protrude and pose a danger to employees' heads or pose a trip hazard should be removed. These types of hazards include furniture, such as coat-racks, that is situated along passageways. Furniture and equipment may have protrusions that extend out at eye level, with nothing below the hazard to provide visual warning. In addition, surplus furniture, equipment, and boxes should not be temporarily stored in hallways, passageways, or near doorways.

In general, personnel should be alert to hazardous objects that they might accidentally encounter. Hazards should be removed if possible or identified with a warning device at a minimum. Some of the approved warning devices are high visibility warning tape, contrasting colors, and warning signs.

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The following general guidelines are approved safety practices:

- File cabinets and storage cabinets will be bolted together or fastened to the wall or floor if their load, location, or style represents a tipping hazard.
- Bookcase units will not be stacked higher than four units without additional safeguards.
- All new stairways, aisles, and exits must comply with National Fire Prevention Association (NFPA) Standards 101, Life Safety Code, and OSHA requirements. Existing units will conform with the intent of these requirements by using operational constraints.
- File drawers will not open into aisles unless sufficient space for a free and unobstructed aisle-way remains with the drawer open.
- Telephone or electric cords are not permitted on the floor in the chair area, in walkways around desks, or in crosswalks.
- Self-adhesive rubber ramps, which serve to cover or permit walking over telephone or electric cords, will not be used at LaRC in walkways or access paths.
- When electric or telephone service is needed in the center of an office area, overhead service and power poles from ceiling to floor will be installed beside the desk or table.

Equipment that is not in use should be placed in a position, which does not create a collision hazard to employees. When equipment is in a non-operational mode it should be positioned safely. For example, crane hooks should be stopped above head level when the crane is not being operated.

2.7 HAZARDOUS MATERIALS

The proper control of hazardous materials is a primary concern of Center management. Safety officials will ensure that their facility is in compliance with the LaRC standards for hazardous material management. OFSH's will become familiar with LPR 1710.12, "Potentially Hazardous Materials," as the document applies to their facility. Also, safety officials, supervisors, and employees should become familiar with the various hazardous materials located in their facility. Personnel are instructed to report any improper handling, labeling, or storage of hazardous materials. This includes materials that are flammable, explosive, or injurious if inhaled, ingested, or otherwise comes into contact with the body. The SFAB Industrial Hygienist is available for assistance or to provide additional information concerning hazardous materials.

2.7.1 Pyrotechnics and Explosives

LaRC policy requires that all pyrotechnics and explosive material, including residual quantities, be controlled throughout the entire cycle of procurement, storage, and disposition. LAPD 1700.2, "Safety Assignments," require that all matters concerning the use of pyrotechnics be coordinated through the OFSH. This includes all research, design verification testing, and operations involving pyrotechnic devices.

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2.7.2 Asbestos Removal or Repair

Prior to any operation involving removal, repair, or any other procedure that may result in the release of airborne asbestos, an inspection is required to evaluate the hazard and recommend appropriate control techniques. An inspection team shall be formed for this purpose that will include the following individuals:

- The LaRC Industrial Hygienist,
- The contractor safety official,
- The contractor operational supervisor (competent person as defined by OSHA regulations), and
- A Facility Representative (either the OFSH or FC).

2.7.3 Battery Installations and Battery Rooms

LaRC policies and requirements addressing battery rooms and battery installations stipulate that they will be maintained in conformance with OSHA, Part 1910.178G and the National Electrical Code (NEC), Article 480. It is the responsibility of each OFSH and FC to ensure that battery installations and battery rooms in their facility are in compliance with these requirements.

2.8 ELECTRICAL HAZARDS

Electrical hazards exist whenever electrical current is exposed (uninsulated) and the potential exists for personnel to make contact with the electrical current.

2.8.1 Extension Cords

Extension cords are the most common cause of unsafe electrical wiring. Often these conditions occur during the normal operation of electrical hand tools. The hazard is compounded if the employee is using an improper load-rated extension cord. Extension cords with metal, knock-out plug receptacles are <u>not</u> to be used.

In office areas, such cords become a hazard when they are under foot, draped across metal furniture, or used in positions where they are subject to wear, cutting, pinching, and pulling. These activities damage the insulation or cause the wire covering to be pulled back at the ends, leaving bare wire, which results in a hazard to the worker.

2.8.2 Working On or Around Electrical Circuits

A life-threatening hazard results if employees drill or cut into walls, partitions, cabinets, or equipment containing live electric wires or cables. Safety procedures require that all electric current to wires or cables be turned off while drilling or cutting activities are occurring. It is imperative that wires and cables be located or removed to preclude the possibility of contact during the drilling or cutting operations. Additionally, work performed on electrically operated equipment will begin only after circuit breakers or switches have been locked out using the Lockout/Tagout system.

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2.8.3 Operating Electrical Equipment

Personnel are restricted at all times from abusing electrical equipment. Also, they are required to immediately report any electrical equipment that is suspected of having an electrical malfunction. Electrical outlets will be checked periodically to ensure that the "third-wire" ground terminal is connected to the building ground. The operation of electrical hand tools in damp or wet locations will be avoided to the extent possible. If this is not possible, ground-fault circuit interrupters will be used to provide a high degree of protection against electrical shock.

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Chapter 3

3. FIRE SAFETY

3.1 GENERAL

The purpose of this chapter is to acquaint FSHs and FCs with fire safety requirements for facilities on LaRC. This familiarization will include the proper identification of building egress, fire detection and/or suppression systems, and other fire safety requirements.

3.2 EXIT ROUTES

One of the key elements of fire safety is to ensure that individuals have an unobstructed avenue to exit buildings in the case of an emergency. For this reason, when LaRC buildings are open, exits must be maintained in a manner that provides free and unobstructed egress. Most importantly, no lock or fastening shall be installed which would prevent escape from any building.

3.2.1 Passageways and Doors

Safety personnel will routinely inspect passageways and doorways to ensure that they are free from obstructions. It is imperative that no obstruction be placed in a location that would prevent employees from exiting a building in the case of an emergency. Doorways shall not be blocked by stored materials or equipment or converted into wall space. Hallways shall not be converted into storerooms for cartons of records, stacks of construction materials, or other items that would block or impede personnel attempting to evacuate a building or facility.

3.2.2 Two Means of Egress

Every work area, building, and facility on LaRC is required to have at least two means of emergency egress. These exits will be located as remotely from each other as possible. This arrangement will increase the likelihood that free access is available to personnel during an emergency when fire or smoke is present in the building.

3.2.3 Enclosure of Between-Floor Openings

Vertical openings between floors of a building, such as stairwells, elevator shafts, and pipe chases, shall be suitably enclosed or protected against the spread of fire, smoke, or fumes during an emergency. These structural designs will prevent fire hazards from spreading to other floors of the building and will afford reasonable safety to building occupants while exiting the building. Doors to these protected vertical openings shall not be blocked open or allowed to remain open, unless they are equipped with an approved door-closing device, and have magnetic door holders with smoke detection for closure.

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3.3 EXIT IDENTIFICATION

All exits are required to be clearly visible and routes to them must be conspicuously marked. Adherence to this procedure ensures that the occupants of buildings know the direction of escape from any point in a building. Doors and passageways that are not exit routes, but which may be mistaken for exit routes, shall be marked (i.e., “NOT AN EXIT"). These markings will preclude such doors and passageways from being mistaken for an exit, thereby endangering persons by entrapping them in a dead-end space.

Adequate and reliable illumination shall be provided for all exits. Emergency lighting shall be provided in accordance with National Fire Protection Association (NFPA) 101, latest revision, Life Safety Code.

3.4 FIRE DETECTION AND SUPPRESSION

Fire detection and alarm systems shall be provided where needed to warn occupants of a fire emergency. Safety personnel will ensure that fire alarm "pull boxes" are not blocked or obscured by physical obstructions. One method of enforcing this policy is by restricting the storage of any materials or equipment near or in front of “pull boxes.”

Policy requires that both fixed and portable fire suppression systems be easily accessible. This access requirement specifies that fire equipment be maintained free from visual or physical obstructions. Also, fire regulations require the use of prominent markings that indicate the location of fire apparatus. These markings indicate the locations of portable fire extinguishers and the controls for fixed manual systems.

3.5 EMERGENCY COORDINATION

When an emergency occurs and a facility is evacuated, occupants are required to move to a safe area away from the scene. This will ensure that emergency personnel have free access to provide emergency services. Because of their direct knowledge of their facility, the FSH and FC should be the main persons to coordinate with the emergency response teams concerning the cause of the alarm or other building hazards.

3.6 FACILITY REENTRY

The FSH and FC have the responsibility to ensure that their building or facility is properly evacuated during an emergency. The evacuation procedure requires that all personnel remain outside the building in a designated safe area until reentry is authorized. Furthermore, reentry to a facility can only be authorized by the Fire Department.

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Chapter 4

4. SAFETY INSPECTIONS AND CORRECTIVE ACTION

4.1 MANAGEMENT SAFETY INSPECTIONS

Safety practices on LaRC are a joint responsibility of all levels of management. According to LAPD 1700.1, “Safety Program,” the success of the safety measures used on LaRC depends directly upon the involvement of line managers. Facility inspections by management personnel and follow-up corrective actions are critical to the safe operation of LaRC facilities. Safety discrepancies shall be addressed in an expeditious manner, since the timely resolution of issues will contribute to the success of the Center Safety Program.

4.1.1 Assignment of Responsibilities

Directors, program managers, off-site managers, facility managers, organizational unit managers, supervisors, and test conductors are encouraged to make periodic inspections of their facilities. When items requiring corrective action are observed or reported, they shall be immediately brought to the attention of the FSH. To rectify the discrepancy, the FSH will contact the appropriate individual or organization responsible for bringing the issue to closure.

4.2 SFAB INSPECTIONS

An annual Safety and Health Audit is performed by SFAB personnel on each LaRC facility. These audits are performed to assure compliance with the appropriate Occupational Safety and Health Administration (OSHA) and LaRC regulations. The results of the Safety and Health Audit are required to be documented. These findings include an outline of any discrepancies that were encountered during the inspection. Also, audits will include suggested methods to rectify discrepancies in order to bring them to closure. These audits are forwarded to the FSH of each facility for proper coordination and disposition. Closure of these discrepancies should be a coordinated effort between the FSH and FC.

The initial identification of floor load standards for each LaRC facility shall be established by the annual OSHA inspection. Thereafter, each OFSH and/or FC is responsible for assuring that appropriate floor loading signs are displayed and the floor loading specifications are not exceeded.

4.3 FIRE PROTECTION AND LIFE SAFETY AUDIT

An annual Fire Protection and Life Safety Audit is required to be performed on each LaRC facility. These audits are performed by the LaRC Fire Department and coordinated by the LaRC Fire Protection Specialist. The process for documenting these audits and addressing identified discrepancies is the same as for the Safety and Health Audits.

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4.4 POTENTIALLY HAZARDOUS MATERIAL INSPECTIONS

In facilities where research is carried on there may be a requirement to conduct special inspections. These special inspections will be completed when the use of potentially hazardous materials or ionizing and/or nonionizing radiation is used in the facility. These inspections are performed by the LaRC Industrial Hygienist and/or Health Physicist. The frequency of these audits (monthly, quarterly, or annually) is determined by the following factors:

- Type of work performed,
- Frequency of operations,
- Degree of hazard involved,
- Number of personnel involved,
- Type and quantity of materials stored or used, and
- The history of discrepancies reported.

4.5 UNSCHEDULED OR SPECIAL INSPECTIONS

Any building, facility, or associated area may be inspected on an unscheduled basis, due to the operation of an unusual activity. Unscheduled or special inspections are conducted when the assigned safety inspector determines that they are necessary. This determination would occur when any operation or activity warrants immediate or special attention, which cannot be delayed until the next regularly scheduled inspection. Special operations involving manned flight support, manned chamber tests, and tests where a high hazard potential exists are examples of activities that could warrant an unscheduled or special inspection.

4.6 COORDINATION OF INSPECTIONS

Prior to conducting any safety inspection, the appropriate FSH or FC will be contacted and invited to participate. At the conclusion of the inspection, these officials will be briefed concerning any discrepancies observed by the inspector. A written report will be forwarded to the responsible FSH so that necessary corrective action(s) can be initiated.

4.7 RESPONSE TO INSPECTION REPORTS

The responsibility of the FSH, when responding to inspection reports, is to take corrective action to resolve the noted safety discrepancies or hazardous conditions. This shall include responding to reports from SFAB inspectors and other safety inspection teams.

4.7.1 Direct Action

When a Safety Inspection Report is received which contains safety discrepancies or hazards, the FSH should make an assessment of the resources required to rectify the discrepancies. First, the FSH must determine whether the correction can be made without outside assistance or authority. If the discrepancy can be rectified in this manner, the FSH will contact the cognizant authority within the organization and initiate

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the corrective action. If the discrepancies cannot be internally rectified, the FSH will use the Work Request System.

4.7.2 Submission of Work Requests

If the work required to rectify a discrepancy is beyond the scope or capability of facility personnel, a work request will be initiated. Langley Form 69, "Work Request," will be submitted to the Zone Maintenance Manager to initiate this process. The Work Request should include a description of the corrective action required, a justification to establish the priority of the request, and a statement that the work is required to address a safety issue.

4.7.3 Prioritizing of Safety-Related Work Requests

The LaRC Zone Maintenance Manager will receive and log all safety-related Work Requests and forward the requests to the Head, SFAB, for review and prioritization. The Head, SFAB, will prioritize safety-related work requests as shown in the following three paragraphs.

4.7.3.1 Urgent Priority

Urgent priority requests will be reserved for work area deficiencies that represent an imminent danger to workers. In an urgent priority situation, the SFAB will assure that work is abated in the activity, facility, or area from which the request was generated. Additionally, at the direction of the SFAB, the area will be properly "posted" and work activities will be restricted. The work area will remain under this circumscription until the deficiency has been corrected.

The SFAB will coordinate the work schedule required to address an urgent safety discrepancy. This work schedule will be coordinated with, established, and approved by the LaRC Safety Manager. Including the Zone Maintenance Manager into the planning process is a prime factor in coordinating an effective work schedule.

4.7.3.2 High Priority

High priority discrepancies indicate that a serious safety violation, which is in need of repair, exists in a work area. During the period of repair, the facility or activity that necessitated the issuance of a High Priority Work Request must be administratively and/or procedurally controlled. These controls will remain in place until the deficiency has been corrected. The schedule of work to correct the deficiency will be coordinated by the OFSH. The work activities will be established by the LaRC Safety Manager in concert with the Zone Maintenance Manager and the FSH. The affected area will be "posted" by SFAB, indicating the existence of the deficiency, and will remain posted pending completion of the required work.

4.7.3.3 Normal Priority

Normal priority discrepancies indicate that a minor safety deficiency exists in a work area but the probability of an accident occurring is unlikely. A normal priority safety condition is usually rectified by a rapidly implemented corrective procedure. This

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procedure may routinely take eight or less hours to complete and should be initiated as quickly as possible or reasonable. In instances where a rapid abatement of the hazard is not possible and the projected schedule for abatement will exceed 3 months, the OFSH will coordinate the work activities and completion date. In these instances, the Safety Manager will approve the work schedule and will coordinate the schedule with the Zone Maintenance Manager and the OFSH.

4.8 ACCIDENT REPORTING

Any personnel who observe an accident or injury on LaRC which requires a response by the security force or fire department should report the incident immediately by calling 911. All accidents that occur on LaRC involving a personnel injury or damage to government or personnel property are required to be reported through the formal LaRC reporting process. The type and extent of documentation required depends upon the type of incident and the extent of damage or injury incurred. The procedures for reporting such injuries and accidents to the appropriate officials are specified in LMS-CP-4760, "Reporting Injuries, Illnesses, Compensation Claims, and Unsafe Working Conditions."

4.8.1 Reporting to the Facility Safety Head

The FSH is not specifically assigned the task of dealing with the process of formally reporting accidents, injuries, or incidents that occur on the Center. Neither is the FSH responsible for conducting the investigation of the incident. However, because of their overall responsibilities, the FSH should be immediately notified of any accident or injury that occurs in their facility.

4.8.2 Medical Treatment of Injuries

All employees at LaRC are required to seek proper medical attention and treatment for any injury, which is received as a result of their employment. When minor accidents occur, both civil service and contracts employees may receive emergency treatment at the Occupational Health Clinic. If an injury occurs that is serious enough to warrant the transportation of the injured person to a hospital, the City of Hampton Fire Department will respond and transport the individual to a local hospital.

4.8.3 Supervisory Reporting of Accidents

The supervisor of any employee injured on the Center is required to accurately report the incident by completing Langley Form 95, "Supervisor's Report of Accident." This form provides information regarding how the injury occurred and any corrective actions, which are required to prevent similar accidents or injuries from occurring.

4.9 REVIEW OF PURCHASE REQUESTS

The FSH and FC should review purchase requests issued for the procurement of new safety equipment. This process will ensure that safety officials are aware of the intended use of new equipment and support the requirements for its purchase. Due to the overall safety responsibilities of the FSH's, it is essential that they pay specific attention to these purchases. If questions arise concerning the purchase of safety

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equipment, the OFSH will be the point of contact concerning the necessity for the equipment and the requirements supporting its purchase. Individuals with inquiries concerning the purchasing requirements for safety equipment should contact the cognizant OFSH.

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Chapter 5

5. SAFETY PROGRAM POLICY DOCUMENTS

5.1 LaRC SAFETY PROGRAM

The responsibility for providing a safe and healthful working environment on LaRC rests with the Center Director and the Center's management staff. In support, the SMAO Safety Manager implements the day-to-day operation of the LaRC Safety Program. Most importantly, the LaRC Safety Program is designed to provide a systematic approach that involves all employees and managers in the Center safety management.

The objective of the LaRC Safety Program is to ensure each employee has a safe and healthful working environment, engineered to be free from unacceptable hazards. The LaRC Safety Program is a systematic process designed to support this objective by ensuring the safe operation of the Center. It is designed to proactively identify and abate hazards that could contribute to accidents causing property damage, personal injuries, or fatalities.

5.2 SAFETY MANUAL

The LaRC Safety Manual contains directives, procedures, and guidelines necessary for LaRC safety officials to execute their safety responsibilities. The Safety Manual is furnished to Associate Directors, Organizational Unit Managers, FSH's, FC's, and other individuals assigned safety responsibilities. In summary, the LaRC Safety Manual implements the LaRC Safety Program and provides policy guidance for safety management on the Center.

Refer to the LaRC Safety Manual contents for more information on particular functional areas.

5.3 SAFETY PERMIT

A Safety Permit is generally required for operations, which may pose significant hazards in the workplace. Safety Permits are required to document procedures, the use of specific equipment, precautions that are in-place, and the personnel who will be conducting the operations. This process will also assure that the OFSH with direct knowledge of the operation is available to monitor the operation. Additionally, the Safety Permit process assures that an independent, third-party review is conducted and assures personnel conducting the operation are adequately trained and qualified for their positions.

Safety Permits are required for specific operations and a complete description and applicability of the operations are specified in the following LPR's:

- LPR 1710.8, "Nonionizing Radiation" (Laser, Microwaves)
- LPR 1710.5, "Ionizing Radiation" (X-Rays or Radioactive Materials)
- LPR 1710.7, "Use and Handling of Explosives and Pyrotechnics"

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- LPR 1710.12, “Potentially Hazardous Materials” (Toxics, Flammable, etc.)

Additionally, depending upon the type of hazardous material being used at a facility and the scope of the activities, Principal FSH’s and OFSH’s will have additional responsibilities. The above LPR’s are the prescribing documents that outline these additional responsibilities.

5.4 PROCUREMENT, INVENTORY, AND STORAGE OF HAZARDOUS MATERIAL

The OFSH is required to approve all requests for the procurement, inventory, and storage of Hazardous Material. This process requires the use of specific forms, which must be processed through an approval procedure.

The purchase of hazardous materials requires the processing of Langley Form 44, "Hazardous Material - Procurement, Inventory, and Storage Record." This form requires the signatures of safety officials to assure they are in agreement with the acquisition of this material. The signature of the OFSH is required to certify that approval has been obtained for any acquisition of hazardous materials. In addition, the approval process for the form requires the signature of the LaRC Safety Manager. When hazardous materials require internal transfers on LaRC, including stock requisitions, the transfer is documented on Langley Form 44B, "Hazardous Material Reissue Card." This internal transfer process has an approval procedure that must be complied with before materials are moved.

Under GSA Federal Standard 313A, Materials Safety Data Sheets (MSDS), are required for the purchase, inventory, and transfer of a wide variety of toxic chemicals, flammables, and other materials. Under normal conditions, some of these chemicals might not be considered hazardous. Because of the operational environment on LaRC, however, they do require documentation. The SFAB Industrial Hygienist is the point of contact for questions concerning these issues. The OFSH should contact SFAB concerning questions or if additional information is needed.

Individuals who require further details concerning the procurement, inventory, and storage of Hazardous Material should reference LPR 1710.12, “Potentially Hazardous Materials.”

5.5 FACILITY RESUMES

All research facilities shall implement and maintain a Facility Resume (FR). The implementation and update of the FR shall be the responsibility of the FSH, with concurrence by the FC.

As a minimum, FR’s for facilities currently under the Configuration Management (CM) program shall contain the following items:

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- Facility Emergency Procedures including the location of isolation devices (valves, breakers, etc.) for all energy sources located in the facility for systems such as water, air, hydraulic, electrical, and gases. A copy of these procedures may be obtained from the LaRC Fire Chief.
- A statement indicating a list of all relief devices and valves located within the facility can be found in the Computerized Maintenance Management System (CMMS) (a.k.a. MAXIMO).
- A description of the process used to certify and recertify Qualified Operators.
- A current list of all Qualified Operators.
- A statement indicating (a) the FSH and FC responsible for coordinating and approving the facilities lockout/tagout energy control procedures and (b) the physical location of the lockout/tagout records.
- A description of systems located within the facility. This should include a brief summary identifying the type of system(s) and research conducted within the facility. High-risk facilities shall provide information within the resume pertaining to the Safety Analysis Report (SAR) and other documentation available in the Configuration Management On-Line (CMOL).
- A statement indicating a current copy of the Facility Baseline List is available in CMOL and with the facilities working master documentation, located in the facility (location shall be indicated by building and room number).
- A statement indicating the location of the facility's Material Safety Data Sheets (MSDS's) book.
- A statement indicating the chemical inventory of the facility is available in the LaRC Chemical Tracking System (CMTS).
- A copy of the facility's winterization plan.
- A statement indicating the location of facility's calibration process and calibration records (i.e. web site address or specific room number and file cabinet).

As a minimum, FR's for facilities not currently under the CM program, including Laboratory Risk Evaluation Program (LREP) facilities, shall contain the following items:

- Facility Emergency Procedures including the location of isolation devices (valves, breakers, etc.) for all energy sources located in the facility for systems such as water, air, hydraulic, electrical, and gases. A copy of these procedures may be obtained from the LaRC Fire Chief.
- A statement indicating a list of all relief devices and valves located within the facility can be found in the CMMS.
- A description of the process used to certify and recertify Qualified Operators.
- A current list of all Qualified Operators.
- A statement indicating (a) the FSH and FC responsible for coordinating and approving the facilities lockout/tagout energy control procedures and (b) the physical location of the lockout/tagout records.
- A description of systems located within the facility. This should include a brief summary identifying the type of system(s) and research conducted within the facility.

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A listing of pertinent documentation (drawings, procedures, etc.) pertaining to the operation of the facility.

- A statement indicating the location of the facility's Material Safety Data Sheet (MSDS) book.
- A statement indicating the chemical inventory of the facility is available in the LaRC CMTS.
- A copy of the facility's winterization plan.
- A statement indicating the location of facility's calibration process and calibration records (i.e. web site address or specific room number and file cabinet).

Facility Resumes for facilities currently under the CM program may be maintained in CMOL. The FSH shall make this decision with concurrence from the FC. If the FR is not maintained in CMOL, then a copy of the FR shall be maintained within the facility.

Facility Resumes for facilities not currently in the CM program shall be maintained within the facility.

All FR's shall be updated when any major system changes are implemented within the facility. Minor changes, such as qualified operator changes, may be redlined and updated in CMOL annually. All FR's shall be verified annually.

NOTE: Facility calibration information is not a safety requirement. This requirement fulfills a Langley Management System requirement indicating the location of documentation describing the facility calibration process and the location of the calibration records.

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Chapter 6

6. FACILITY CONFIGURATION MANAGEMENT

6.1 GENERAL

This program is described in detail in LPR 1740.4, “Facility Systems Safety and Configuration Management.”

The LaRC Facility System Safety Analysis Program exists to ensure the safe and continuous operation of selected ground-based LaRC facilities. It is composed of the engineering, research, and facility analytical processes and their resultant supporting documentation. It consists of three separate programs with two subprograms. They are the:

- Facility Configuration Management (CM) Program, which includes:
  - Pressure Systems Configuration Management (PSCM)
  - Software Configuration Management (SWCM)
- Laboratory Risk Evaluation Program (LREP)
- Asbestos CM Program (ACMP)

The LaRC facilities within the Facility CM Program have been assigned unique Effort Code (EC) numbers to aid in tracking their configuration controlled documentation. Those facilities and their EC numbers are listed in Figure 6-1, “Configuration Management Facility List.”

The objectives of the Facility System Safety Analysis Program are to ensure that:

- The appropriate level of safety analysis has been conducted for each facility.
- The baseline for controlled documents for those facilities has been established.
- Those analyses and supporting documents are kept current through active CM Programs.

The objectives of the CM Program are to:

- Document and provide procedural and risk information to both management and operating personnel.
- Record and maintain the current status of equipment and services within the covered facilities.

6.2 FACILITY CONFIGURATION MANAGEMENT PROGRAM

The LaRC Facilities Configuration Management (CM) Program covers LaRC high-risk facilities. A complete list of these facilities is contained in Table 6.0, page 6-4, Configuration Management Facility List. Each facility that is under CM is required to maintain a series of documents, which record the pedigree of the facility or research apparatus. These documents are divided into four primary categories: Safety Analysis

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Report (SAR), Standard Operating Procedures (SOP), FR, and Facility Baseline List (FBL).

6.2.1 The Safety Analysis Report

The SAR documents potential undesired events that have been identified in that facility. Also, the SAR specifies the methods that are in place to adequately control these hazards. Finally, it assures that the systems design and operation does not expose personnel or equipment to unacceptable risk due to the existence of a credible single point failure. The SAR is a Configuration Controlled Document (CCD).

6.2.2 Standard Operating Procedures (SOPs)

Standard Operating Procedures specify the methods and standards of facility operations, which are currently in effect. They govern the safe operation of the facility or research apparatus, which is under CM. Specifically, SOP's specify the detailed operational sequences to be used to ensure safe operations. Also, SOP's are CCD's.

6.2.3 Facility Resumes

Facility Resumes are also CCD's, that include, as a minimum, emergency procedures, a list of all relief devices and valves, qualified operator certifications, lockout/tagout procedures, system descriptions, chemical inventory and facility winterization plans. Paragraph 5.5 outlines the specific requirements for FR's.

6.2.4 The Facility Baseline List

The Facility Baseline List (FBL), also a CCD, shows the CCD's that are required to be maintained for each facility and research apparatus which is maintained under CM. The proper maintenance of the FBL is critical in supporting the safe operation of a CM facility or research apparatus.

6.3 CHANGE NOTIFICATION SHEET (CNS)

Facilities in the LaRC CM Program are required to submit a CNS when there is a change to the facility and/or its controlled documentation. These changes shall be incorporated into the necessary facility documentation. The changes will provide necessary risk classification information. Risk assessment will be provided by the FSH and the Safety Manager or designated SFAB personnel.

6.4 LABORATORY RISK EVALUATION PROGRAM (LREP)

Over 120 laboratories on LaRC are covered by this program. The Program's objectives are to:

- Establish a separate CM Program for laboratories at LaRC, which are neither currently under the existing CM Program nor covered under Safety Permit.
- Increase safety awareness at the operator level at those facilities.
- Enhance the capability of SMAO in monitoring the safety aspects of Laboratory operations and assisting in the resolution of unsafe practices.

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6.5 ASBESTOS CONFIGURATION MANAGEMENT

The Asbestos Cm Program (ACMP) objectives are:

- Establish a program that will enable the Center to comply with the myriad clean air emission regulations established by the Environmental Protection Agency (EPA), the Occupational Safety and Health Administration (OSHA), and the Commonwealth of Virginia.
- Increase safety awareness and minimize the risk of asbestos exposure to personnel.
- Institute controls to prevent the release of asbestos fibers, restrict future asbestos use, and develop surveillance and control of known, existing asbestos applications in Center Facilities.

Over 250 LaRC facilities participate in the ACMP. Each facility was inspected to identify friable and nonfriable asbestos-containing building material (ACBM) and written inspection reports were provided to the FSH's. These reports are on file at the facilities and are the baseline documents for the ACMP.

It is LaRC policy that, prior to any operation involving removal, repair, or any other procedure, which may release airborne asbestos, an inspection must be completed to evaluate potential hazards and recommend appropriate controls. Additionally, an inspection team, one member being the FSH or FC of the affected facility, will establish operational control procedures to be documented through issuance of an "Asbestos Safety Permit."

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EC	FACILITY NAME	FAC. NO.	ADDRESS
01	High Pressure Air System	1247D/E & 1215	7E East Reid Street
02	Hypersonic CF_4 Tunnel	1275	20 Lewis Loop
03	8-Foot High Temperature Tunnel	1265	10 East Reid Street
04	1- X 3-Foot High Enthalpy Aerothermal Tunnel	1265	10 East Reid Street
05	Hypersonic Blowdown Tunnels (8): • 20” Mach 6 Tunnel • Nozzle Test Chamber • 12” Mach 6 High Reynolds Number Tunnel • Gas Mixing Apparatus • 18” Mach 8 Tunnel • 1/2 Meter Quiet Tunnel • 20” Supersonic Wind Tunnel • Probe Calibration Tunnel	1247D	10D East Reid Street
07	Hypersonic N^2 Tunnel	1247	1B East Reid Street
12	Entry Structures Facility	1267	6 East Reid Street
13	Visual Motion Simulator	1268A	24 West Taylor Street
14	Drive Control	1241	9 West Taylor Street
16	31-Inch Mach 10 Tunnel	1251A	16A Victory Street
17	15-Inch Mach 6 High Temperature Tunnel	1251A	16A Victory Street
18	Transonic Dynamics Tunnel	648	226 Dodd Boulevard
19	14- X 22-Foot Subsonic Tunnel	1212C	17C West Taylor Street
21	16-Foot Transonic Tunnel	1146	11A West Taylor Street
22	Aircraft Noise Reduction Laboratory	1208	2 North Dryden Street
23	Hypersonic Materials Test Apparatus	1148	8 West Taylor Street
24	Unitary Wind Tunnel	1251	16A Victory Street
25	Scramjet Test Facility	1247B	1B East Reid Street
26	High Reynolds Number Helium Tunnel Complex	1247H	2H East Marvin Street
27	High Reynolds Number Helium Recovery System	1247B	1B East Reid Street
28	Hypersonic Helium Tunnel Facility	1247B	1B East Reid Street
29	Aircraft Landing Dynamics Facility	1257-1262	2 West Bush Road
33	Impact Dynamics Research Facility	1297	12 West Bush Road
34	0.3-Meter Transonic Cryogenic Tunnel	1242	7 West Taylor Street
35	Anechoic Noise Facility	1218A	3A South Wright Street
36	Jet Noise Apparatus	1221A	12A Langley Boulevard
37	Thermal Acoustic Fatigue Apparatus	1221A	12A Langley Boulevard
40	Low Turbulence Pressure Tunnel	582A	582A Thornell Avenue
50	Vacuum Sphere Control and 60-Foot Space Simulator	1295B-D	2B South Warner Street
58	Impact and Projectile Range	1275	20 Lewis Loop
61	12-Foot Low Speed Tunnel	644	644 Andrews Street
62	20-Foot Vertical Spin Tunnel	645	645 Andrews Street
66	Differential Maneuvering Simulator	1268A	24 West Taylor Street
67	General Purpose Fighter Simulator	1220	1 South Wright Street
68	General Aviation Simulator	1268A	24 West Taylor Street
69	7-Inch High Temperature Tunnel	1264	17 North Marvin Street
71	Vitiated Heater, Test Cell #2	1221C	12C Langley Boulevard
80	Combustion and Mixing Research Apparatus, Test Cell #1	1221C	12C Langley Boulevard
84	Hangar Water Deluge System	1244	6 East Taylor Street
85	Heavy-Duty Brazing Vacuum Furnace	1232A	6A Langley Boulevard
86	16-Meter Thermal Vacuum Chamber	1293B	4B West Taylor Street
89	Autoclaves	1267A	6A East Reid Street
91	Composite Shop Autoclave	1238B	3B East Durand Street
92	Hypersonic Helium Tunnel Recovery System	1247B	1B East Reid Street
97	Space Systems Structures Research Laboratory	1293A	6A West Taylor Street
98	Steam Distribution System	1215	14 West Taylor Street
99	National Transonic Facility (NTF)	1236	5 West Taylor Street

Figure 6.1, Configuration Management (CM) Facility List.

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7. RECORDS

Langley Form 44, “Hazardous Materials.”

Langley Form 44B, “Hazardous Material Reissue Card.”

Langley Form 69, “Work Request.”

Langley Form 95, “Supervisor’s Report of Accident.”

Langley Form 495, “Safety Operators Clearance Procedures.”

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Langley Research Center

LPR 1740.6
Effective Date: November 17, 2005
Expiration Date: March 17, 2010

PERSONNEL SAFETY CERTIFICATION

National Aeronautics and Space Administration

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Responsible Office: Safety and Mission Assurance Office

PREFACE

P.1 PURPOSE

This Langley Procedural Requirements (LPR) sets forth qualification and training requirements for certification of personnel to handle engineering models, ground support equipment, space flight test and research articles, test and qualifications articles, facility equipment hardware, chemicals, radiation, laser, and pyrotechnic devices.

These standards are established (1) so that personnel handling program hardware shall be trained to perform their work to meet established technical standards and (2) to ensure operations are conducted safely. This shall assure that personnel assigned to handle program hardware have the highest level of reliability, thereby enhancing the successful accomplishment of Langley Research Center's (LaRC) missions. It specifies the certification processes to be followed to obtain the worker certification and recertification.

P.2 APPLICABILITY

These requirements apply to all persons performing work at LaRC, including civil servants, contractors, research associates, and others. Non-compliance with this LPR shall result in appropriate disciplinary action that may include termination for a civil servant employee or exclusion from the Center for a contractor employee, research associate or others.

P.3 AUTHORITY

a. NPR 1800.1, "NASA Occupational Health Program Procedures."
b. NPR 8715.3, "NASA Safety Manual."
c. 29 CFR Part 1910, "Occupational Safety and Health Standards."
d. 29 CFR Part 1926, "Occupational Health Regulations for Construction"
e. American National Standard Institute (ANSI)

P.4 REFERENCES

a. LPR 1710.4, "Personnel Protection - Clothing and Equipment."
b. LRP 1710.5, "Ionizing Radiation."
c. LPR 1710.7, "Use and Handling of Explosive and Pyrotechnics."
d. LPR 1710.8, "Nonionizing Radiation."
e. LPR 1710.10, "Safety Clearance Procedures for the Control of Hazardous Energy (Lockout/Tagout).

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f. LPR 1710.12, "Potentially Hazardous Materials."
g. LPR 1740.2, "Facility Safety Requirements."
h. NASA Langley Form 29, "Safety Permit Request."
i NASA Langley Form 38, "Safety Permit Request - Radioactive Material."
j. NASA Langley Form 48, "Safety Permit Request - Radiation Machine."
k. NASA Langley Form 49, "Safety Permit Request - Laser/Microwave."
l. NASA Langley Form 56, "Radioactive Material Transfer."
m. NASA Langley Form 60, "Confined Space Entry Permit."
n. NASA Langley Form 61, "Lifting Certification Card."
o. NASA Langley Form 62, "Chemical Worker's Certification Card."
p. NASA Langley Form 65, "Worker Certification Card."
q. NASA Langley Form 66, "Worker Appointment and Certification Form."
r. NASA Langley Form 185, "Certification of Operators to Perform Lifting Operations."
s. NASA Langley Form 241, "Non-personal Service (NPS) Contractor Employee Shop Machine Lockout Appointment Form."
t. NASA Langley Form 402, "Civil Service Employee Shop Machine Lockout Appointment Form."
u. NASA Langley Form 451, "Non-Personal Service (NPS) Contract Employee Safety Operator Appointment Form."
v. NASA Langley Form 452, "Civil Service Employee Safety Operator Appointment Form."
w. NASA Langley Form 453, "NASA Langley Safety Operators Permit."
x. NASA Langley Form 492, "Radiation Worker’s Certification Card."
y. NASA Langley Form 519, "Civil Service Employee Safety Operator Field Verifier Form."
z. NASA Langley Form 520, "Non-personal Services Contract Employee Safety Operator Field Verifier Form."
aa. NASA-STD-8719.9, "Standard for Lifting Devices and Equipment."
ab. NSS-1740.12, "Explosives Safety."

P.5 CANCELLATION

LPR 1740.6 dated July 22, 2004.

Original signed on file

Lesa B. Roe
Director

DISTRIBUTION:

SDL 040, SDL 410, SDL 411 and SDL 412.
305/Safety and Facility Assurance Branch (200 copies)

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CHAPTER 1

1. INTRODUCTION

1.1 PURPOSE

This document specifies the certification requirements for personnel who perform selected functions on LaRC that require unique occupational safety qualifications. Specifically, it addresses responsibilities, qualifications, training standards, credentials, and medical surveillance issues surrounding those specific functions. In addition, it specifies the certification processes to be followed to obtain the worker certifications and recertifications. These functions are performed by civil servants, contractors, research associates or others on LaRC. The functions are:

- Safety Operator,
  - Craft Specific Lockout/Tagout Safety Operators,
  - Shop Machine Lockout/Tagout Safety Operators,
  - Safety Operator Field Verifier,
- Ionizing Radiation Worker,
- Nonionizing Radiation (Laser) Worker,
- Chemical Worker,
- Pyrotechnic Worker,
- High Worker,
- Hardware Handler,
  - Lifting Operator,
  - Forklift Operator,
- Aerial Manlift Operator,
- Confined Space Worker,
- Respirator Users.

1.2 SCOPE

This document defines the specific requirements of civil service and contract employees, as well as research associates and others who are certified to perform the functions specified in paragraph 1.1 above. The scope of this document addresses the:

- Training requirements for certification,
- Position responsibilities and qualifications,
- Documentation required to authorize certification,
- Certification card requirements,
- Medical examination and surveillance requirements, and
- The location of other sources for more detailed information.

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1.3 GENERAL

LaRC has established personnel safety certification standards to ensure that individuals performing specified functions are trained to:

- Perform their work in accordance with applicable safety and health standards,
- Ensure that required high-risk operations are conducted in a safe and healthful environment, and
- Ensure that the highest standards of safety and performance are maintained while accomplishing the Center's mission.

1.4 RESPONSIBILITY

The responsibility for the implementation and maintenance of LaRC safety policies and standards is delegated to the appropriate management level. Depending upon the task, the personnel safety certification process shall be managed by either the head of the organization, the Facility Safety Head (FSH)/Organizational Facility Safety Head (OFSH), Contract/Program Manager or the first-line supervisor where the function is being performed. These personnel shall ensure that normal and emergency operating procedures are established and that personnel performing the functions are properly trained and certified.

1.5 APPLICABILITY

These personnel safety certification guidelines and procedures shall apply to the functions specified in paragraph 1.1. Additionally, civil servants, contractors, research associates, and others (hereafter referred to as contractors in this document) who perform these functions shall be governed by these procedural requirements. Furthermore, these procedural requirements also apply to other government agency employees who perform the tasks or functions outlined in paragraph 1.1.

1.6 CERTIFICATION DOCUMENTATION

The official documents to be used in processing individuals for safety certification are outlined on Table 1.1, Personnel Safety Certification Documentation. These indicated forms are designed for use by civil servant employees who are applying for personnel safety certification. All contracts/agreements awarded by LaRC shall require that contractor employees also comply with the safety certification processes identified in this LPR. The contracting company shall establish their safety certification process using forms, which are equivalent to the forms identified in Table 1.1.

1.7 MEDICAL SURVEILLANCE REQUIREMENTS

Some of the functions governed by the LaRC personnel safety certification process require medical surveillance. To expedite the process, the Center has established a series of LaRC Occupational Medicine Examination Protocols (OMEP's) for the positions, which require such surveillance. The schedule of medical examinations required for certification is outlined in Table 1.2.

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Table 1.1, Personnel Safety Certification Documentation

POSITION TITLE	DOCUMENT REQUIRED TO PROCESS	CERTIFICATION ISSUED	CERTIFICATION PERIOD
SAFETY OPERATOR	NASA Langley Form 452 - C/S NASA Langley Form 451 - Contractors	NASA Langley Form 453 - Safety Operator's Permit	4 years
CRAFT SPECIFIC LOCKOUT/TAGOUT SAFETY OPERTORS	NASA Langley Form 452 - C/S NASA Langley Form 451 - Contractors	Craft Specific Lockout/Tagout Identification Card	4 years
SHOP MACHINE LOCKOUT/TAGOUT OPERATORS	NASA Langley Form 402 - C/S NASA Langley Form 241 - Contractors	Shop Machine Lockout Identification Card	4 years
SAFETY OPERATOR FIELD VERIFIER	NASA Langley Form 519 - C/S NASA Langley Form 520 - Contractors	NONE	N/A
IONIZING RADIATION WORKER	NASA Langley Form 66	NASA Langley Form 492 - Radiation Worker's Certification Card	2 year
NON-IONIZING RADIATION WORKER	NASA Langley Form 66	NASA Langley Form 492 - Radiation Worker's Certification Card	1 year
CHEMICAL WORKER	NASA Langley Form 66	NASA Langley Form 62 - Worker's Certification Card	1 year
PYROTECHNIC WORKER	NASA Langley Form 29 - Safety Permit Request	NASA Langley Form 498 - Approved Safety Permit	1 year
HIGH WORKER	NASA Langley Form 66	NONE	N/A

HARDWARE HANDLERS: a. CLASS I and CLASS II LIFTING OPERATORS b. FORKLIFT OPERATOR	NASA Langley Form 66 and NASA Langley Form 185 NASA Langley Form 66	NASA Langley Forms 61 - Lifting Operator's Certification Card NASA Langley Form 65 - Workers Certification Card	4 years 3 Years
AERIAL MANLIFT OPERATOR	NASA Langley Form 66	NASA Langley Form 65 - Workers Certification Card	4 years
CONFINED SPACE WORKER	NASA Langley Form 60 - Confined Space Entry Permit	NONE	N/A
RESPIRATOR USER	NASA Langley Form 66	NASA Langley Form 65 - Workers Certification Card	1 year

Table 1.2, LaRC Personnel Safety Certification Medical Examination Requirements

WORKER CLASSIFICATION	PRE CERTIFICATION	ANNUAL	TERMINATION	OCCUPATIONAL MEDICINE PROTOCOL No.
SAFETY OPERATOR *	None	None	None	N/A
CRAFT SPECIFIC LOCKOUT/TAGOUT OPERATOR*	None	None	None	N/A
SHOP MACHINE LOCKOUT OPERATOR	None	None	None	N/A
SAFETY OPERATOR FIELD OPERATOR	None	None	None	N/A
IONIZING RADIATION WORKER **	Required	Required	Required	005
NONIONIZING RADIATION WORKER **	Required	None	Required	004
CHEMICAL WORKER **	Required	Required	None	012
PYROTECHNIC WORKER	None	None	None	N/A
HIGH WORKER **	Required	Required	None	001
HARDWARE HANDLERS **	Required	Required	None	016B
AERIAL MANLIFT OPERATOR **	Required	Required	None	016B
CONFINED SPACE MONITOR	None	None	None	N/A
RESPIRATOR USER	Required	Required	None	003

*** Subject to Random Drug Testing**

**** Medical Examinations Provided in Accordance With LaRC Occupation Medicine Examination Protocols (OMEPs).**

1.8 RECORDS

The following forms were completed when implementing requirements:

NASA Langley Form 452, "Civil Service Employee Safety Operator Appointment Form."
NASA Langley Form 451, "Non-Personal Service (NPS) Contract Employee Safety Operator Appointment Form."
NASA Langley Form 453, "NASA Langley Safety Operators Permit."
NASA Langley Form 66, "Worker Appointment and Certification Form."
NASA Langley Form 29, "Safety Permit Request."
NASA Langley Form 492, "Radiation Worker’s Certification Card."
NASA Langley Form 65, "Worker Certification Card."
NASA Langley Form 61, "Lifting Certification Card."
NASA Langley Form 60, "Confined Space Entry Permit."
NASA Langley Form 185, "Certification of Operators to Perform Lifting Operations."
NASA Langley Form 48, "Safety Permit Request - Radiation Machine."
NASA Langley Form 38, "Safety Permit Request - Radioactive Material."
NASA Langley Form 56, "Radioactive Material Transfer."
NASA Langley Form 49, "Safety Permit Request - Laser/Microwave."
NASA Langley Form 62, "Chemical Worker's Certification Card."
NASA Langley Form 241, "Non-personal Service (NPS) Contractor Employee Shop Machine Lockout Appointment Form."
NASA Langley Form 519, "Civil Service Employee Safety Operator Field Verifier
NASA Langley Form 520, "Non-personal Services Contract Employee Safety Operator Field Verifier Form."

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Chapter 2

2. SAFETY OPERATORS/FIELD VERIFIERS

2.1 CERTIFICATION

The certification of safety operators, craft specific lockout/tagout safety operators, shop machine lockout operators, and safety operator field verifiers shall be performed in accordance with the requirements identified in the latest version of LPR 1710.10, "Safety Clearance Procedures for the Control of Hazardous Energy (Lockout/Tagout)."

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Chapter 3

3. IONIZING RADIATION WORKER

3.1 CERTIFICATION

All personnel who operate, manipulate, or who have any other type of physical control over the use of ionizing radiation-producing equipment or material shall be required to be trained and safety certified as Ionizing Radiation Workers. Most hazardous operations at LaRC are covered by a NASA Langley Form 498, "Safety Permit." A NASA Langley Form 498 shall be initiated by the submission of either a NASA Langley Form 38, "Safety Permit Request - Radioactive Material" or NASA Langley Form 48, "Safety Permit Request - Radiation Machine." Ionizing radiation-producing equipment or material shall be specifically authorized by NASA Langley Form 498. Additionally, personnel who are likely to receive a radiation dose in excess of 10 percent of the limits specified in LPR 1710.5, "Ionizing Radiation," Chapter 5, as a result of exposure to radiation-producing equipment on LaRC, shall also be trained and certified as Ionizing Radiation Workers. Questions concerning this certification requirement shall be directed to the Radiation Safety Officer (RSO).

3.2 RESPONSIBILITY

It is the responsibility of each FSH/OFSH to ensure that personnel within their facility, who fall under the parameters outlined in paragraph 2.1, shall be trained and certified under the safety certification requirements of an Ionizing Radiation Worker.

3.3 QUALIFICATIONS

As a minimum, and prior to working with ionizing radiation, candidate personnel shall be required to specify the radiation experience and training they have received in the following areas:

- General description of radiation and radiation hazards (provided by RSO or contracting company),
- Basic principles of radiation safety (provided by RSO or contracting company),
- Appropriate Federal regulations and LPR 1710.5,
- Emergency procedures (provided by FSH), and
- Radiation safety procedures relevant to duties associated with employment (provided by each FSH).

3.4 DOCUMENTATION

Ionizing Radiation Workers on LaRC include both civil service and contract employees. There are specific documents that these workers shall complete and, in some cases, possess that identify them as certified Ionizing Radiation Workers. These documents are discussed in the following paragraphs.

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3.4.1 Worker Appointment and Certification Forms

Applicants shall complete and submit the appropriate Appointment and Certification Form. That form shall stipulate that the training and safety certification requirements of an Ionizing Radiation Worker have been fulfilled.

3.4.1.1 Civil Service Workers

Civil servants shall complete and submit NASA Langley Form 66, "Worker Appointment and Certification Form."

3.4.1.2 Contractors

Contract personnel shall complete and submit an appropriate comparable form provided by their company to the RSO. The contractor's form shall provide for equivalent information as required by NASA Langley Form 66 and it shall contain an approval process.

3.4.2 Radiation Worker's Certification Card

Upon receipt and approval of a NASA Langley Form 66, "Worker Appointment and Certification Form," the RSO shall issue the civil service requester a NASA Langley Form 492, "Radiation Worker's Certification Card." Contractor employees shall be issued an equivalent certification card by their contracting company, upon receipt and approval of the contracting company's comparable form. The worker shall have the card on-hand or readily accessible, as proof of his/her certification, while performing applicable tasks.

3.4.2.1 Revalidation of Certification

NASA Langley Form 492's or contractor equivalent's are valid for two years from the date of issuance. It is the responsibility of each radiation worker to have the NASA Langley Form 492 or contractor equivalent revalidated by the RSO or contracting company prior to the card expiration date.

3.4.2.2 Termination of Certification

Upon termination of employment, or when the worker no longer needs to be certified to perform ionizing radiation work, the worker shall immediately surrender the NASA Langley Form 492 to the RSO or contractor equivalent to the contracting company.

3.5 MEDICAL SURVEILLANCE

Due to the potential dangers involved in radiation, all Ionizing Radiation Workers shall undergo and pass medical examinations. These examinations shall be required (1) before they are certified to begin work, (2) annually while they are functioning in the position, and (3) upon termination. Civil servants shall receive medical examinations at the LaRC Occupational Medical Center (OMC) in accordance with LaRC OMEP's. Additionally, contracts issued on LaRC shall require the same level of medical surveillance for contract employees. Medical surveillance requirements for contract employees, however, shall be the responsibility of the contracting company.

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3.5.1 Pre-Certifi cation Examination

Civil servants shall receive these medical examinations at the LaRC OMC, Building 1149. They are accomplished through routine processing of the NASA Langley Form 66 and scheduled by the RSO. Contractor personnel examinations shall be scheduled and accomplished in accordance with the guidelines established by their company.

3.5.2 Annual Examinations

Ionizing Radiation Workers shall be required to undergo and pass an annual medical examination to maintain their certification. These examinations shall be conducted at the same locations and under the same guidelines as the pre-certification examinations. The medical records of these personnel shall be specifically identified so that the examining physician is alerted to examine the employee for symptoms relating to radiation exposure.

3.5.3 Termination Examinations

Upon termination of employment, or when an individual no longer requires safety certification as an Ionizing Radiation Worker, the individual shall undergo a termination medical examination. Termination medical examinations shall be scheduled and conducted under the same guidelines as the annual medical examinations. Line supervisors shall be responsible for notifying the RSO when civil servants or contractor employees are being decertified as Ionizing Radiation Workers. This notification is required two weeks prior to the termination so that the examination can be scheduled.

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Chapter

4. NONIONIZING RADIATION (LASER) WORKER

4.1 CERTIFICATION

All personnel who operate, manipulate, or who have any other type of physical control over the use of nonionizing radiation-producing equipment or material shall be required to be trained and safety certified as Nonionizing Radiation Workers. In addition, all nonionizing radiation-producing equipment or material shall be specifically authorized by the issuance of a NASA Langley Form 498. Application for that NASA Langley Form 498 shall be initiated by submission of NASA Langley Form 49, "Safety Permit Request - Laser/Microwave." Questions concerning this certification requirement shall be directed to the RSO.

4.2 RESPONSIBILITY

It is the responsibility of each FSH/OFSH to ensure that personnel within their facility who fall under the parameters outlined in paragraph 2.1 are trained and certified under the safety certification requirements for a Nonionizing Radiation Worker.

4.3 QUALIFICATIONS

As a minimum, and prior to working with nonionizing radiation, candidate personnel shall be required to specify the radiation experience and training they have received in the following areas:

- General description of nonionizing radiation and its hazards (provided by RSO or contracting company),
- Basic principles of nonionizing radiation safety (provided by RSO or contracting company),
- Federal regulations and LPR 1710.4, “Personnel Protection – Clothing and Equipment,“
- Emergency procedures (provided by FSH), and
- Radiation safety procedures relevant to duties associated with employment (provided by each FSH).

4.4 DOCUMENTATION

Nonionizing Radiation Workers on LaRC include both civil service and contract employees. There are specific documents that these workers shall complete and, in some cases, possess that identify them as Nonionizing Radiation Workers. These documents are discussed in the following paragraphs.

4.4.1 Worker Appointment and Certification Forms

Applicants shall complete and submit the appropriate Appointment and Certification Form. That form shall stipulate that the training and safety certification requirements of a Nonionizing Radiation Worker have been fulfilled.

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4.4.1.1 Civil Service Workers

Civil servants shall complete and submit NASA Langley Form 66.

4.4.1.2 Contractors

Contract personnel shall complete and submit an appropriate comparable form provided by their company. The contractor's form shall provide for equivalent information as required by the NASA Langley Form 66 and it shall contain an approval process.

4.4.2 Radiation Worker's Certification Card

Upon receipt and approval of a NASA Langley Form 66, "Worker Appointment and Certification Form," the RSO shall issue the civil service requester a NASA Langley Form 492, "Radiation Worker's Certification Card." Contractor employees shall be issued an equivalent certification card by their contracting company, upon receipt and approval of the contracting company's comparable form. The worker shall have the card on-hand or readily accessible, as proof of his/her certification, while performing applicable tasks.

4.4.2.1 Revalidation of Certification

NASA Langley Form 492's or contractor equivalent's are valid for one year from the date of issuance. It is the responsibility of each radiation worker to have the NASA Langley Form 492 or contractor equivalent revalidated by the RSO prior to the card's expiration date.

4.4.2.2 Termination of Certification

Upon termination of employment, or when the worker no longer needs to be certified to perform nonionizing radiation work, the worker shall immediately surrender the NASA Langley Form 492 to the RSO or contractor equivalent to the contracting company.

4.5 MEDICAL SURVEILLANCE

Due to the potential dangers to workers' eyes involving nonionizing radiation (lasers), all Nonionizing Radiation Workers shall be required to undergo and pass an eye examination by an ophthalmologist. These examinations shall be required (1) before workers are certified, and (2) upon termination. Civil servants shall receive eye examinations at the OMC in accordance with LaRC OMEP's. Additionally, contracts issued on LaRC shall require the same level of eye examinations for contract employees. Eye examination requirements for contract employees, however, shall be the responsibility of the contracting company.

4.5.1 Pre-certificat ion Examination

Civil servants shall receive these eye examinations at the LaRC OMC, Building 1149. They are accomplished through routine processing of the NASA Langley Form 66 and scheduled by the RSO. Contractor personnel eye examinations shall be scheduled and accomplished in accordance with the guidelines established by their company.

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4.5.2 Termination Examinations

Upon termination of employment, or when an individual no longer requires safety certification as a Nonionizing Radiation Worker, the individual shall undergo a termination eye examination. Termination eye examinations shall be scheduled and conducted under the same guidelines as the pre-certification medical examinations. Line supervisors shall be responsible for notifying the RSO when civil servants or contractor employees are being decertified as Nonionizing Radiation Workers. This notification shall be required two weeks prior to the termination so that the examination can be scheduled.

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Chapter 5

5. CHEMICAL WORKER

5.1 CERTIFICATION

LaRC civil service and contract employees who handle specified potentially hazardous materials (PHM) shall be classified as Chemical Workers. Specifically, Chemical Workers conduct operations or perform functions using materials listed on NASA Langley Form 498's. Personnel classified as Chemical Workers shall be required to have the specified training and certification specified herein.

5.2 RESPONSIBILITY

It is the responsibility of each OFSH to ensure that personnel who function within their facility as a Chemical Worker are trained and certified. The training and certification shall be in compliance with the parameters established herein.

5.3 QUALIFICATIONS

As a minimum, and prior to working with PHM, individuals shall be familiar with applicable NASA Langley Form 498's and shall complete training in the following topics, as applicable:

- Toxic Chemicals and Basic Hazard Communication.
- Toxic Chemical Monitoring*.
- Accident Investigation and Safety Planning.
- Flammable, Corrosive, and Reactive Chemicals.
- Compressed Gases*.
- Cryogenic Liquids*.
- Fire Safety.
- Storage.

* If needed for the operation planned, additional site training in personal protective equipment and ventilation control systems may be required.

Chemical Workers shall receive formal training in an approved chemical training course prior to appointment. The course shall address the topic areas in detail, providing a basis for the Chemical Workers to safely perform their specific functions.

5.4 DOCUMENTATION

Personnel performing work on LaRC as a Chemical Worker shall be required to complete specific documentation and request certification to perform their duties. Chemical Workers on LaRC may be either civil service employees or contract employees. There are specific authorizing documents that shall be required to be processed and issued for both of these classes of workers.

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5.4.1 Worker Appointment and Certification Forms

Personnel requiring certification as Chemical Workers on LaRC shall apply for and document the applicable training they have received. Documentation shall be required to be made on the appropriate Appointment and Certification Form. Specifically, the form shall stipulate that the worker has fulfilled the requirements for certification as a LaRC Chemical Worker.

5.4.1.1 Civil Service Workers

Civil servants shall use NASA Langley Form 66 to certify that the requirements to work as a Chemical Worker have been satisfied.

5.4.1.2 Contractors

Contract personnel who are requesting certification as a Chemical Worker shall use a comparable form provided by their company. The contractor's form shall provide for equivalent information as NASA Langley Form 66 and shall contain an approval process.

5.4.2 Chemical Worker's Certification Card

Upon satisfactory completion and submission of the appropriate NASA Langley Form 66, SFAB shall issue a NASA Langley Form 62, "Chemical Worker's Certification Card." The worker shall have the card on-hand or readily accessible, as proof of his/her certification, while performing applicable tasks.

5.4.2.1 Revalidation of Certification

The NASA Langley Form 62 is valid for one year from the date of issuance. It is the responsibility of each Chemical Worker to have the NASA Langley Form 62 revalidated by SFAB prior to the card's expiration date.

5.4.2.2 Termination of Certification

Upon termination of employment, or when the worker no longer needs to be certified to perform chemical work, the worker shall immediately surrender NASA Langley Form 62 to SFAB.

5.5 MEDICAL SURVEILLANCE

Due to the potential danger that chemical exposure presents to LaRC Chemical Workers, they shall be required to undergo scheduled medical examinations. These examinations shall be required (1) before workers are certified, (2) annually while they are functioning in the position, and (3) as directed by exposure. Civil servants shall receive medical examinations at the OMC in accordance with LaRC OMEP's. Additionally, contracts issued on LaRC require the same level of medical surveillance for contract employees. Medical surveillance requirements for contract employees, however, shall be the responsibility of the contracting company.

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5.5.1 Pre-certificat ion Examination

Civil servants shall receive these medical examinations at the LaRC OMC, Building 1149. They are accomplished through routine processing of the NASA Langley Form 66 and scheduled by the OFSH. Contractor personnel examinations shall be scheduled and accomplished in accordance with the guidelines established by their company. For the initial examination of Chemical Workers, OMEP's and contractor equivalents shall be reviewed and requirements tailored/modified by medical and functional officials as appropriate for each situation.

5.5.2 Annual Examinations

Chemical Workers shall be required to undergo and pass an annual medical examination to maintain their certification and to determine if they have symptoms that relate to chemical exposure. The medical records of Chemical Workers shall be specifically identified so that the examining physician can be alerted to symptoms relating to chemical exposure. These examinations shall be conducted at the same locations and under the same guidelines as the pre-certification examinations. Individuals operating under a permitted operation shall be required to participate in annual examinations.

5.5.3 Exposure Examinations

Upon exposure to certain chemicals a Chemical Worker, shall undergo a medical examination. These examinations shall be scheduled and conducted under the same guidelines as the pre-certification and annual medical examinations. Line supervisors shall be responsible for notifying the OFSH when civil servant Chemical Workers have sustained exposure to certain chemicals. (See LPR 1710.12, "Potentially Hazardous Materials.)

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Chapter 6

6. PYROTECHNIC WORKER

6.1 CERTIFICATION

All personnel who handle, transport, install, test, or have physical control over the use of pyrotechnic devices, systems, or material shall be required to be safety certified as Pyrotechnic Workers. Pyrotechnic Workers are restricted to performing work on pyrotechnics whose use has been specifically authorized by a NASA Langley Form 498. Pyrotechnic workers may be either civil service or contract employees. Also, these workers may be further classified as Restricted Pyrotechnic Workers. Restricted Pyrotechnic Workers shall be authorized to handle only a limited type or quantity of pyrotechnics for a specific application.

6.2 RESPONSIBILITY

It is the responsibility of each first-line supervisor to ensure that personnel within their organization who handle pyrotechnics are trained and certified for that purpose. The responsibility for the pyrotechnic safety training is also shared by the FSH who is responsible for the pyrotechnic activity.

6.3 QUALIFICATIONS

As a minimum, and prior to working as a certified Pyrotechnic Worker, individuals shall successfully complete the following:

- Receive instruction regarding the associated hardware with which the individual worker shall be required to work. The worker shall complete a four-hour lecture course on the hardware they will be using. This course shall be taught by the Pyrotechnic Support Engineer,
- Obtain a working knowledge of appropriate Federal regulations and LPR 1710.7, “Use and Handling of Explosives and Pyrotechnics,” and
- Receive an on-the-job training program with a LaRC-Certified Pyrotechnic Technician. The training program shall consist of side-by-side training involving the certified technician and the Pyrotechnic Worker seeking certification.

6.4 DOCUMENTATION

In order to use pyrotechnics on LaRC, a NASA Langley Form 29, "Safety Permit Request, "shall be submitted and forwarded through the approval process. Subsequent to the request, a NASA Langley Form 498 shall be issued for that purpose. Pyrotechnic Workers shall be identified on the NASA Langley Form 498.

6.4.1 Safety Permit Request

The prescribing document governing the issuance of a NASA Langley Form 498 authorizing a worker to use pyrotechnics on LaRC is LPR 1710.7. The worker shall

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contact the Pyrotechnic Support Engineer for assistance in filling out the NASA Langley Form 29. The NASA Langley Form 29 shall be forwarded through the approval process to obtain the following signatures:

- Pyrotechnic Support Engineer,
- Project Engineer,
- Supervisor of individual requesting safety permit,
- LaRC Safety Manager, and
- OFSH.

6.4.2 Safety Permit

The holder of the NASA Langley Form 498 shall be an authorized Pyrotechnic Worker in accordance with the provisions of LPR 1710.7. The permit shall be reviewed at least annually by the Pyrotechnic Support Engineer and updated whenever an operational change is required. It shall always reflect existing operations and defined hazard control techniques, which result in acceptable risk levels.

6.4.3 Py rotechnic Worker Certification

Pyrotechnic personnel shall be “Certified” when their names are listed on a valid NASA Langley Form 498. All NASA Langley Form 498’s, which certify Pyrotechnic Workers, shall be reviewed annually.

6.5 MEDICAL SURVEILLANCE

No medical examinations shall be required for personal safety certification of Pyrotechnic Workers on LaRC.

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Chapter 7

7. HIGH WORKER

7.1 CERTIFICATION

Personnel whose normal or periodic duties or assignments require them to function at elevated heights are required to be trained and safety certified as High Workers. Elevated levels at this Center are defined as working spaces that are 25 feet or more above ground level, and which are not enclosed by normal structural walls and ceilings. This definition is consistent with the American National Standard Institute (ANSI) and the Occupational Safety and Health Administration (OSHA), 29 CFR Part 1926 standards. It includes substations, gantries, and certain hazardous roofs. Not included in this category are internal balconies, flat roofs having appropriate loading capacity and OSHA-compatible rails, guards, parapets, and so forth. Heights of less than 25 feet shall, however, be categorized as elevated if management determines that personnel exposure to those conditions could result in injury or death.

7.2 RESPONSIBILITY

It is the responsibility of the line supervisor to comply with the requirements of LPR 1740.2, “Facility Safety Requirements.” Supervisors shall refer all questions relative to working at elevated levels to the LaRC Safety Manager or the Occupational Health Officer (OHO) for advice and guidance. Supervisors shall ensure that all personnel under their supervision designated as High Workers are, and remain, certified in accordance with the requirements herein.

7.3 QUALIFICATIONS

As a minimum, and prior to working as a High Worker, candidate personnel shall:

- Receive instruction regarding working at elevated levels specific to the tasks that are to be performed. Participate in discussion with the OFSH and Facility Coordinator regarding the work in that facility, and
- Possess a working knowledge of the appropriate Federal regulations and LPR 1740.2

7.4 DOCUMENTATION

High Workers on LaRC include both civil service and contract employees. There are specific documents that these workers shall complete that certify them to be High Workers. NASA Langley Form 66 shall be used for government personnel to determine and certify that the qualifications for worker training and safety certification have been satisfied. NASA Langley Form 66 shall be initiated by the line supervisor. Contractor personnel shall use a form, which supplies the equivalent information of NASA Langley Form 66.

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7.5 MEDICAL SURVEILLANCE

Due to the potential dangers involved in working at heights, all High Workers shall undergo medical examinations. These examinations shall be required (1) before they are certified to begin work and (2) annually while they are functioning as a High Worker. Civil servants shall receive these medical examinations at the LaRC OMC in accordance with LaRC OMEP's. Additionally, contracts issued on LaRC shall require the same level of medical examinations for contract employees. Medical surveillance requirements for contract employees, however, shall be the responsibility of the contracting company.

7.5.1 Pre-Certificati on Medical Examination

Civil servants shall receive these medical examinations at the LaRC OMC, Building 1149. They are accomplished through routine processing of the NASA Langley Form 66 and scheduled by the OFSH. Contractor personnel examinations shall be scheduled and accomplished in accordance with the guidelines established by their company.

7.5.2 Annual Medical Examinations

High Workers shall be required to undergo and pass an annual medical examination to maintain their certification. These examinations shall be conducted at the same locations and under the same guidelines as the pre-certification examinations.

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Chapter 8

8. HARDW ARE HANDLER

8.1 CERTIFICATION

Hardware Handlers at LaRC are classified as Lifting Operators or Forklift Operators. They are distinguished by the certification criteria required to perform distinctly different categories of functions. Lifting Operators are further divided into two sub-classifications:

- Class I - General: Rigger and Equipment Operator
- Class II - Restricted: Technical Employees (restricted to the specific equipment they are qualified to operate).

Personnel who operate, manipulate, or who have any other type of physical control over the use of handling/lifting equipment on LaRC shall be required to be trained and safety certified. Hardware Handlers are defined as individuals who operate overhead or mobile and/or permanently installed cranes, derricks, forklifts, portable or fixed hoisting assemblies, winches, and general equipment such as wire ropes, slings, hooks, bridles, riggings, and other fittings critical to handling/lifting operations. These examples are not all inclusive; and, additional equipment operators may require safety certification at the discretion of SFAB.

8.2 RESPONSIBILITY

It is the responsibility of the head of each organization to ensure that personnel who operate special handling equipment or perform critical lifting are trained and certified in compliance with this document.

8.3 QUALIFICATIONS

As a minimum, and prior to working as a Hardware Handler, personnel shall successfully complete the training to be safety certified for the position. The required qualifications are outlined in the following paragraphs.

8.3.1 Class I - General: Rigger and Equipment Operator Qualifications

Riggers and equipment operators who are classified as Class I: General Operators, shall meet the requirements in the following paragraphs to be safety certified:

8.3.1.1 Testing Requirements

Testing of Class I Lifting Operators shall include written examinations that contain questions addressing the work performed by Class I riggers and special equipment operators. The questions shall address, as a minimum, the following subject areas:

- Determination of center of gravity (CG),
- Determination of load weight,

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- Calculation of lifting-line strength such as cable and rope and margin of safety,
- Calculation of sling tension loads,
- Use of common slings and hitches,
- Selection of sizes and use of chocks,
- Use of hydra-set,
- Use of proof-loading specifications,
- Use of hand signals,
- Use of and determining strength of knots,
- Use of and determining strength of shackles and hooks,
- Distortion of loads (blocking),
- Safety applications, and
- Knowledge of quality assurance requirements.

8.3.1.2 Proficiency Examination Requirements (Riggers)

Proficiency testing for Class I Lifting Operators (Riggers) shall include, as a minimum, performance of the work functions listed below:

- Conducting a series of difficult load attachments involving a determination of weight and CG,
- Selecting method of attachment,
- Selecting hooks, bridles, slings, and so forth,
- Hand signaling a typical lift, move, and relocation of load, crane boom, and pendant line assembly,
- Demonstrating knowledge of hand signals used with mobile and lifting equipment as defined in Lifting Program Hardware Class I Certification.

8.3.1.3 Proficiency Examination Requirements (Lifting and Special Equipment Operators)

Proficiency testing for Class I Lifting Operators (Lifting and Special Equipment Operators) shall include, as a minimum, performances listed below:

- Operating mobile cranes,
- Operating overhead or gravity cranes,
- Operating forklifts,
- Operating portable lifting cranes,
- Operating industrial truck cranes,
- Operating Hy-Ranger vehicles,
- Operating all types of bucket trucks, and
- Demonstrating operational proficiency in:
  - Equipment inspection procedure,
  - Positioning crane for lift,
  - Outrigger deployment,
  - Full-range boom and cab travel (empty),

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- Hand-signal motions (empty),
- Lifting and braking with load,
- Hand-signal motions (loaded), and
- A series of load placements.

8.3.1.4 Experience requirements

Class I - General: Rigger and Equipment Operators shall possess at least a minimum of four years job related experience in the Building and Trades Union or have been employed for two years as a first class maintenance rigger.

8.3.2 Class II - Restricted: Technical Employees Qualifications

This classification of Lifting Operators shall be restricted to operating the specific equipment listed on their NASA Langley Form 61, "Lifting Certification Card." Certification of Class II Lifting Operators is based upon the following:

- Related experience,
- Appropriate testing requirements,
- Appropriate proficiency examinations,
- Approved training course, and
- Acceptable period of on-the-job training.

8.3.2.1 Testing Requirements

Testing of Class II Lifting Operators shall include written examinations that contain appropriate questions addressing the work to be performed. The questions shall address, as a minimum, the subject areas listed below:

- Determination of center of gravity (CG),
- Determination of load weight,
- Calculation of lifting-line strength such as cable and rope and margin of safety,
- Calculation of sling tension loads,
- Use of common slings and hitches,
- Selection of sizes and use of chocks,
- Use of proof-loading specification,
- Use of hand signals,
- Use of and determining strength of shackles and hooks,
- Distortion of loads (blocking),
- Safety applications, and
- Knowledge of quality assurance requirements.

8.3.2.2 Proficiency Examinations

Class II Lifting Operators shall be required to pass a proficiency examination before they are safety certified. The examinations shall include:

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- Conducting a series of typical load attachments (i.e., location of CG, weight determination, and selecting lifting devices such as hooks, bridles, slings, and so forth),
- Hand signaling a lift operation, and
- Demonstrating operational proficiency in special pieces of lifting equipment (i.e., lifting, braking, load placement, etc.) with and without hand signals.

8.3.3 Forklift Operators

8.3.3.1 Testing Requirements

Testing requirements for Forklift Operators shall include written examinations that contain appropriate questions addressing the demands of the work to be performed. The questions shall address, but are not limited to, the subject areas listed below.

- Safety applications and safety inspections,
- Knowledge of equipment limitations, capabilities, and design considerations,
- Knowledge of equipment operations and control systems,
- Equipment care and damage reporting requirements,
- Use of required safety equipment,
- Ground slope restrictions,
- Emergency operation procedures,
- Lifting, moving, and setting-down load restrictions, and
- Weight restrictions.

Forklift Operators shall successfully pass the appropriate written test establishing that the worker has operational safety and knowledge of forklift use.

8.3.3.2 Proficiency Examination Requirements

Proficiency testing for Forklift Operators shall be required before they can be safety certified. This hands-on examination shall include, as a minimum:

- Demonstrating proper use of forklift controls,
- Following proper procedures for unattended forklift,
- Demonstrating competency in basic maneuvering skills,
- Demonstrating competency in picking up a load,
- Demonstrating competency in driving with a load,
- Demonstrating competency in stacking a load, and
- Demonstrating competency in loading/unloading a trailer, rail car, or other vehicle.

8.3.3.3 Experience Requirements

Workers requiring safety certification as a Forklift Operator shall be required to complete the following:

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- Attend a two-hour classroom training program addressing the following issues as they relate to forklift utilization:
  - Safety,
  - Emergency procedures,
  - General performance standard,
  - Requirements,
  - Pre-operational checks, and
  - Safety related defects and symptoms for forklifts.
- Complete a minimum of six hours of hands on training on a forklift, and
- Receive an informal annual review by their organization on equipment operation and safety procedures.

8.4 DOCUMENTATION

Forklift Operators and both Class I and Class II Lifting Operators shall be required to be safety certified through the approval process outlined in this document.

8.4.1 Class I Lifting Operator Documents

Civil servant employees who request safety certification on LaRC as a Class I Operator shall process their request on NASA Langley Form 66, and NASA Langley Form 185, "Certification of Operators to Perform Lifting Operations." These forms shall be used to document and certify that the qualifications required in paragraph 5.3 have been satisfied. Contract personnel who require certification shall use an appropriate comparable form for certification. The contractor's form shall provide information equivalent to that on NASA Langley Form 66 and shall contain an approval process. NASA Langley Form 61, "Lifting Certification Card," shall be issued to certified civil service lifters who are qualified to perform lifts with specific equipment. Contractors shall issue a certification card equivalent to NASA Langley Form 61 to all of their certified lifters. The NASA Langley Form 61 shall list, on its reverse side, the specific equipment the individual is certified to operate. The worker shall have the card on-hand or readily accessible, as proof of his/her certification, while performing applicable tasks. Recertification shall be required every four years and shall follow the same process as the original certification process.

8.4.2 Class II Lifting Operator Documents

NASA Langley Form 66 and NASA Langley Form 185 shall be used to initiate the recommendation for the certification of Class II Lifting Operators. These forms certify that all of the requirements contained in paragraph 5.3 have been satisfied. These forms shall require the signatures of the following authorizing individuals:

- Supervisor/Contract Manager,
- OUM Training Coordinator,
- Classroom Instructor,
- Applications Instructor,
- OUM/COTR,
- LaRC Safety Manager

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NASA Langley Form 61 or the contractor equivalent certifies that the holder has successfully completed the course work and physical requirements in accordance with the minimum OSHA training requirements. The NASA Langley Form 61 shall document the specific equipment that the lifting operator is certified to operate. The worker shall have the card on-hand or readily accessible, as proof of his/her certification, while performing applicable tasks. Recertification shall be required every four years and shall follow the same process as the original certification process.

8.4.3 Forklift Operator Documents

Forklift Operators shall be required to be safety certified through the approval process outlined in this document. Civil servant employees who require safety certification on LaRC as a Forklift Operator shall process their request on NASA Langley Form 66. This form shall be used to document and certify that worker qualifications required in paragraph 5.3.3 have been satisfied. Contract personnel who require certification shall use an appropriate comparable form provided by their company for certification. The contractor's form shall provide equivalent information as NASA Langley Form 66 and it shall contain an approval process. NASA Langley Form 65, "Worker Certification Card," shall be issued to certified civil service Forklift Operators. Contractors shall issue a certification card equivalent to NASA Langley Form 65 to all of their certified Forklift Operators. The reverse side of the NASA Langley Form 65 shall show the specific forklift equipment that the worker is certified to operate. Recertification of a Forklift Operator shall be required every three years. The worker shall have the card on-hand or readily accessible, as proof of his/her certification, while performing applicable tasks. The recertification process shall follow the same procedures that were used during the original certification process.

8.5 MEDICAL SURVEILLANCE

Hardware Operators at LaRC can be either civil service or contractor employees. The work performed by these individuals requires strict adherence to LaRC OMEP's. Class I Lifting Operators shall be required to have (1) pre-certification and (2) annual medical examinations as specified in LaRC OMEP's. Class II Lifting Operators shall be required to have (1) pre-certification medical examinations and (2) medical examinations every four years at the time of recertification with a requirement to have a visual and hearing acuity test performed each year between recertification. Forklift Operators shall be required to have (1) pre-certification medical examinations and (2) medical examinations every three years at the time of recertification with a requirement to have a visual and hearing acuity test performed each year between recertification. Hardware Handler candidates and certified Hardware Handlers shall successfully pass these OMEP's to be certified/recertified. Civil service employees shall have their required medical examinations at the OMC. All contracts/agreements awarded on LaRC shall require that the contracting company provide medical surveillance of their personnel who will perform these duties.

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8.5.1 Pre-Certificati on Medical Examination

Personnel requiring certification as Hardware Handlers shall undergo and pass a medical examination in compliance with LaRC OMEP's, prior to issuance of a NASA Langley Form 61 or NASA Langley Form 65 or contractor equivalent. This examination is accomplished through routine processing of NASA Langley Form 66 or the equivalent contractor's form. A medical disqualification shall result if a candidate does not satisfy the requirements of the OMEP's.

8.5.2 Medical Examinations

All LaRC Class I Lifting Operators shall annually undergo and pass a medical examination in accordance with LaRC OMEP's. All LaRC Class II Lifting Operators shall undergo and pass a medical examination every four years at the time of their recertification, with visual and hearing acuity tests required each year in between recertification, in accordance with LaRC OMEP's. All LaRC Forklift Operators shall undergo and pass a medication examination every three years at the time of their recertification, with visual and hearing acuity tests required each year in between recertification, in accordance with LaRC OMEP's.

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Chapter 9

9. AERIAL MANLIFT OPERATOR

9.1 CERTIFICATION

Aerial Manlift Operators shall be trained and safety certified to operate the manlift equipment that is authorized for use on the Center. There are three classes of equipment that workers shall be separately certified to operate through the safety certification process. The specific manlift equipment that requires separate safety certification are:

- Genie Boom Manlift,
- JLG Manlift, and
- High Lift Manlift.

All aerial manlift equipment shall be used under the direct control of at least two certified operators. Workers undergoing safety certification training shall be assisted by two other safety certified operators, during the operation/use of any aerial manlift equipment. Additionally, a separate safety certification shall be required to operate each individual type of equipment. Workers who operate aerial manlift equipment shall possess a NASA Langley Form 61 or contractor equivalent, specifying the type of equipment they may operate.

9.2 RESPONSIBILITY

It is the responsibility of the head of each organization that uses the aerial manlift equipment to ensure that personnel who operate the equipment are trained and certified in compliance with this document.

9.3 QUALIFICATIONS

As a minimum, and prior to working as an Aerial Manlift Operator, individuals shall successfully complete the appropriate training and safety certification authorizing them to operate the equipment. The qualifications are outlined in the following paragraphs.

9.3.1 Testing Requirements

Testing of Aerial Manlift Operators shall include written examinations that contain appropriate questions addressing the work to be performed. The questions shall address, as a minimum, the subject areas listed below.

- Safety applications,
- Knowledge of equipment limitations and capabilities,
- Knowledge of equipment operations and control systems,
- Equipment care and damage reporting requirements,
- High voltage and electrical operational restrictions,
- Use of required safety equipment,

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- Wind restrictions,
- Ground conditions restrictions,
- Ground slope restrictions,
- Emergency operation procedures,
- Safety zone requirements,
- Lifting restrictions,
- Weight restrictions, and
- Successfully pass the appropriate written test that establishes the worker has safety and operational knowledge of the aerial manlift equipment they are certified to operate.

9.3.2 Proficiency Examination Requirements

Proficiency testing for Aerial Manlift Operators shall include, as a minimum, demonstrated performance of work functions listed below:

- Aerial lift buckets operations,
  - Full-range of operation of the bucket from ground and bucket stations,
  - Knowledge of safety rules and regulations, and
  - Positioning of bucket.
- Equipment inspection procedures, and
- Outrigger deployment (if applicable).

High Reach Bucket Truck Operators shall be required to acquire a Commercial Drivers License - Class B with an air brake endorsement. Aerial Manlift Operators shall receive an informal annual review by their organization on equipment operation and safety procedures.

9.3.3 Experience Requirements

Workers requiring safety certification as an Aerial Manlift Operator shall complete the following:

- Certification as a High Worker,
- A two-hour classroom training program on the following:
  - Safety,
  - Emergency procedures,
  - General performance standard,
  - Requirements,
  - Pre-operational checks,
  - Safety related defects and symptoms for manlift devices, and
- A minimum of six hours of hands on training on each manlift device for which the worker requires certification.

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9.4 DOCUMENTATION

Civil servant employees who require safety certification on LaRC as an Aerial Manlift Operator shall process their request on NASA Langley Form 66. This form shall be used to document and certify that the qualifications of the worker, required in paragraph 9.3, have been satisfied. Contract personnel who require certification shall use a comparable form provided by their company for certification. The contractor's form shall provide for equivalent information as NASA Langley Form 66 and shall contain an approval process. The NASA Langley Form 61 or contractor equivalent shall be issued to certified workers. The NASA Langley 61 or contractor equivalent shall list, on the reverse side of the card, the specific manlift equipment the worker is certified to use. The worker shall have the card on-hand or readily accessible, as proof of his/her certification, while performing applicable tasks. Recertification shall be required once every four years and shall follow the same process as the original certification process.

9.5 MEDICAL SURVEILLANCE

The work performed by Aerial Manlift Operators shall require medical surveillance with strict adherence to the LaRC OMEP's. Specifically, these positions shall require (1) pre-certification medical examinations and (2) medical examinations every four years at the time of recertification with a requirement to have a visual and hearing acuity test performed each year between recertification, in accordance with specified LaRC OMEP's. Candidates shall undergo and pass these medical examinations to be certified/recertified. Civil service employees shall have their required medical examinations at the LaRC OMC. Additionally, all contracts/agreements awarded on LaRC shall require that the contracting company medically certify its workers who will perform these duties.

9.5.1 Pre-Certificati on Medical Examination

Personnel requiring certification as Aerial Manlift Operator shall first undergo and pass a medical examination in compliance with the LaRC OMEP's. This examination shall be accomplished through routine processing of NASA Langley Form 66 or the equivalent contractor's form. A medical disqualification shall result if a worker does not successfully complete the medical protocol.

9.5.2 Medical Examinations

All Aerial Manlift Operators at LaRC shall undergo and pass a medical examination every four years at the time of their recertification, with visual and hearing acuity tests required each year in between recertification, in accordance with LaRC OMEP's.

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Chapter 10

10. CONFINED SPACE WORKER

10.1 CERTIFICATION

All individuals who participate in the entry of confined spaces shall be properly trained and safety qualified as confined space workers. This includes all personnel that will be entrants, attendants and/or entry supervisors. The safety certification shall be completed in accordance with this document. A confined space is defined as a space that is not normally occupied by personnel and, by design, has limited or restricted openings for entry and exit, may lack adequate ventilation, may contain or produce “dangerous air contamination," and, therefore, may not be safe for entry. Confined spaces normally include, but are not limited to, boilers, furnaces, degreasers, storage tanks, test chambers, vessels, tunnels, compartments, pits, vats, sewers, underground utility vaults, manholes, certain locations within aircraft and spacecraft when not in flight, and any other location not specifically covered that is designated a confined space (see LPR 1740.2).

10.2 RESPONSIBILITY

It is the responsibility of each first-line supervisor and FSH to ensure that personnel within their organization who function as Confined Space Workers are trained and qualified.

10.3 QUALIFICATIONS

As a minimum, and prior to working as a confined space monitor, individuals shall receive training covering the following subjects:

- Hazard recognition,
- Proper respiratory protection for confined spaces,
- Use of atmospheric testing devices to include training on the manufacturers’ specified field checks, normal use, and specific limitations of the equipment,
- Lockout and tagging procedures,
- Use of special equipment and tools,
- Emergency and rescue methods and procedures, and
- Emergency entry and exit procedures.

10.4 DOCUMENTATION

NASA Langley Form 60, "Confined Space Entry Permit," shall be used to document the certification of Confined Space Workers. NASA Langley Form 60 shall be used by both government and contract personnel to certify that the qualifications and training required to become safety certified have been satisfied. NASA Langley Form 60 shall require the signature of the qualifying supervisor to approve the certification of a worker as a Confined Space Worker.

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10.5 MEDICAL SURVEILLANCE

Employees who perform work as Confined Space Workers shall not be required to undergo a medical examination prior to safety certification.

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Chapter 11

11. RESPIRATOR USER

11.1 CERTIFICATION

All personnel required to wear respiratory protection devices, in the performance of their job assignments, with the exception of voluntary use of disposable single use filtering face pieces, shall be required to be certified as Respirator Users.

11.2 RESPONSIBILITY

It shall be the responsibility of the FSH to ensure that personnel within their facility, who fall under the parameters outlined in paragraph 11.1, are trained and certified under the safety certification requirements of a Respirator User.

The SFAB designated Certified Industrial Hygienist shall serve as the LaRC Respiratory Protection Officer (RPO), responsible for the Center's respiratory protection program.

11.3 QUALIFICATIONS

As a minimum, and prior to working as a respirator user, individuals shall receive training covering the following subjects:

- When respiratory protection is required,
- Limitations of respiratory protection,
- Procedures for detecting failure of respiratory protection devices,
- Procedures for wearing respiratory protection devices,
- Procedures for cleaning respiratory protection devices,
- Procedures for inspection of respiratory protection devices,
- Employee responsibilities.
- Quantitative fit testing.

Respirators Users, who will be wearing tight fitting respirators, shall be quantitatively fit tested prior to using the respirator and annually there after.

11.4 DOCUMENTATION

Respirator Users on LaRC include both civil service and all contract employees. There are specific documents that these workers shall complete and in some cases, possess that identify them as certified Respirator Users. These documents are discussed in the following paragraphs.

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11.4.1 Worker Appointment and Certification Forms

Applicants shall complete and submit the appropriate Appointment and Certification form. That form shall stipulate that the training and safety certification requirements of a Respirator User have been fulfilled. Civil servants shall be issued a NASA Langley Form 65, "Worker Certification Card," by the SFAB designated IH. Contractors shall be issued an equivalent certification card by their contracting company.

11.4.1.1 Civil Service Workers

Civil servants shall complete and submit NASA Langley Form 66, “Worker Appointment and Certification Form.”

11.4.1.2 Contractors

Contactors shall complete and submit an appropriate comparable form provided by their company. The contractor’s form shall provide for equivalent information as required by NASA Langley Form 66 and it shall contain an approval process.

11.5 MEDICAL SURVEILLANCE

Due to the potential dangers to workers all Respirator Users shall be required to undergo scheduled medical examinations. These examinations shall be required (1) before they are certified to begin work, and (2) annually while they are functioning in the position requiring the respiratory protection. Civil servants shall receive medical examinations at the LaRC OMC, in accordance with LaRC OMEPs. Additionally, contracts issued on LaRC shall require the same level of medical surveillance for contract employees. Medical surveillance requirements for contract employees, however, shall be the responsibility of the contracting company.

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LPR 1820.2

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Langley Research Center

ERGONOMICS PROGRAM

National Aeronautics and Space Administration

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Responsible Office: Safety and Mission Assurance Office

PREFACE

P.1 PURPOSE

a. This Langley Research Center (LaRC) Procedural Requirements (LPR) sets forth the responsibilities and procedures for the LaRC Ergonomics Program and is part of the Center's Safety Manual. The Safety and Mission Assurance Office (SMAO) is the LaRC contact for the Ergonomics Program.

b. The Ergonomics Program is designed to provide the framework for implementing a successful program for preventing and managing MusculoSkeletal Disorders (MSDs).

P.2 APPLICABILITY

a. These procedural requirements are applicable to all LaRC facilities and employees. The requirements of this LPR are to be incorporated into any contract under which contractor employees will be assigned to on-site LaRC activities that may lead to the development of MSDs.

b. It is the responsibility of Contractors to provide and implement their own ergonomics program. As a minimum, these contractor programs shall be in accordance with the LaRC Ergonomics program as described herein.

P.3 AUTHORITY

a. NPD 1820.1, “NASA Environmental Health Program.”

P.4 APPLICABLE DOCUMENTS

a. NASA Procedural Requirements (NPR) 1800.1, “NASA Occupational Health Program Procedures.”

b. NPR 8715.1, "NASA Safety and Health Handbook, Occupational Safety and Health Programs."

c. NPR 8715.3, "NASA Safety Manual."

d. Langley Policy Directive (LAPD) 1700.2, "Safety Assignments."

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e. LMS-CP-4760, "Reporting Injuries, Illnesses, Compensation Claims and Unsafe Working Conditions."

f. "Ergonomics" proposed OSHA Standard, 29 Code of Federal Regulations (CFR) 1910.900.

g. “Elements of Ergonomics Programs,” National Institutes of Safety and Health

h. Lawrence Livermore National Laboratory Environment, Safety and Health Manual, Volume II, Document 19.1 “*Ergonomics*”

i. Langley Form (LF)19, “Office Ergonomics Evaluation Checklist.”

P.5 MEASUREMENT/VERIFICATION

LF 19, “Office Ergonomics Evaluation Checklist,” is used to gather data for determining compliance in assessing worksites and in coordinating with clinic personnel.

P.6 CANCELLATION

None

Original signed on file, June 9, 2009

Cynthia C. Lee
Associate Director

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CHAPTER 1. Introduction

1.1 Background

1.1.1 Every effort shall be made to ensure that the work environment affords the necessary protection against MusculoSkeletal Disorders (MSDs). MSDs may develop in workers whose jobs involve repetitive motions, force, awkward postures, contact stress, cold temperatures, excessive duration, and vibration.

1.1.2 The principle behind ergonomics is that by fitting the job to the worker through adjusting the workstation, rotating between jobs, taking frequent breaks, or using mechanical assistive devices, MSDs can be reduced and ultimately eliminated.

1.1.3 The aim of this procedural requirement is to:

a. Identify work practices and operations which may lead to MSDs,

b. Prevent MSDs among employees,

c. Provide a work environment free from ergonomic hazards, and to

d. give priority to engineering and administrative controls to the greatest extent practicable to eliminate, or control work operations that may lead to the development of MSDs.

1.1.4 Ergonomic-related injuries are usually associated with prolonged exposure to inappropriate work conditions or practices rather than acute exposure injuries such as sprains and strains.

1.2 Issuance and Control

1.2.1 The Safety and Facility Assurance Branch (SFAB) is responsible for the issuance, distribution, and control of these procedural requirements. Revisions shall be reviewed with affected organizations and documented on a Transmittal Notice.

1.3 Guidance, Definitions, and Terminology

1.3.1 Appendices A, “Guidance,” C, "Definitions and Terminology," and D, "Acronyms," are included to assist with these procedural requirements.

CHAPTER 2. Responsibilities

2.1 Ergonomics Program Officer (ErgPO)

2.1.1 The LaRC Industrial Hygienist is the ErgPO and is responsible for:

a. Implementing and administering the Ergonomics Program (EP).

b. Evaluating levels of employee exposure to ergonomic hazards and recommending means of controlling exposures.

c. Ensuring that personnel are instructed, individually or in groups, by qualified personnel concerning the health hazards associated with repetitive motions, force, awkward postures, contact stress, cold temperatures, excessive duration, and vibration and methods to mitigate them.

d. Maintaining survey data relative to MSD hazards and employee exposures.

e. Conducting an annual review to ensure that employee training is adequate.

f. Making recommendations to the Occupational Medicine Clinic (Health Clinic) on the placement or reassignment of personnel with significant musculoskeletal disorders, after conferring with the Occupational Health Officer (OHO), Office of Human Resources (OHR).

g. Providing ergonomics consultative services.

h. Conducting follow-up evaluations for personnel who have reported to the clinic for MSDs and for personnel who have modifications made to their work place in response to a MSD complaint.

2.2 Occupational Medicine Clinic (Health Clinic)

2.2.1 The Health Clinic, OHR, is responsible for:

a. Obtaining work histories in support of the EP, and evaluating test results.

b. Scheduling and conducting appropriate medical examinations, and/or referring personnel to an appropriate medical consultant.

c. Notifying the employee's supervisor if a change in job assignment or workstation layout is recommended as a result of a MSD.

d. Notifying and coordinating with the ErgPO when an employee reports with a MSD.

2.3 Ergonomic Evaluators (Ergo Evaluators)

2.3.1 These individuals are the backbone of the LaRC ergonomics program providing assistance in recognizing problems and recommending solutions. Approximately 40 people (1% of the population) from various levels within the organizations at LaRC serve as Ergo Evaluators. Ergo Evaluators are responsible for:

a. Attending training to develop knowledge and expertise in ergonomic principles through lecture and hands-on technical exercises.

b. Scheduling and conducting worksite evaluations as requested.

c. Notifying the employee's supervisor if a change in workstation layout is recommended.

d. Educating co-workers on the principles of ergonomics.

e. Proactively addressing ergonomic stressors they identify during the normal course of their workday.

f. Requesting assistance from the ErgPO if they are unsure of proper workstation setup or work practices.

2.4 Supervisors

2.4.1 Supervisors are responsible for:

a. Providing the ErgPO and the Health Clinic with the names of personnel with possible MSDs.

b. Referring to the LaRC Health Clinic for examination and follow-up, all personnel complaining of possible MSDs.

c. Enforcing the wearing of personnel protective devices (such as vibration dampening gloves, knee pads, and computer glasses) to reduce the effects of MSDs on the employee.

d. Reviewing employee work activities and identifying tasks, or locations, which may pose an MSD risk.

e. Abating identified MSD hazards.

f. Assuring that employees report to the clinic any suspected MSDs.

g. Assuring the procurement (including credit card purchases) of appropriate Personal Protective Equipment (PPE) and other ergonomic devices by obtaining the approval of

the ErgPO. However, PPE will only be used when engineering controls or administrative controls are not feasible.

h. Notifying the ErgPO of new or previously un-reviewed work activities that are likely to result in MSDs so that ergonomic assessments can be made.

2.5 Employees

2.5.1 Employees are responsible for:

a. Notifying their supervisor of activities that may present a risk for MSDs.

b. Reporting to the clinic for evaluation if they believe that they may be experiencing symptoms of a MSD.

c. Performing work with ergonomic considerations in mind. This includes establishing work areas in a manner consistent with good ergonomic practices.

d. Requesting assistance from an Ergo Evaluator or the ErgPO if they are unsure of proper workstation setup or work practices.

e. Assisting in identifying and recommending corrective actions for ergonomic hazards.

APPENDIX A. Guidance

A.1 The procedures for implementing the Ergonomics Program are presented in this chapter. The procedures include training of supervisors and employees regarding common MSDs and the signs/symptoms of exposure, the procedures for evaluating employee workstations for ergonomic hazards, use of ergonomic devices to reduce the likelihood and severity of MSDs, and recordkeeping.

A.2 MSD Hazard Evaluation

MSD hazard evaluation includes identifying workstation layout and work practices, which are likely to result in MSDs.

A.1.1 Work Station Evaluations

A.1.1.1 Any employee who is experiencing discomfort or is concerned about their workstation may request an evaluation. Evaluations may also be requested by supervisors or by the Health Clinic in response to a suspected MSD. Workstation evaluations are performed by the ErgPO or other qualified individuals.

A.1.1.2 Copies of the results of the evaluations, along with the recommended actions, should be distributed to the employee, their supervisor, the Occupational Medicine Clinic (Health Clinic), and the ErgPO.

A.1.1.3 Employees are also encouraged to perform evaluations of their own workstations. (See Langley Form 19, “Office Ergonomics Evaluation Checklist.”)

A.2 Office Environments

A.2.1 MSD-related injuries in the office environment are most often associated with poor workstation arrangement and excessive computer usage without taking breaks. These injuries can be prevented through proper workstation design and the use of micro-breaks.

A.2.1 Engineering Controls

A.2.1.1 Engineering controls are always the preferred method for controlling hazards. In office environments, the primary method of control is the selection of appropriate furniture and the proper position of the furniture and office equipment in relation to the worker.

A.2.1.2 The following describes the proper method for selection and use of office equipment:

A.2.1.2.1 Chairs. When purchasing chairs, the chair selected should be fitted to the individual who will be using it. In general chairs should be highly adjustable, allowing adjustment of the following: seat height and tilt, armrest height and width and back rest height. Chairs being purchased to address ergonomic concerns should have good lumbar support, have a five-point star base and wheels appropriate for the floor surface. The chair height should be positioned such that the thighs are roughly parallel to the floor with the feet flat on the ground, preventing pressure on the back of the lower thigh. It may be necessary to use a footrest to achieve proper positioning. If the seat tilt is adjustable it should be set for a slight forward tilt. The back height and angle should be set so that it provides good lumbar support. The armrests should be set so that the elbows are directly below the shoulders. Existing chairs will be used until unserviceable unless there are indications that their use will lead to an MSD.

A.2.1.2.2 Work Surfaces. Work surfaces should be of a height such that the workers forearms are roughly parallel to the floor and deep enough to accommodate all necessary equipment such as monitors and keyboards. Additionally, the working position should not require the workers forearms or wrists to contact any sharp corners. Articulated keyboard trays can be used to provide adjustability to workstations.

A.2.1.2.3 Computer Input Devices

A.2.1.2.3.1 Keyboards should be located directly in front of the worker at a height allowing their forearms to be roughly parallel to the floor. In addition, the angle of the keyboard should allow the wrists to maintain a neutral position. In general, this means that the keyboard should not be tilted toward the worker and may in fact need to be tilted slightly away from the worker.

A.2.1.2.3.2 Computer mice and trackballs should be positioned so that the worker can use them without having to reach with the shoulder. Mice should be of a size that comfortably fits in the palm of the hand. Mice should not require the user to grip them tightly in order to use them. Avoid small “hockey puck” mice as they require a gripping motion to use them.

A.2.1.2.3.3 Wrist rests should be used with both keyboards and mice/trackballs. The hands should float above the keyboard and the wrist rests should be used during periods of inactivity.

A.2.1.2.4 Computer Monitors. Computer monitors should be positioned directly in front of the worker. The height of the monitor should be set so that the top third of the monitor is at the height of level

vision. Reams of paper are an inexpensive way to raise monitors; however care should be taken to avoid a tipping hazard. The distance of the monitor should be at about the end of arms reach when sitting in working position.

A.2.1.2.5 Lighting. Room lighting should be bright enough to prevent eyestrain. Computer monitors should be positioned to eliminate glare from overhead lighting or windows. Individual bulbs may be removed from overhead lights to control lighting intensity and glare. The use of task lighting is effective for creating areas of localized lighting without increasing the overall brightness of a room.

A.2.1.2.6 Vision.

A.2.1.2.6.1 Vision is an, often, overlooked factor in office ergonomics. Prolonged computer usage without taking frequent breaks can cause eyestrain. Frequent “microbreaks” are recommended where the worker simply changes their depth of focus for a short period of time.

A.2.1.2.6.2 Workers who wear corrective lenses for vision are at additional risk due to the difference in reading and computer monitor distances. The focal length for most reading eyewear is set to approximately 18 inches. Since computer monitors are usually set at farther distances this can cause eyestrain, and in many cases causes the worker to unconsciously hunch forward in order to find their focal length. This can result in neck and shoulder stain. Eyewear can be obtained with the correct focal length for computer use.

A.2.2 Administrative Controls

A.2.2.1 Administrative control measures include:

A.2.2.1.1 Breaks. Taking frequent breaks is perhaps one of the easiest ways to prevent injuries associated with prolonged computer usage. A break of a few minutes should be taken every half hour while using the computer. Studies have shown that it is effective in preventing injury and that productivity and accuracy are actually improved as a result of the frequent breaks.

A.2.2.1.2 Rotation of Repetitive Tasks. Tasks that involve repetitive motions can be rotated between employees in order to lessen the exposure to individuals.

A.2.2.1.3 Protective Equipment. Protective equipment, such as braces, should not be used unless recommended by a medical professional. Do not attempt to treat symptoms yourself by buying over the counter braces or splints. Improper selection of protective equipment can encourage continuing poor work practices and lead to further injury. Report any symptoms of MSDs to the clinic.

A.3 Industrial Environments

A.3.1 MSD injuries in industrial environments can occur from improper lifting and material movement techniques, from performing repetitive tasks and from using hand tools. As each industrial environment is unique only general guidance can be provided regarding evaluation of these types of worksites.

A.3.1.1 Engineering Controls. The use of engineering controls is always the preferred method to control hazards. The primary engineering controls for industrial type setting are the use of proper material handling equipment and design of work areas to prevent awkward or stressful positions or motions. The selection of ergonomically designed hand tools is also important.

A.3.1.2 Material Handling.

A.3.1.2.1 The selection of proper handling equipment can be complex and should be made in consultation with knowledgeable personnel. Situations in which material-handling aides should be considered include the movement of large, heavy or awkwardly shaped items, and work environments where employees repeatedly perform lifts. Manual lifting requirements are discussed in Section A.3.2.1.

A.3.1.2.2 Common material handling equipment includes pallet jacks, pump-jack tables and mechanical lifting aides, such as vacuum lift assist devices.

A.3.1.2 Work Area Design.

A.3.1.2.1 When designing industrial work areas consideration needs to be made for the types of tasks to be performed. Shelves and parts bins should be placed at heights that keep loads at the proper working height and do not require excessive reaching and the active working area should be directly in front of the worker.

A.3.1.2.2 Work surfaces such as benches should also be kept at heights consistent with the working position of the employee (e.g., sitting or standing). Standing work locations should have floor mats and stools to increase worker comfort.

A.3.1.3 Tool Selection

A.3.1.3.1 Selecting appropriate hand tools can greatly increase worker comfort and prevent injuries associated with gripping small objects. Tool handles should allow workers to keep a neutral position during use and be large enough to grip comfortably. Hand tools should be well balanced to reduce the amount of torque on the wrist. Do not use tools with finger grooves molded into them, there is no standard hand or finger size and these tools are likely to cause unnecessary pressure from the grooves.

A.3.1.3.2 Vibrating power tools have the ability to cause nerve injury. Whenever possible tools with built in vibration dampeners should be selected. Tools handles should be comfortable to grip and padded when possible. Tool handles should also be set at an angle consistent with their use position. As an example, consider installing screws: To install screws vertically above waste level, using an electric screwdriver with a handle that is on the same plane as the screw will allow the wrist to maintain a neutral position.

A.3.2 Administrative controls.

A.3.2.1 Administrative controls include:

A.3.2.1.1 Lifting Techniques.

A.3.2.1.1.1 When lifting objects care should be taken to use proper lifting techniques in order to avoid back injuries. **More than one person should be used to lift objects that weigh more than 40 pounds, are large, or are awkwardly shaped.**

A.3.2.1.1.2 If lifting from the ground, start the lift in a squatting position with the item between the knees. Use handles if provided, otherwise position the hands in locations that will provide adequate support. Pick the item up off the ground and straighten the legs keeping the back straight. Keep the item as close to the body as possible and at about waist level while moving it.

A.3.2.1.1.3 When moving items from elevated surfaces ensure that the lift starts as close to the body as possible and do not twist the body while lifting.

A.3.2.2 Rotation of Duties. Rotate lifting duties among personnel who are physically capable of performing the lifts.

A.3.3 Protective Equipment. The use of protective equipment, such as back braces or lifting belts, is not recommended by NIOSH and should not be used unless recommended by a medical professional.

A.4 Laboratory Environments

A.4.1 Laboratory environments present some unique challenges that must be addressed on a case-by-case basis. In most cases they can be considered to be a combination of office and industrial environments and the principles previously described can be applied.

A.5 Non-Workplace Environments

A.5.1 MSDs occur as a result of chronic exposure to improper working positions or techniques. Many people engage in activities outside of the work place that can pose ergonomic risks. Examples include: computer use, painting and drawing, woodworking, working on automobiles and other mechanical equipment and gardening. It is very important to note that these exposures are additive to the exposure at work. This can even lead to personnel having a MSD injury that will be difficult to diagnose the cause of and correct since the exposure condition will not occur in the workplace.

A.5.2 The principles used to prevent MSD injuries at work also apply to non-work settings.

A.6 Training

A.6.1 Ergonomic Concerns are addressed in the Annual Training that is provided for all supervisors working at LaRC. On-line training programs and site-specific training by SFAB personnel are also available. Training includes the following items:

a. Common MSD
b. Signs and symptoms of MSDs
c. Correct workplace design and proper work habits

A.7 Additional Information

A.7.1 The Internet contains many resources regarding ergonomics, some of which are high quality, some of which are not. The following sites have been evaluated and are recommended resources:

a. Occupational Safety and Health Administration (OSHA): .osha-slc.gov/SLTC/ergonomics/index.

b. National Institute for Occupational Safety and Health (NIOSH): .cdc.gov/niosh/homepage.

c. Repetitive Stress Injury Information: .MSDnews.com/

d. University of California at Los Angeles Ergonomics Program: .ergonomics.ucla.

e. Cornell University Ergonomics Web: ://ergo.human.cornell.edu/

f. United States Army Center for Health Promotion and Preventive Medicine (USACHPPM) Ergonomics Program: ://chppm-www.apgea.army.mil/ergopgm/ergohome.

g. Department of Defense Ergonomics Working Group: ://www.ergoworkinggroup.org/myweb/IndexFrames/index2.

Appendix B. Ergonomic Injuries and Their Symptoms

B. 1 The following are common ergonomic injuries and their common symptoms. This list is not exhaustive and **should not** be used for self-diagnosis of an injury. It is merely a guide to understanding the warning signs of MSDs. Individuals experiencing symptoms should seek professional medical advice.

Injury	**Symptoms**
Carpal tunnel syndrome	Symptoms include tingling, numbness and burning sensation in the thumb, index and/or middle finger. Aching sensation and wrist pain (often at night) are also common. It is caused by compression of the median nerve which runs through the middle of the wrist
Tendonitis	Symptoms include pain, tenderness, swelling and /or weakness of the hand, arm or shoulder. Redness of the hand or wrist may also occur. It is caused by the tendons of the wrists, hands, or shoulder becoming inflamed from overstretching or constriction.
Tenosynovitis	Symptoms include swelling, pain and/or tenderness of the hand. It is caused by inflammation of the tendon and the sheath that it passes through.
DeQuervains disease	This disease is a progressive constriction of the tendon sheath, affecting the tendons on the side of the wrist and base of the thumb. Symptoms include pain and difficulty in moving the thumb.
Rotator cuff injury	Caused by inflammation of one or more of the rotator cuff tendons in the shoulder, symptoms include pain and limited mobility of the shoulder.
Raynoud's syndrome (White finger)	Caused by damage to blood vessels in the finger from use of vibrating tools, especially in cold climates. Symptoms include paleness, tingling or burning sensation in the fingers.
Epicondylitis (Tennis elbow)	Tendonitis of the elbow. Symptoms include pain, swelling and/reduced mobility of the elbow.
Trigger finger	This is due to swelling in the tendon sheaths of the finger causing the tendon to lock in the sheath. It results in snapping or jerking movement when attempting to move the finger.
Synovitis	Swelling of the bursae (fluid filled sac's used to cushion movement) in the knee, elbow, or shoulder.
Back Injuries	Static postures can add a tremendous amount of pressure to the back muscles and spinal discs. Sitting in a slouched position can overstretch the spinal ligaments and strain the spinal discs. A load that slips or shifts as it is being lifted, and a slip and fall can jolt the back with resulting muscle strain or tearing of soft tissue in the back.

Appendix C. Definitions and Terminology

C.1 Cold Temperatures - reduce blood flow throughout the body and decreases tactile feedback. Reduced blood flow minimizes the nutrients that travel to the muscles. Reduced tactile feedback will cause the hands to work harder than they have to.

C.2 Compression/Contact Stress - any outside object coming into contact with the body causes compression. Items such as a hard edge, sharp surface, corner, or excessive weight can cause damage to the body's soft tissues (nerves, tendons, blood vessels, etc.).

C.3 Duration - the length of any period of work activity which poses a MSD risk. The longer the duration task the greater the exposure and the greater the risk of an MSD.

C.4 Ergonomics - the application of knowledge about human capacities and limitations to the design of workplaces, jobs, tasks, tools, equipment, and the environment.

C.5 Frequency - the rate at which you repeat specific physical motions or exertions

C.6 Force - physical exertion by or pressure applied to any part of the body to move, direct, or operate equipment. The less force required to operate equipment the less traumatic it is to the body. Ideally we want all systems to require a minimum of force.

C.7 Musculoskeletal disorders (MSDs) - work-related disorders caused by improper job, tool, and workstation design, by application of excessive force on the body, or by unusual postures. In general, the term MSD only applies to injuries received from chronic exposures rather than acute injuries such as strains and sprains. Other terms commonly associated with MSD are Cumulative Trauma Disorder (CTD) and Repetitive Stress Injury (RSI).

C.8 Posture - the position of any part of your body during a work activity. Neutral postures are important because they maximize the amount of strength a worker can exert, maximizes worker comfort, and minimizes the risk of worker injury.

C.9 Repetition - Repetition or use of the same body parts continuously throughout the workday is damaging to the body. Micro traumas from repetition can result in inflammation of the tendons, muscle irritation or entrapment syndromes, and nerve irritation. Prolonged exposure to repetitive motions can result in even more traumatic injuries.

C.10 Segmental Vibration - Segmental vibration affects a part of the body, the most common type of segmental vibration is hand-arm, it is usually cause by a worker holding a vibrating hand tool for a long period of time. This action causes reduced blood flow to the fingers and can lead to blanching of the fingers.

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C.11 Whole Body Vibration - Segmental vibration affects a part of the body, the most common type of segmental vibration is hand-arm, it is usually cause by a worker holding a vibrating handtool for a long period of time. This action causes reduced blood flow to the fingers and can lead to blanching of the fingers.

Appendix D. Acronyms

EP	Ergonomics Program
ErgPO	Ergonomic Program Officer
LaRC	NASA Langley Research Center
MSD	Musculoskeletal disorder
OHCM	Office of Human Capital Management
OMC	Occupational Medicine Clinic
PPE	Personal Protective Equipment
SFAB	Safety and Facility Assurance Branch

Langley Research Center

LPR 2710.1
Effective Date: March 6, 2006
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LANGLEY RESEARCH CENTER NOISE CONTROL AND HEARING CONSERVATION PROGRAM

National Aeronautics and Space Administration

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Responsible Office: Safety and Mission Assurance Office

PREFACE

P.1 PURPOSE

This Langley Research Center Procedural Requirements (LPR) sets forth the procedural requirements and responsibilities for the Langley Research Center (LaRC) Noise Control and Hearing Conservation Program under the direction of the Safety and Facility Assurance Branch (SFAB), Safety and Mission Assurance Office (SMAO).

P.2 APPLICABIITY

These procedural requirements are applicable to all LaRC facilities. These procedural requirements are to be incorporated in any contract under which contractor employees will be assigned to on-site LaRC high noise or potential high noise areas.

It shall be the responsibility of Contractors to provide and implement their own written noise control and Hearing Conservation Programs (HCP). As a minimum, these programs shall be in accordance with the LaRC programs as described herein. If a contracting company performs work in high noise areas, the hearing conservation program shall include regular noise dosimetry to determine worker exposure. If exposures exceed the action level of 80 dB(A), workers shall be given annual audiograms, training, and be included in an effective hearing conservation program. As with other mandated safety programs, the HCP and associated records of LaRC contractors shall be subject to audit by the Hearing Conservation Program Officer (HCPO) or his/her designated representative.

The provisions of these procedural requirements, which define periodic noise hazard evaluations, personal hearing protective devices, education, audiometric testing, and personnel pre-selection criteria shall not apply to hearing-impaired personnel.

NOTE: Excessive stretching of the tympanic membrane (eardrum) is the source of pain from high intensity noise in normal hearing individuals. Noise, which is painful to normal hearing, will also be painful to the hearing-impaired who have eardrums. Therefore, the hearing-impaired should be protected from steady-state noise over 120 dB(A) and high-level impulse noise over 150 dB(C) sound pressure level (SPL) (Appendix B, “Definitions and Terminology") and educated accordingly. In addition, any residual hearing should be closely monitored if the hearing-impaired are exposed to high-level noise.

P.3 AUTHORITY

It is LaRC policy to comply with NASA regulations and Federal Laws as prescribed in the following documents:

a. Noise Control Act of 1972, as amended.

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b. "Occupational Noise Exposure," 29 Code of Federal Regulations (CFR) 1910.95.
c. "Basic Program Elements for Federal Employee Occupational Safety and Health Program," 29 CFR Part 1960.
d. Executive Order 12196 of February 26, 1980, "Occupational Safety and Health for Federal Employees."
e. American National Standards Institute (ANSI) Standards S3.6-1969 and
f. Sl.4-1971.
g. NASA Procedural Requirements (NPR) 1820.1, "Hearing Conservation."

P.4 REFERENCES

a. NASA Procedural Requirements (NPR) 8715.3, "NASA Safety Manual."
b. NPR 8715.1, "NASA Safety and Health Handbook Occupational Safety and Health Programs."
c. Langley Policy Directive (LAPD) 1700.2, "Safety Assignments."
d. LMS-CP-4760, "Reporting Injuries, Illnesses, Compensation Claims and Unsafe Working Conditions."
e. American Conference for Governmental Industrial Hygienists, Threshold Limit Values.

P.5 CANCELLATION

LPR 2710.1, dated July 22, 2004, is rescinded and shall be destroyed.

Lesa B. Roe
Director

DISTRIBUTION:
305/Safety and Facility Assurance Branch, SMAO (25 copies)

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Chapter 1

1. INTRODUCTION

1.1 BACKGROUND

Every effort shall be made to ensure that the work environment affords the necessary protection and conservation of LaRC employees' hearing. Noise-induced hearing loss is a serious threat to people exposed to hazardous noise levels. Loss of hearing can occur from exposure to impulse or impact noise as well as from exposure to steady-state (continuous/intermittent) noise. The hearing loss may be temporary or may become permanent through repeated unprotected exposure to intense noise. Initial deterioration of hearing may not be apparent to the individual. By the time there is employee awareness of the loss, the impairment may be substantial and irreversible.

Hearing loss due to noise exposure is preventable. Preventive efforts shall be taken to conserve the hearing of personnel employed at LaRC by implementing a HCP (Chapter 3 and Appendix A).

If controls fail to reduce sound levels to within the specified limits, or during the period controls are being initiated, the remaining components of the HCP, as addressed in Chapter 3 and Appendix A, shall be implemented. Personal hearing protective equipment, under administrative controls (limitation of exposure duration), shall be used as warranted.

The aim of this procedural requirement is to:

- Minimize noise generated by LaRC operations.
- Prevent occupational noise-related hearing loss among employees.
- Provide a work environment free from hazardous noise.
- Give priority to engineering procedures to the greatest extent practicable to eliminate, control, or isolate sources of hazardous noise.

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1.2 ISSUANCE AND CONTROL

The SFAB shall be responsible for the issuance, distribution, and control of these procedural requirements. Revisions shall be reviewed with affected organizations and documented on a Transmittal Notice.

1.3 DEFINITIONS AND TERMINOLOGY

Appendices B, "Definitions and Terminology," and C, "Acronyms," are included to assist with using these procedural requirements.

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Chapter 2

2. RESPONSIBILITIES

2.1 GENERAL

This chapter describes the responsibilities of the Hearing Conservation Program Officer (HCPO), Occupational Health Services (OHS), and line management.

2.2 HEARING CONSERVATION PROGRAM OFFICER (HCPO)

The SFAB Industrial Hygienist or his/her designee shall be the HCPO and is responsible for:

- Implementing and administering the HCP.
- Ensuring that personnel who work in hazardous noise areas, including supervisors/managers, are instructed, individually or in groups, by qualified personnel concerning health hazards associated with noise exposure, noise control measures, and the HCP requirements.
- Maintaining a current inventory of all hazardous noise areas and noise levels recorded in these areas. (The inventory shall be maintained in the SFAB.)
- Making recommendations on the placement or reassignment of personnel with significant hearing loss based on the suggestion of the Occupational Health Officer (OHO), Office of Human Capital Management (OHCM), the need for additional employee training and specific limitations on exposures, and environmental monitoring, audiometric test results, and medical findings.
- Measuring and analyzing noise levels to evaluate levels of employee exposures recommend appropriate means of controlling exposures found to be excessive and to achieve regulatory compliance. Potential noise exposure areas shall be identified by industrial hygiene audits, investigation of complaints, participation in construction design reviews, and review of purchase requisitions, contracts, and engineering (noise abatement) drawings.
- Conducting a pre-operational survey of each new operation, job, or procedure, which has an associated noise hazard potential before normal operations begin; and, identifying tools and equipment which generate excessive noise levels.
- Conducting, as requested, resurveys to evaluate each hazardous noise or job area in order to maintain master lists of areas which require hearing protection.
- Reviewing facility (i.e., rehabilitation and operational) plans to assure that adequate attention is being given to noise exposure controls.
- Maintaining survey data relative to noise levels and employee exposures.
- Selecting hearing protective devices (in conjunction with OHO) to be used and assessing the adequacy of all noise control measures.
- Ensuring the procurement and stocking of personal hearing protection devices.
- Conducting an annual review to ensure that employee hearing protection training is adequate.

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2.3 OCCUPATIONAL HEALTH SERVICES (OHS)

The OHS, OHCM, shall be responsible for:

- Obtaining noise exposure histories, supervising audiometric testing in support of the HCP, and evaluating test results.
- Maintaining a registry of personnel working in hazardous noise areas, scheduling and conducting appropriate medical examinations, and/or referring personnel to an audiologist or an appropriate medical consultant.
- Notifying employees on detection of a significant hearing loss, and explaining the need and plans for further testing referrals. The employee's supervisor shall be notified if further testing substantiates a significant hearing loss. The supervisor and employee shall be notified if a change in job assignment is recommended as a result of hearing loss. This change shall be implemented in accordance with applicable personnel actions.
- Ensuring that physicians have hearing conservation training and that personnel performing audiometry are certified by the Council on Accreditation for Occupational Hearing Conservation. (Persons who operate microprocessor audiometers do not need to be certified.)
- Ensuring that audiometric equipment is calibrated and that ambient noise levels in the test environment permit measurements to 0 dB hearing level (ANSI S3.6-1969).
- Maintaining audiometric test results and other medical records pertinent to the HCP.
- Ensuring that hearing protectors available from the LaRC Stockroom fit properly. Hearing protectors include molded earplugs, disposable foam inserts, and earmuffs.

2.4 SUPERVISORS

Supervisors shall be responsible for:

- Reporting to the HCPO suspected noise hazards in their functional areas.
- Supplying the HCPO and the OHS with the names of personnel working in designated hazardous noise areas or being exposed to hazardous noise. This is required so that the necessary training, hearing protective devices, baseline monitoring audiometric examinations, and other needed care or examinations can be provided.
- Referring to the LaRC Occupational Health Clinic (OHC) for examination and fitting of personal protective devices all personnel who complain of hearing loss or other hearing or ear problems.
- Ensuring employees keep their appointments at the LaRC OHC for examination and fitting of hearing protective devices.
- Enforcing the wearing of needed hearing protective devices to conserve hearing and ensuring that administrative controls are followed.
- Advising the HCPO of any changes in operations requiring noise determinations or evaluations.

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- Assuring procurement (including credit card purchases) of personal protection and noise generating equipment by obtaining the approval of the HCPO.

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Chapter 3

3. PROCEDURES

The procedures for implementing the HCP are presented in this chapter. The procedures include noise hazard evaluation, application of engineering control measures, use of personal hearing protection devices, audiometric testing, worker training, and recordkeeping. Refer to Chapter 2 of this document for responsibilities.

3.1 NOISE HAZARD EVALUATION

Noise hazard evaluation includes identifying hazardous noise areas, registering employees working in these areas, and posting signs and decals in those areas.

3.1.1 Hazardous Noise Areas

Areas shall be identified by noise measurement as specified in Appendix A. Areas shall be resurveyed within 30 days of any modification affecting the noise levels. A walkthrough inspection shall be conducted during the industrial hygiene audit if no documentation of noise levels exists in facility noise files. Where significant differences from the previous surveys are noted, the area shall be resurveyed. The results of these surveys shall be recorded by the HCPO. These records shall be retained for at least 40 years.

Full work shift dosimetry shall be performed periodically in facilities with operations where personnel are exposed to noise levels in excess of 75 dB(A) for extended periods and there is reason to suspect that exposure may approach the LaRC Action Level of 80 dB(A). Dosimetry for civil servants shall be conducted by the SFAB Industrial Hygienist or his/her designee. Dosimetry procedures and results shall be reviewed by a Certified Industrial Hygienist (CIH). Contractors shall be responsible for conducting their own noise dosimetry in accordance with LaRC, NASA, ANSI and OSHA standards. The HCPO and/or CIH or his/her designee may provide guidance to contractor organizations when requested, but noise dosimetry and worker exposure assessment shall be the responsibility of the contracting company/organization.

3.1.2 Employees Working in Hazardous Noise Areas

A register of employees who work in designated hazardous noise areas shall be maintained by line management officials within each LaRC facility. The dates, levels of noise, and period of employment in designated hazardous noise areas shall be recorded in these employees' medical records.

3.1.3 Posting of Hazardous Noise Areas or Equipment

All work areas or equipment which produce sound pressure levels of 85 dB(A) or greater, or 140 dB(C) sound pressure level for impulse/impact noise, shall be prominently posted with signs and decals as prescribed in Appendix A. These signs and decals are available from the HCPO.

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3.2 ENGINEERING CONTROL MEASURES

Engineering control measures include the following:

- Effective engineering noise controls shall be the primary methods used to protect personnel from the hazards of noise. All practical design approaches to reduce levels by acoustical engineering shall be explored and used to reduce steady state noise levels to below ~~85~~ 80dB(A) and impulse noise levels to below 140 dB(C), or to the maximum extent possible. In each instance where, at the design stage, the known or suspected noise level is expected to exceed current maximum allowable limits, the cognizant project or facilities engineer shall document and forward these findings to the HCPO. Corrective action to abate all levels to acceptable levels shall be included.
- * New equipment being considered for purchase is to have the lowest noise emission levels that are technologically and economically feasible and compatible with performance and environmental requirements. When purchasing products for use at LaRC, employees shall ensure the vendors specify the maximum noise levels that can be expected.
- * Acoustic considerations shall be included in the criteria of plans and specifications for all new facilities, substantial modification projects for facilities, and for aircraft and spacecraft systems and subsystems. The objective shall be to ensure, if feasible, an A-weighted sound pressure level of less than ~~85~~ 80 dB(A) at all locations in which personnel may be present during normal operations.

3.3 PERSONAL HEARING PROTECTION DEVICES

Selection of personal protection hearing devices depends on the noise level, type of noise (steady state or impulse), and personnel comfort. Appendix A presents descriptions of personal protection hearing devices.

3.3.1 Steady-State Noise Exposure

Approved personal hearing protection devices shall be issued to and used by all employees who either work in designated hazardous noise areas or with hazardous noise equipment where there are steady-state noise exposure levels of 80 dB(A) or greater. Hearing protection devices shall be provided to employees for voluntary use whenever there is equipment or operations

Earplugs or earmuffs may attenuate steady-state noise from approximately 15 dB in the lower frequencies to approximately 35 dB in the higher frequencies. Earplugs shall be worn in combination with earmuffs when personnel work in areas where the steady-state noise levels are 110 dB(A) and above. This combination provides approximately 5 to 10 dB more attenuation at most frequencies. Occupancy in areas with steady-state noise levels of 120 dB(A) and above requires that hearing protection devices be worn in combination and that a limitation be placed on daily exposure time (administrative controls). The tradeoff rate between noise level and allowable daily exposure is 3 dB(A)

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3.3.2 Impulse Noise Exposure

Measures for protecting hearing against impulse noise shall be the same as for steady-state noise. Protective devices shall be worn when impulse noise levels exceed 140 dB(C). Earplugs shall be worn in combination with earmuffs in areas with impulse noise in excess of 165 dB(C).

3.3.3 Availability of Protective Devices

Adequate protective devices (disposable earplugs and earmuffs) shall be maintained and made available from the LaRC Stockroom. Contractors shall make a variety of hearing protection equipment available to their employees. All hearing protective devices shall have a minimum Noise Reduction Rating (NRR) of 27.

3.4 AUDIOMETRIC TESTING AND MEDICAL EVALUATION

Audiometry, as specified in Appendix A, is a primary element of the HCP. All employees, who are exposed to:

- The action level of 80 dB(A)as an 8-hour TWA, for 30 or more days per year; or
- An equivalent TWA of 85 dB(A) for 8-hours, for any 1 day per year; or

Duration (Hours)	dB(A)
24.3	77
16	80
8	85
4	88
2	91
1	94
0.5	102
0.25	105
0.125 or less	108

- Impact or impulsive noise in excess of the limits

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Sound Level dB(C)	Permitted Number of Impacts or Impulses per Day
140	100
130	1000
120	10,000

shall be required to take pre-certification, annual and termination audiometric testing. Audiometric testing is used to identify the presence of early changes in hearing sensitivity. In combination with a history of all noise exposure, including off-duty noise exposure, audiometry makes it possible to determine if the issued hearing protection is being used and if engineering controls are adequate. It may be possible to identify individuals who are highly susceptible to noise-induced hearing loss.

Civil servant audiograms shall be provided by OHS at the LaRC Occupational Health Clinic. Contractors shall provide audiograms to employees by utilizing a qualified vendor that provides audiometric testing services. All audiometric testing and review shall be performed by personnel certified by the Council for Accreditation in Occupational Hearing Conservation.

3.5 TRAINING

Training shall be required for personnel working in, supervising, or managing hazardous noise areas.

3.5.1 Personnel Working in Hazardous Noise Areas

All personnel who routinely work in hazardous noise areas, or with hazardous noise equipment, shall be trained periodically regarding the permanent nature of noise induced hearing loss, type and use of personal protective measures, and the requirements of the HCP. The symptoms that may be experienced before permanent hearing loss occurs shall be explained and the importance of obtaining early medical/audiologic evaluation of these symptoms shall be stressed. In addition, personnel shall be encouraged to use hearing protectors whenever they are exposed to hazardous noise during off-duty activities (for example, from lawn mowers, firearms, and so forth). As designated by the HCPO, or other trained designees, this training shall be performed by OHS at the time of worker audiometric testing. Contractor employees shall be trained by their respective employer.

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3.5.2 Supervisory and Managerial Personnel

The HCPO or other trained individuals shall conduct training for supervisors and managers of personnel in hazardous noise areas emphasizing their responsibilities in the program.

3.6 RECORDS

The SFAB shall identify buildings with hazardous noise levels and shall furnish this information to the OHS. During the industrial hygiene audits of these buildings, a list of the names of the personnel in the HCP shall be updated and furnished to the OHS. Records pertaining to the conduct of the HCP shall be maintained in accordance with Appendix A.

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Appendix A

A. ELEMENTS OF THE NASA LaRC HEARING CONSERVATION PROGRAM

The basic elements of the LaRC Hearing Conservation Program includes noise hazard evaluation, posting of hazardous noise areas and equipment, personal hearing protection devices, and monitoring audiometry.

A.1 NOISE HAZARD EVALUATION

Noise measurements should be made by industrial hygienists or other personnel who have been trained in noise evaluation techniques. A noise survey should be conducted with a sound level meter to identify areas and equipment which have intensity levels of:

- ~~85~~ 82 dBA or greater for steady and/or intermittent noise.
- 140 dB peak sound pressure or greater for impact/impulse noise.

A.1.1 Sound Level Meter

The sound level meter should conform, as a minimum, to the requirements for a Type 2 sound level meter as specified in ANSI Standard Sl.4-1971. Measurements should be taken at the approximate position of the worker's more exposed ear, using the A-weighting network and slow meter response for continuous noise and C-weighting for impulse noise. A sufficient number of readings should be taken to account for variations in noise levels.

A.1.2 Acoustical Calibrator (Pistonphone)

The sound level meter should be calibrated with the acoustic calibrator, before and after noise measurements, on the day that measurements are to be made. The Industrial Hygienist using the sound level meter should maintain a record of these daily calibrations.

A.1.3 Annual Calibration

Annually, the acoustic calibrator should be comprehensively calibrated by the factory or factory equivalent. The results of these procedures should be maintained on calibration worksheets. When the equipment is found to be out of calibration, the Hearing Conservation Program Officer should be notified that corrective actions are being taken.

A.2 POSTING OF HAZARDOUS NOISE AREAS AND EQUIPMENT

Caution signs, visible to personnel entering or working in the area, should be posted at entrances to or on the periphery of hazardous noise areas to alert workers and visitors that a noise hazard exists and that proper precautions should be taken. Signs should have wording in black letters on a yellow background as follows:

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CAUTION - NOISE AREA - MAY CAUSE HEARING LOSS -
USE PROPER HEARING PROTECTION

Caution decals, designed for individual pieces of equipment, should be affixed on each tool or piece of equipment which produces hazardous noise levels. These decals should have black lettering on a yellow background as follows:

CAUTION - NOISY EQUIPMENT - MAY CAUSE HEARING LOSS - USE PROPER HEARING PROTECTION

NOTE: Exceptions may be made when an entire space is designated as a hazardous noise area and the tools/equipment are stationary.

A.3 PERSONAL HEARING PROTECTION DEVICES

Personal hearing protection devices include earplugs and earmuffs.

A.3.1 Care of Earplugs

Properly fitted earplugs will not cause damage to the normal ear canal provided the plugs are kept reasonably clean. Preformed earplugs (single and triple flange) and foam earplugs should be cleaned with a mild soap and water solution and rinsed thoroughly.

A.3.2 Hand-Formed Earplug Inserts (Disposable)

Hand-formed earplug inserts do not require medical fitting or an inventory of multiple sizes. However, employees should be instructed how to use them. Cutting hand-formed plugs into halves should not be permitted since this will result in an inadequate mass and markedly reduced noise attenuation. For hygienic reasons, hands should be clean when preparing hand-formed earplugs for insertion.

A.3.3 Earmuffs

Earmuff requirements include:

- Type II earmuffs are designed to be worn with the suspension system over the head, in back of the head, or under the chin. Earmuffs are readily seen by supervisors. When earmuffs are used, the headband should be properly adjusted to ensure a snug fit. When eyeglasses are worn with earmuffs, it is important that the ear cup seals of the earmuffs fit well around the temples of the eyeglasses. Even a small "leak" defeats the purpose of wearing earmuffs.

- Earmuffs should be periodically inspected for torn, punctured, or hardened seals. Damaged units should be discarded and replaced. Units issued to individuals should be kept clean from dirt or other debris that could cause possible health problems.

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A.4 MONITORING AUDIOMETRY

All monitoring audiometry should comply with Occupational Safety and Health Act (OSHA) 29 CFR 1910.95 (g), (h), Appendices C, D, and E.

A.5 RECORDS

The OHO should ensure that records pertaining to the HCP are maintained for 40 years. Records should include as a minimum:

- Records relative to disposition of personnel for whom administrative noise controls have been recommended and those who are being carefully monitored, including:
  - special actions and/or recommendations, which are directed at engineering controls.
  - data and information concerning the calibration and repair of sound measuring equipment and audiometers.
  - data and information on audiometric test booths, personnel hearing protectors, and auditory risk criteria.
  - data and information for use in the education program of personnel exposed in hazardous noise areas.
- Records and results of all audiometric examinations and all other pertinent information should also be maintained as a permanent part of the individual's medical record and include:
  - the audiometric test results and training performed for hearing conservation purposes.
  - an occupational noise exposure history and pertinent noise survey data and/or relevant non-occupational noise exposure.
- A current Center-wide register of personnel who routinely work in designated hazardous areas should be kept and appropriate entries should be made in the individual's medical record.

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Appendix B

B. DEFINITIONS AND TERMINOLOGY

Administrative Controls. Any procedure that limits daily exposure to noise by control of the work schedule.

Audiogram. A record of the threshold of audibility as a function of frequency obtained for each ear during an audiometric examination.

Audiologist. A professional specializing in the study and rehabilitation of hearing, who is certified by the American Speech, Hearing and Language Association, or licensed by a state board of examiners.

Audiometer. An electronic instrument that conforms to the requirements and specifications of ANSI Standard S3.6-1969 used for measuring hearing threshold levels.

Baseline Audiogram. The audiogram against which future audiograms are compared.

Decibel. A unit of measurement of sound level. The decibel level of a sound is related to the logarithm of the ratio of sound pressure to a reference pressure. The dB has meaning only when the reference is known. The internationally accepted reference pressure used in acoustics and at LaRC is 20 micropascals (μPa).

- **dBA (decibels - A-weighted).** A unit of measurement of sound level corrected to the A-weighted scale, as defined in ANSI Sl.4-1971 (R 1976), using a reference of 20 micropascals.
- **dBC.** A unit of measurement of sound level corrected to the C-weighted scale. The C scale discriminates very little against low frequencies, approximating a uniform response over the frequency range from 25-8,000 Hertz (Hz).

Engineering Control. Any design procedure that reduces the sound level either at the source of the noise or within the hearing zone of the individuals.

Hazardous Noise. This noise consists of the following two types:

- Steady-State Noise is continuous/intermittent noise equivalent to 85 dB or greater A-weighted sound pressure level (dBA) and is considered hazardous.
- Impulse or Impact Noise is sound with a rise time of not more than 35 milliseconds to peak intensity and a duration of not more than 500 milliseconds to the time when the level is 30 dB below the peak. If the impulses recur at intervals of less than one-half second, they will be considered as steady-state noise. Noise equivalent to 140 dB or greater peak sound pressure level (dBP) is considered to be hazardous.

Hearing Threshold Level (HTL). The amount, in decibels, by which the threshold of audibility for an ear differs from the standard audiometric level.

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Hertz (Hz). The international symbol for cycles per second. It is the unit of measurement for the frequency of tones.

Listening Checks. Preliminary checks of the audiometer, performed by the audiometric technician, to detect noise, distortion, intermittent tones, and other audiometer malfunctions, which would preclude valid testing.

Monitoring Audiogram. Periodic audiometric tests, obtained subsequent to the reference audiogram, which are used to detect shifts in the individual's threshold of hearing.

Reference Audiogram. A reference audiogram is the first audiogram obtained (and available) after employment begins at LaRC. This audiogram should be obtained when the individual is free from auditory fatigue and other transient otologic pathology. (The term "reference audiogram" also applies to preplacement, preassignment, entrance, or baseline audiograms.)

Sound Pressure Level. A sound measurement expressed in decibels obtained with a sound level meter that has a flat frequency response (slow time) equivalent to twenty times the common logarithm of the ratio of the measured A-weighted sound pressure to the Standard Reference pressure of 20 micropascals (measured in decibels).

Sound Level Meter. An electronic instrument, which measures sound levels conforming to the requirements for a Type II sound level meter as specified in ANSI Sl.4-1971.

Time-Weighted Average (TWA). The constant sound level, over an 8-hour workday exposure, which results in the same noise dose as is measured.

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Appendix C

C. ACRONYMS

ANSI	American National Standards Institute
CFR	Code of Federal Regulations
CIH	Certified Industrial Hygienist
HTL	Hearing Threshold Limit
IH	Industrial Hygiene
LPR	Langley Procedural Requirements
LaRC	Langley Research Center
NASA	National Aeronautics and Space Administration
HCP	Hearing Conservation Program
HCPO	Hearing Conservation Program Officer
NHB	NASA Handbook
NHS	NASA Health Standard
NPR	NASA Procedural Requirements
OHO	Occupational Health Officer
OHCM	Office of Human Capital Management
OHS	Occupational Health Services
OHC	Occupational Health Clinic
SMAO	Safety and Mission Assurance Office
SFAB	Safety and Facility Assurance Branch
OSHA	Occupational Safety and Health Administration
SPL	Sound Pressure Level
TWA	Time-weighted average

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Langley Research Center

LPR 8717.1

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JOB HAZARD ANALYSIS PROGRAM

National Aeronautics and Space Administration

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Office of Primary Responsibility: Safety and Mission Assurance Office

PREFACE

P.1 PURPOSE

This Langley Procedural Requirement (LPR) establishes the minimum procedural requirements for employees to perform a Job Hazard Analysis (JHA) at NASA Langley Research Center (LaRC). It provides a safety assessment technique that identifies uncontrolled hazards and steps to eliminate or reduce them to an acceptable risk level. This JHA program fulfills the procedural requirement for performing workplace analysis as required by the Occupational Safety and Health Administration (OSHA).

P.2 APPLICABILITY

This LPR applies to all NASA LaRC civil service and contractor employees. Contractor employees shall either utilize this LPR or develop an alternate procedure that meets the intent of this LPR. All alternate procedures shall be reviewed and approved by the Safety and Facility Assurance Branch (SFAB), Safety and Mission Assurance Office (SMAO). Any deviations or waivers to the procedural requirements of this LPR shall be approved by SFAB.

P.3 AUTHORITY

NPR 8715.3, “NASA General Safety Program Requirements”

P.4 APPLICABLE DOCUMENTS

a. OSHA Handbook 3071, “Job Hazard Analysis,” (1998/2002 Versions)
b. Swartz, George. “Job Hazard Analysis: A Guide to Identifying Risk in the Workplace,”
c. KDP-KSC-P-3221, “Job Hazard Analysis (JHA) Selection”
d. NASA Langley Form 338, "Job Hazard Analysis Master Listing of Jobs."
e. NASA Langley Form 275, "Job Hazard Analysis (JHA) Worksheet."
f. NASA Langley Form 164, "Report of Safety/Health Concern/Close Call."
g. LMS-CP-4309, “Identification, Recording, and Evaluation of Required/Mandatory Training."

P.5 MEASUREMENT/VERIFICATION

Through the reduction of injuries, illnesses, equipment/property damage, and close calls occurring on Center.

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P.6 CANCELLATION

None

Original signed on file

Lesa B. Roe
Center Director

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1. INTRODUCTION

1.1 BENEFITS OF A JOB HAZARD ANALYSIS

a. The Job Hazard Analysis (JHA) program shall actively involve employees at LaRC in the identification of unsafe conditions during a “job” performed in their workplace. Also, employees shall participate in the resolution of identified unsafe conditions through their recommendations for design, engineering controls, safety devices, warning devices, training, or personal protective equipment, while performing the “job.” JHA’s shall be used by employees as a useful training tool for mentoring new employees and refreshing needed skills in demanding multi-facility workplaces.

1.2 VALUE OF A JOB HAZARD ANALYSIS

a. Supervisors shall use the identified unsafe conditions on a JHA to eliminate and prevent hazards in their workplaces, thereby reducing the number of work-related injuries and illnesses; providing safer, more effective work methods; and increasing worker productivity. The JHA shall also be used as a tool for training new employees in the steps required to safely perform their assigned jobs.

1.3 EXCLUSIONS

a. “Jobs” performed under the following programs shall not require a JHA:

(1) Any facility procedure currently in Configuration Management On-line (CMOL) program.
(2) Laboratory Operating Procedures (LOP’s) currently in CMOL.
(3) Any task/process currently conducted under a Safety Permit (e.g., Potentially Hazardous Materials Permit (PHM), Non-Ionizing Radiation (LASER) Permit, Pyrotechnic Permit)

b. Branch Heads/Line Supervisors shall have the authority to instruct employees to create and utilize JHA’s for “jobs” in accordance with the procedural requirements of this LPR.

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2. RESPONSIBILITIES

2.1 ORGANIZATIONAL UNIT MANAGER

The Organizational Unit Manager (OUM), or assigned designee, shall be responsible for:

a. Implementing and enforcing the JHA program within their organization.
b. Annually reviewing their organization's JHA program.
c. Determining appropriate corrective actions for JHA recommendations when asked by the Branch Head/Line Supervisor.

2.2 BRANCH HEADS/LINE SUPERVISORS

The Branch Head/Line Supervisor shall be responsible for:

a. Establishing a Master Job List of JHA's, using NASA Langley Form 338, "Job Hazard Analysis Master Listing of Jobs," which schedules and prioritizes JHA's to be conducted.
b. Assigning an employee to create/review each JHA listed on NASA Langley Form 338, using NASA Langley Form 275, "Job Hazard Analysis (JHA) Worksheet."
c. Enforcing employees to perform JHA's in which they've been assigned.
d. Assisting employees in performing JHA's, when needed.
e. Reviewing/approving the completed JHA's for thoroughness.
f. Prioritizing, tracking, and implementing accepted recommendations resulting from completed JHA's. Implementation of accepted recommendations involving engineering modifications shall be managed with identified interim action until modifications are complete. When recommendations are not feasible, the OUM shall determine the appropriate corrective action.
g. Scheduling the review of all JHA's, located on NASA Langley Form 338 annually to determine if there have been changes to the job and ensure hazards associated with any changes have been assessed and the appropriate steps added to the JHA.

2.3 FACILITY SAFETY HEAD

The Facility Safety Head (FSH) shall be responsible for:

a. Reviewing/approving the completed JHA's for thoroughness.
b. Maintaining the master NASA Langley Form 338 and NASA Langley Form 275 copies of all completed JHA's pertaining to their assigned facilities.
c. Ensuring all approved JHA's are available to organizational employees via hard or digital copy.
d. Ensuring the review of all JHA's within their facility are reviewed annually.

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2.4 EMPLOYEE

The employee shall be responsible for:

a. Understanding the requirements of this LPR before performing a JHA.
b. Informing Branch Heads/Line Supervisors of “job’s” in which a JHA has not been created and they feel an uncontrolled hazard is present.
c. Identifying uncontrolled hazards in a “job,” which has a JHA and requesting a review of the JHA when circumstances pertaining to the "job" change.
d. Developing a JHA by defining the sequence of steps or activities, identifying the potential hazards present in each step or activity, and recommending safe practices (e.g., engineering controls, actions, procedures, personal protective equipment (PPE)) to eliminate or reduce each hazard.
e. Documenting the JHA for the selected process or activity by completing each of the three sections on NASA Langley Form 275. (NOTE: Additional subject matter expert resources, as needed, may be utilized to assist in the job evaluation, including, but not limited to Facility Safety Heads/Facility Coordinators, the Safety and Facility Assurance Branch, cognizant system engineers, Standard Practice Engineers, etc.)
f. Recommending any changes to their Branch Head/Line Supervisor required to facilitate personnel safety; including, but not limited to, specific procedures, policies, equipment, training, etc.
g. Providing the Branch Head/Line Supervisor with a completed JHA.

2.5 SAFETY AND FACILITY ASSURANCE BRANCH (SFAB)

SFAB employees shall be responsible for

a. Assisting in the development/completion of a NASA Langley Form 275, as requested.
b. Supporting organizations in implementing the LaRC JHA program.

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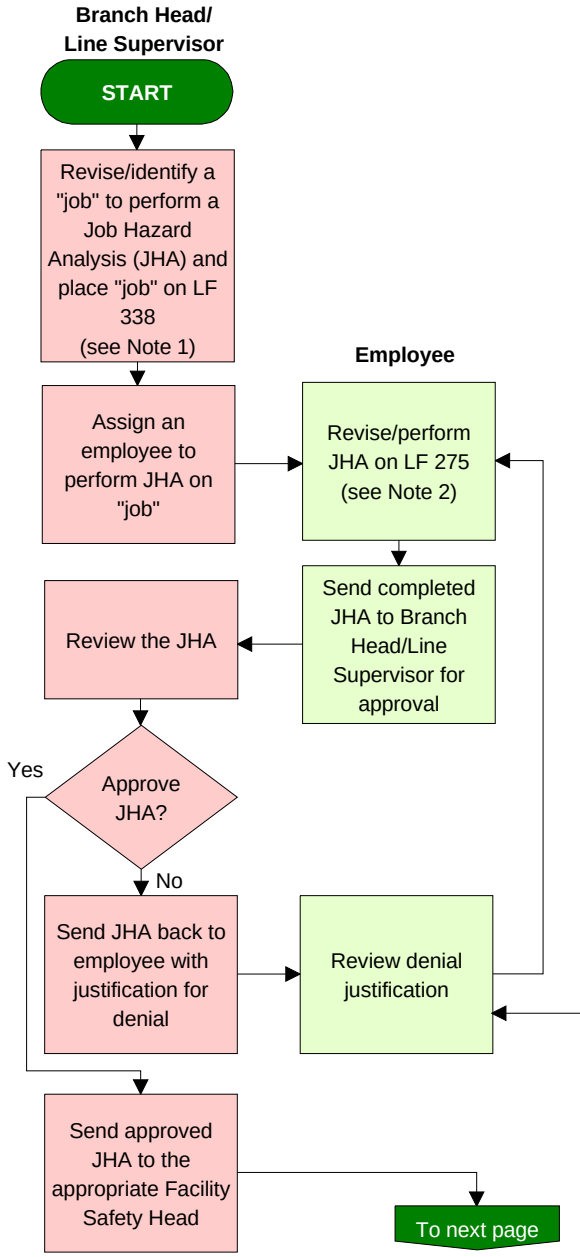
3. CREATING, WRITING, REVIEWING, AND MAINTAINING JOB HAZARD ANALYSIS IN THE WORKPLACE

3.1 GENERAL

Once the need for a JHA is identified on the organizations NASA Langley Form 338, the JHA shall be prepared using NASA Langley Form 275.

3.2 PROCESS



General Information

The following records are generated by this procedural requirement and should be maintained in accordance with CID 1440.7:
LF 338, "Job Hazard Analysis Master Listing for Jobs"
LF 275, "Job Hazard Analysis (JHA) Worksheet"

Note 1
Identify a job in accordance with Chapter 5, Establishing Precedence for Creating JHA's.

If an illness or injury occurs on a specific job, the JHA shall be reviewed immediately to determine whether changes are required in the JHA. In addition, if a "close call" or "near miss" has resulted from an employee's failure to follow job procedures, this shall be discussed with all employees performing the job.

Note 2
Request assistance from supervisor, if needed.

Complete all required information to ensure all potential hazards associated with job are identified and adequate preventive control methods are described appropriately. See the following chapters on completing LF 275:
Chapter 6, "Identifying Sequences of Steps or Activities"
Chapter 7, "Identifying Workplace Hazards"
Chapter 8, "Identifying Hazard Controlling Techniques"

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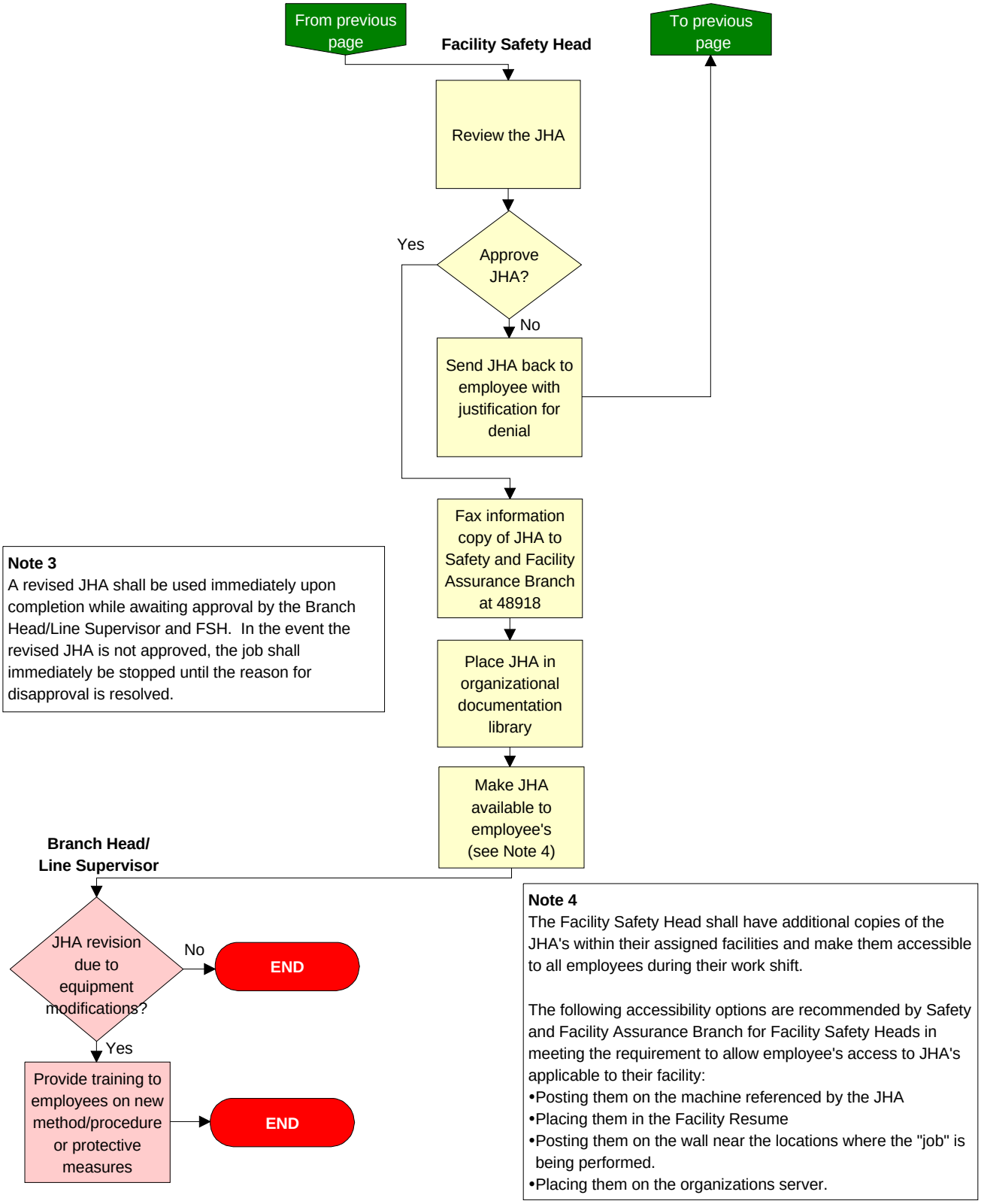

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4. UTILIZATION OF A JOB HAZARD ANALYSIS IN THE WORKPLACE

4.1 GENERAL

All LaRC employees shall utilize JHA's in the workplace to proactively abate hazards encountered in their work environments while performing a "job." If a documented JHA does not exist, the "job" shall be placed on the organizations NASA Langley Form 338 and scheduled for creation. The only exception for not placing the "job" on the NASA Langley Form 338 is if the "job" is considered time-critical (refer to Section 4.3 of this LPR for the procedural requirements pertaining to time-critical JHA's). Procedural requirements for establishing precedence for jobs to be analyzed are discussed in Chapter 5 of this LPR.

4.2 REVIEWING ESTABLISHED JHA'S

Employees shall review approved/renewed JHA's a minimum of monthly, when they perform a "job" covered by a JHA. This review shall be performed prior to beginning the "job" and the employee shall acknowledge their review by placing their initials next to the first step in the JHA, next to the second step, and continue to initial next to each job step until they have initialed all of the job steps for that particular JHA. After an employee has initialed next to all the job steps, the employee shall give the initialed copy to the FSH for review and verification.

4.3 TIME - CRITICAL JHA

During operations, a "job" may need to be performed, which is not covered under a JHA. An on-the-run mental or oral review of the situation, using the JHA procedural requirement, shall be performed in lieu of recording the steps on paper.

Any "job," which utilizes the time-critical JHA methodology, shall not be performed more than once without being flagged for requiring a JHA. "Jobs" performed more than once shall not be considered time-critical and shall utilize a documented JHA using NASA Langley Form 275. If a documented JHA does not exist, the "job" shall be placed on the organizations NASA Langley Form 338 and scheduled for creation.

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5. ESTABLISHING PRECEDENCE FOR CREATING JHA'S

5.1 GENERAL

A JHA shall be performed for all "jobs" in the workplace, whether the job task is "special" (non-routine) or routine. Even one-step jobs, such as those in which only a button is pressed, shall be analyzed by evaluating surrounding work conditions. In order to ensure the "jobs" with the most potential hazards are addressed first, precedence for creating JHA's shall be established by each organization.

5.2 JHA DEVELOPMENT PRIORITIZATION

JHA's shall first be created for any "job" within an organization that has resulted in an injury or illness, damage to NASA property or equipment, or a close call/or near miss reported on a NASA Langley Form 164, "Report of Safety/Health Concern/Close Call." Branch Heads/Line Supervisors shall review any injuries or illnesses, damage to NASA property or equipment, or close calls/near misses reported via a NASA Langley Form 164 from the previous 4 years (from the effective date of this LPR) and create JHA's for those "jobs" related to these incidents.

5.3 REQUIREMENTS FOR PRECEDENCE OF JOBS TO BE ANALYZED

The following shall be followed by Branch Heads/Lines Supervisors to determine the precedence of jobs to be analyzed within their organization:

a. Jobs with a history of injuries or illnesses.
b. Jobs with a history of "close calls."
c. Jobs where an employee/supervisor requests a JHA be performed.
d. Jobs that have repetitive tasks with potential for an injury or illness.
e. Jobs that require the handling of hazardous material.
f. Jobs that take place in hazardous physical environments (e.g., work at heights, loud noise, extreme temperatures, confined spaces).
g. Jobs that require the use of personal protective equipment engineering controls, etc.
h. Jobs that involve a **NEW** process/procedure/machine/chemical.

The procedural requirement for performing a JHA on a particular "job" is set forth in Chapter 4 of this LPR

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6. IDENTIFYING SEQUENCES OF STEPS OR ACTIVITIES

6.1 GENERAL

Nearly every job can be broken down into job tasks or steps. In the first part of the JHA, list each step of the job in order of occurrence as you perform the job.

6.2 NUMBER OF WORDS

Enough information shall be provided to describe each job action, but do not make the breakdown too detailed. Three or four words are normally enough to describe each step in the task. Begin each step with action words, such as “remove”, “carry”, “assemble”, “open”, etc. (a list of action verbs may be found in Appendix D of this LPR).

6.3 BREAKING DOWN THE TASK

The task shall be broken down into its basic steps, for example, what is done first, what is done next, and so on (Figure 1). This shall be done by:

a. Observing the task performed by another employee.
b. Discussing it with other employees.
c. Using your experience and knowledge of the task.
d. A combination of all three.

6.4 NUMBER OF JOB STEPS

JHA’s shall contain 10 job steps or less. Identifying more than 10 job steps may hinder the employee’s ability to understand the procedures identified in the JHA. Jobs in which 10 or more steps are warranted shall be split up to allow multiple JHA’s to be established. This will allow the employee to review each JHA before performing the job and help the employee remember the hazards associated with each step. Remember, the objective is to keep it brief to increase job hazard awareness, not impact production.

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Figure 1. A worker performing the basic job steps for grinding iron castings.

Grinding Castings: Job Steps

1. Reach into metal box to right of machine, grasp casting and carry to wheel.

2. Push casting against wheel to grind off burr.

3. Place finished casting in box to left of machine.

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7. IDENTIFYING WORKPLACE HAZARDS

7.1 GENERAL

After each job step has been recorded on NASA Langley Form 275, the preparer shall examine each job step to determine the hazards associated with it and the potential for resulting in an incident (Figure 2).

7.2 DETERMINATION OF HAZARD IDENTIFICATION

a. Preparers shall ensure all tasks are thoroughly reviewed to identify their hazards. The following questions shall be asked, as minimum, to ensure all appropriate hazards are identified.

(1) Is personal protective clothing and equipment, including safety harnesses required?
(2) Are work positions, machinery, pits or holes, and hazardous operations adequately guarded?
(3) Are lockout/tagout procedures required for machinery deactivation during maintenance procedures?
(4) Will the wearing of clothing or jewelry present a hazard of getting caught in the machinery or otherwise cause a hazard?
(5) Are there fixed objects that may cause injury, such as sharp machine edges?
(6) Is the flow of work improperly organized (e.g., Are rapid movements required that may cause a hazard)?
(7) Can an employee get caught in or between machine parts?
(8) Can an employee be injured by reaching over moving machinery parts or materials?
(9) At any time will an employee be in an off-balance position?
(10) Will the employee be positioned to the machine in a manner that is potentially dangerous?
(11) Will the employee be required to make movements that could lead to or cause hand or foot injuries, or strain from lifting, the hazards of repetitive motions?
(12) Can an employee be struck by an object or lean against or strike a machine part or object?
(13) Can an employee fall from one level to another?
(14) Can an employee be injured from lifting or pulling objects, or from carrying heavy objects?
(15) Will environmental hazards, such as, dust, chemicals, radiation, welding rays, heat, or excessive noise, result from the performance of the job?

The preparer shall ask questions, as each job requires, until all hazards have been identified.

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Figure 2. Existing or potential hazards for grinding iron castings.

Grinding Castings: Hazards

1. Hand Struck Against (SA) metal box or casting while removing from bin on the right.

2. Hand Struck Against (SA) wheel. Struck By (SB) flying sparks.

3. Hand Struck Against (SA) metal box or casting while placing in bin on the left.

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8. IDENTIFYING HAZARD CONTROLLING TECHNIQUES

8.1 GENERAL

After each hazard or potential hazard has been identified, the hazards shall be controlled (Figure 3). This shall be accomplished by the utilization of several hazard-controlling methods. General statements, such as “Be Careful,” shall not be acceptable. Be as specific as possible in your recommendations for hazard control.

8.2 HAZARD CONTROLLING METHODS

8.2.1 Engineering

Engineering controls involve changing the physical condition, materials, or procedural requirements that create the hazard. Engineering control measures shall be considered the most effective means to eliminate the hazard or reduce its severity. While other hazard measures may provide protection from hazards, they do not eliminate or control the source of the hazard.

8.2.2 Safety

Using PPE to control hazards shall be considered using safety to abate the hazards. PPE does not control the hazard, but it protects/reduces the hazards effect on the employee. Examples of PPE are hard hats, safety glasses, ear protection, gloves, respirators, face shields, safety shoes, etc.

8.2.3 Warning

Visual and audible means to alert personnel to hazards shall be acceptable, but shall not be considered barriers. Engineering and safety hazard controlling methods shall be considered barriers from hazards. Warning devices are effective only when personnel are aware of them in sufficient time to react; and do, in fact, react.

8.2.4 Administrative

Administrative Controls involve re-arranging work schedules, improving housekeeping, controlling access, or using procedures (Lockout/Tagout) to control the hazards.

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Figure 3. Shows the recommendations for new steps and protective measures when grinding iron castings.

Grinding Castings: Safe Procedures or Personal Protection Equipment

1. Wear gloves and steel-toed shoes.

2. Provide larger guards over the wheel. Provide safety goggles.

3. Provide for removal of completed stock.

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APPENDIX A: DEFINITIONS

Analysis – Separation of steps relating to a "job" to identify unsafe conditions.

Cause - The stimulus or triggering mechanism/act, which precipitates an undesired event (accident).

Configuration Management On Line (CMOL) - A web-based application that enables users to access LaRC facility Configuration Controlled Documents electronically via their desktop computer.

Controls - Actions taken to eliminate hazards or reduce their risk.

Effect - The consequence of an undesired event/accident in terms of equipment damage and/or personnel injury, illness, or death.

Hazard - A condition, which has the potential to result in damage to equipment and/or personnel injury, illness, or death.

Job - A sequence of steps that together accomplish a work goal for the mission of NASA.

Potential Hazards - Any hazard, if left uncontrolled, could result in an unplanned event or series of events resulting in harm to public safety or health, injury, illness, or death to employees, or damage to or loss of assets.

Risk - A possible loss expressed in terms of severity and probability.

Risk Assessment - The process of detecting hazards and assessing associated risks. Step 1 and Step 2 of a JHA constitute a risk assessment.

Severity - Expected consequence of an event in terms of degree of injury, illness, property damage, or other mission-impairing factor.

Standard Operating Procedures (SOP's) - Detailed, written, step-by-step instructions to be routinely followed in operating a facility. SOP's contain all of the information considered pertinent to safe and efficient operation of the facility. SOP's are the source documents for Operational Checklists and are the basis, in part, for the facility Hazard Control Analysis. SOP's may also be used for training operator personnel. SOP's are under the control of the Configuration Management Program.

Undesired Event - An event (or series of events), which unleashes the potential inherent cause of a hazard and, either directly or indirectly, results in damage and/or personnel injury, illness, or death.

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APPENDIX B: INJURY SOURCE DEFINITIONS AND ACRONYMS

The following definitions and their identified acronyms shall be used in identifying workplace hazards.

Struck By (SB)

A Struck By injury occurs when the employee is stationary and an object in motion contacts the employee. Examples of Struck By injuries are an employee being hit in the mouth by the inner door of a restroom as another individual is exiting; a hammer driving an employee's finger instead of a nail; or sparks from a welding operation contacts an employee's forearm causing burns.

Struck Against (SA)

A Struck Against injury occurs when the object is stationary or moving and the employee in motion contacts the object. Examples of Struck Against injuries are an employee walking into an open filing cabinet door; an employee walking into forklift forks at knee height, sustaining contusions and/or lacerations; or an employee applying leverage to loosen a bolt, slipping and striking a steel surface.

Caught Between (CB)

A Caught Between injury occurs when the employee becomes stuck between two different objects, commonly referred to as a “pinch point”. Examples of Caught Between injuries are an employee's foot being caught between a dock and a trailer during warehouse unloading operations; or an employee setting a heavy box on the ground, lodging their hand between the box and the ground.

Contact With (CW)

A Contact With injury occurs when the employee is stationary or in motion and the hazard (chemical, sharp edge, etc.) contacts the employee. Examples of Contact With injuries are an employee placing their hand on a hot surface; an employee walking by and contacting a bare wire, suffering a severe shock; or an employee drops a box of corrosive chemicals and begins cleaning it up with paper towels, in lieu of the appropriate protective gloves

Contacted By (CBy)

A Contact By injury occurs when the employee is stationary or in motion and the hazard forces the employee to contact the hazard. Examples of Contacted By injuries are an employee opens a valve and is sprayed in the face by a chemical; or an employee is cleaning a tool and the tool slips out, falls into the cleaning solution, and splashes the employee in the face.

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Caught On (CO)

A Caught On injury occurs when the employee becomes part of a stationary or moving object. Examples of Caught On injuries are an employee accessing the ceiling of a building and during ascent the employee's ring becomes hung on an object, resulting in severe lacerations or severance of the finger; or an employee dragging an extension cord has the cord suddenly stopped at a “pinch point” and is swept off their feet.

Caught In (CI)

A Caught In injury occurs when the employee, or part of the employee, becomes enclosed by an object. Examples of Caught In injuries are an employee entering a confined space becomes lodged in the narrow access opening; or a supervisor notices there is no possible way to open a storage room from the inside and has the problem corrected to prevent any Caught In incidents.

Fall, Same Level (FS)

A Fall, Same Level injury occurs when the employee is forced by gravity to the same level in which they were either standing, walking, or running. Examples of Fall, Same Level injuries are an employee slips on a wet floor while entering the restroom; or an employee trips over an unsecured extension cord placed across a walking path.

Fall, To Below (FB)

A Fall, To Below injury occurs when the employee is forced by gravity to a lower level from which they were either standing, walking, or running. Examples of Fall, To Below injuries are an employee overextending on a ladder and falling; or an employee being distracted by a fellow employee inadvertently walks off the edge of a warehouse loading dock.

Overexertion (O)

An Overexertion injury occurs when the employee or a part of the employee body fails to properly function due to stress or strain. Examples of Overexertion injuries are an employee decides to lift an object over 50 pounds and injures their back or an employee while lifting several heavy objects begins to have cramps in their legs because of a low potassium level.

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Exposure (E)

An Exposure injury occurs when the employee, or a part of the employee, becomes susceptible to gases, vapors, fumes, dust, mists, temperature extremes, oxygen deficiencies, and noise. Exposure injuries can be of an acute or chronic nature. Examples of Exposure injuries are an employee working in extremely hot weather fails to hydrate and becomes disoriented and faints; or an employee ignores the low-level oxygen alarm in a room and walks into the room and passes out due to the low-level of oxygen.

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APPENDIX C: TYPICAL JOBS IN WHICH WORKPLACE HAZARDS WOULD REQUIRE A JHA

The following are examples of jobs in which a JHA may eliminate workplace hazards.

Shop Operations
Operating a Power Band Saw
Operating a Bench Grinder
Using the 5-ton Bridge Crane
Using a Circular Saw to Cut Metal
Handling Compressed Gases
Using the 10 inch monarch EE Lathe to Cut Metal Components
Using a Drill Press on Aluminum Components
Drilling & Milling
Hand Soldering (Replacing Components for a PC Board))
Electrical Wiring - High Voltage
Setting up an Extension Ladder
Using a Forklift to Move Material
Replacing Light Bulbs with the 65-Ft JLG Boom
Using Portable Electrical Power Tool
Cutting Wood on a Table Saw
Bending/Forming Metal with the Power Press Brake
Applying Conformal Coating to PC Boards

Miscellaneous Operations
Filling Vehicle Tank from Underground Storage Tank

Laboratory Operations
Handling Laboratory Animals
Using Laboratory Scales
Moving Large Cryogenic Liquid Dewar from Loading Dock to Lab
Operation of Spectra-Physics Model PIV 400-30 Nd Laser
Handling Compressed Gases
Transferring of Chemicals Between Containers
Dry Waste Packing a 55 Gallon Drum
Using the Steam Sterilizer

Office Activities
Filing Activities
Moving/Storing Office Supplies
Mail Distribution
Operating the Paper Shredder
Operating the Paper Cutter
Removing Misfed Paper from Copier
Cleaning Office Furniture and Equipment
Connecting Electrical Equipment in the Office
Using a Computer

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APPENDIX D: JHA ACTION VERBS

Accounts
Acquires
Adapts
Adjusts
Administers
Adopts
Advises
Advocates
Allocates
Allots
Alters
Amuses
Analyzes
Answers
Applies
Appoints
Appraises
Approves
Arbitrates
Arranges
Assembles
Assesses
Assigns
Audits
Authorizes
Awards
Balances
Bargains
Batches
Budgets
Calculates
Calibrates
Carries
Categorizes
Certifies
Checks
Circulates
Classifies
Cleans
Climbs
Coaches
Codes
Collaborates
Collates
Collects
Compares
Compiles
Composes
Computes
Condenses
Confers
Confirms
Consolidates
Constructs
Consults
Controls
Converts
Conveys
Coordinates
Copies
Corrects
Correlates
Corresponds
Counsels
Counts
Creates
Debates
Decides
Defends
Defines
Delegates
Deliberates
Delivers
Demonstrates
Describes
Designates
Designs
Destroys
Detects
Determines
Develops
Devises
Diagnoses
Digs
Directs
Disburses
Disciplines
Discovers
Discusses
Dismantles
Dispatches
Dispenses
Displays
Disseminates
Distributes
Drafts
Drives
Dumps
Duplicates
Edits
Elaborates
Elects
Eliminates
Employs
Encourages
Endorses
Enlists
Enters
Entertains
Escorts
Estimates
Evaluates
Examines
Exchanges
Exercises
Exhibits
Experiments
Explains
Extracts
Fabricates
Fastens
Feeds
Files
Forecasts
Formulates
Garners
Gathers
Gauges
Generates
Governs
Grades
Guards
Guides
Hauls
Hires
Hypothesizes
Identifies
Illustrates
Implements
Imports
Improves
Indexes
Indicts
Informs
Innovates
Inspects
Installs
Instructs
Interprets
Interviews
Inventories
Invents
Investigates
Issues
Itemizes
Joins
Judges
Justifies
Leads
Lifts
Loads
Locates
Lubricates
Manages
Manipulates
Manufactures
Maps
Matches
Measures
Mediates
Mends
Mixes
Modifies
Monitors
Motivates
Moves
Negotiates
Notifies
Nullifies
Observes
Obtains
Opens
Operates
Organizes
Originates
Outlines
Overhauls
Oversees
Packages
Permits
Persuades
Picks up
Plans
Posts
Predicts
Prescribes
Presents
Preserves
Prevents
Procures
Produces
Programs
Promotes
Proofreads
Proposes
Pulls
Purchases
Pushes
Quantifies
Questions
Ranks
Rates
Reaps
Rebuilds
Recommends
Reconciles
Records
Reduces
Refers
Refines
Registers
Regulates
Reinforces
Rejects
Releases
Remits
Repairs
Replaces
Reports
Represents
Rescinds
Rescues
Researches
Resolves
Retrieves
Reviews
Revises
Rewards
Salvages
Scans
Schedules
Scores
Screens
Seals
Searches
Selects
Sells
Sends
Serves
Services
Smells
Solicits
Solves
Sorts
Stacks
Stores
Studies
Submits
Summarizes
Supplies
Surveys
Synthesizes
Systematizes
Tabulates
Teaches
Tends
Testifies
Tests
Totals
Traces
Trades
Trains
Transacts
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Transfers
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ENVIRONMENTAL PROGRAM MANUAL

National Aeronautics and Space Administration

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Responsible Office: Environmental and Logistics Branch, Center Operations Directorate

PREFACE

P.1 PURPOSE

This Langley Procedural Requirements (LPR) sets forth procedural requirements and responsibilities to ensure that NASA Langley Research Center (LaRC) personnel comply with the Center's environmental program. LaRC is committed to conducting all operations in a safe, healthful and environmentally acceptable manner. The Center's environmental policy is to comply with all applicable Federal, State, and local environmental regulations. In situations involving noncompliance, LaRC will take immediate corrective action in order to achieve compliance. LaRC will seek out and implement opportunities to achieve and maintain compliance by emphasizing pollution prevention methodologies. LaRC is committed to identifying and implementing pollution prevention opportunities through active involvement of all employees.

P.2 APPLICABILITY

This LPR applies to all organizational elements of LaRC and to all personnel working in or visiting areas under the administrative control of LaRC.

P.3 AUTHORITY

Endangered Species Act (ESA) of 1973, 7 U.S.C. § 136 and 16 U.S.C. § 460 et seq.
Toxic Substances Control Act (TSCA) of 1976, 15 U.S.C. § 2601 et seq.
Archeological Resources Protection Act of 1979, 16 U.S.C. § 470aa-mm.
National Historic Preservation Act of 1966, 16 U.S.C. § 470 et seq.
Clean Water Act (CWA) of 1977, 33 U.S.C. § 1251 et seq.
Resource Conservation and Recovery Act (RCRA) of 1976, 42 U.S.C. § 6901-6992.
National Aeronautics and Space Act of 1958, as amended, 42 U.S.C. § 2451 et seq.
National Environmental Policy Act (NEPA) of 1969 as amended, 42 U.S.C. § 4321-4347.
Noise Control Act of 1972 as amended by Quiet Communities Act of 1978, 42 U.S.C. § 4901-4918.
Clean Air Act (CAA) of 1970, 42 U.S.C. § 7401 et seq.
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) of 1980, 42 U.S.C. § 9601 et seq.
Superfund Amendments and Reauthorization Act (SARA) of 1986, 42 U.S.C. § 9601 et seq.
Emergency Planning & Community Right-To-Know Act (EPCRA) of 1986, 42 U.S.C. § 11001 et seq.
Pollution Prevention Act (PPA) of 1990, 42 U.S.C. § 13101 and 13102, et seq.
Farm Security and Rural Investment Act of 2002, 7 U.S.C § 7901 et. seq.
State Air Pollution Control Board, 9 Virginia Administrative Code (VAC) § 5, 2006.

Department of Environmental Quality, 9 VAC § 15, 2004.
Virginia Waste Management Board, 9 VAC § 20, 2006.
State Water Control Board, 9 VAC § 25, 2006.
Virginia Regulation Concerning Licensed Asbestos Contractor Notification, Asbestos Project Permits And Permit Fees, 16 VAC § 25-20-30, 1993.
Virginia Tidal Wetlands Act, 28.2 Code of Va. § 13, 1972.
Exec. Order No. 11,593 (Protection and Enhancement of the Cultural Environment), 3 C.F.R. 559-562 (1971).
Exec. Order No. 11,990 (Protection of Wetlands), 3 C.F.R. 121 (1977).
Exec. Order No. 13,287 (Preserve America), 3 C.F.R. 13287 (2003).
Exec. Order No. 13,423 (Strengthening Federal Environmental, Energy, and Transportation Management), 3 C.F.R. 13423 (2007).
NASA Regulations on Environmental Quality, 14 C.F.R. § 1216 (2000).
Occupational Safety and Health Standards, 29 C.F.R. § 1910 (2006).
Basic Program Elements for Federal Employee Occupational Safety and Health Programs and Related Matters, 29 C.F.R. § 1960 (2004).
National Register of Historic Places, 36 C.F.R. § 60 (2004).
Protection of Historic Properties, 36 C.F.R. § 800 (2004).
Environmental Protection Agency Regulations, 40 C.F.R. § 1-1068 (2007)
Council on Environmental Quality (CEQ) Regulations, 40 C.F.R. § 1500-1518 (2007).
Federal Acquisition Regulation (FAR) 48 C.F.R. § 1-99 (2007).
Department of Transportation Regulations, Shippers – General Requirements for Shipments and Packagings, 49 C.F.R. § 173 (2003).
Endangered and Threatened Wildlife and Plants, 50 C.F.R. § 17 (2002).
NPD 8500.1, NASA Environmental Management.
NPR 4310.1, Identification and Disposition of NASA Artifacts.
NPR 8530.1, Affirmative Procurement Program and Plan for Environmentally Preferable Products.
NPR 8553.1, NASA Environmental Management System.
NPR 8580.1, Implementing the National Environmental Policy Act and Executive Order 12114.
LAPD 8800.1, LaRC Environmental Compliance, Restoration and Pollution Prevention Program.
LPR 1710.12, Potentially Hazardous Materials – Hazardous Communication Standard.
LPR 1740.2, Facility Safety Requirements.
LPR 1740.4, Facility System Safety Analysis and Configuration Management.
LMS-CP-4759, Acquisition of Hazardous Materials.
LMS-CP-8530, Facility Multi-media Environmental Audit Process.
Langley Form 44, Hazardous Materials – Procurement, Inventory and Storage Record.
Langley Form 163, Waste Material Data Sheet.
Langley Form 243, Appointment of Facility Environmental Coordinator(s) (FEC).
Langley Form 461, Environmental Project Planning Form.

P.4 APPLICABLE DOCUMENTS

EPA Comprehensive Procurement Guidelines

Unified Facilities Guide Specifications
LPR 2710.1, Langley Research Center Noise and Hearing Conservation Program.
LaRC Environmental Resource Document (ERD)
LaRC Integrated Spill Contingency Plan
LaRC PCB Management and Spill Prevention, Control and Countermeasure Plan
LaRC Specifications Kept Intact (SpecsIntact)

(Persons interested in receiving a copy of one of the above documents should contact the Environmental Management Team at extension 43500.)

P.5 MEASUREMENT/VERIFICATION
To verify compliance with this NPR the Environmental Management Team performs multi-media environmental audits of LaRC facilities, as described in chapter 1.2.

P. 6 CANCELLATION

LPR 8800.1, dated August 9, 2004

ORIGINAL SIGNED ON FILE

Cynthia C. Lee
Associate Director

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1 INTRODUCTION

1.1 RESPONSIBILITY

A. Conducting operations in an environmentally acceptable manner is each employee's responsibility. The success of LaRC's environmental program depends on cooperation and support from all LaRC personnel.

B. Langley Policy Directive (LAPD) 8800.1, *"LaRC Environmental Compliance, Restoration and Pollution Prevention Program*," includes general responsibilities for LaRC management and organizations regarding the Center's environmental program. The directive specifies that overall responsibility for LaRC's environmental compliance, restoration, and pollution prevention program lies with the Center Director. Day-to-day management of the program is the responsibility of the LaRC Environmental Management Team (EMT) within the Environmental and Logistics Branch. Each Organizational Unit Manager is responsible for appointing, in writing, Facility Environmental Coordinators (FEC's) for facilities and operations under their cognizance. Onsite contractors may be appointed as FEC's. FEC appointments, updates and changes shall be made using Langley Form 243, "*Appointment of Facility Environmental Coordinator(s)*." Additional information on FEC appointments and changes is available at the EMT website: http://osemant1.larc.nasa.gov/envcord/database/coordm.cfm. FEC's are responsible for assuring proper environmental compliance for the activities within their designated facilities, and EMT is responsible for interfacing with the FEC's to achieve program objectives.

C. In addition to the general responsibilities described above, each chapter of this LPR details specific organization and personnel responsibilities according to the various environmental program areas. Any questions concerning the responsibilities or procedural requirements contained in this LPR should be directed to EMT at extension 43500.

1.2 COMPLIANCE

A. Failure to fully comply with the requirements of this LPR could result in Federal or State regulatory action requiring substantial expenditure of NASA resources and possibly criminal prosecution of the individuals responsible for noncompliance. Citations and fines for violations of environmental laws and regulations are dependent upon the applicable law and the nature of the violation. Charges can range from civil charges for noncompliance to criminal charges for willful violation and/or withheld or falsified information. Penalties can range from an injunction to fines of up to $50,000 per day and 3 years in prison depending on the nature of the violation. The Head of the Environmental and Engineering Compliance Branch is delegated cease and desist authority for any operations that, in the professional judgment of the EMT staff, have an immediate and negative impact on the

environment or that jeopardize the Center's compliance with permit requirements and applicable environmental regulations.

B. In order to ensure compliance with Federal, State and local environmental regulations, EMT conducts, on a continuing basis, multi-media environmental audits of LaRC facilities. EMT documents the audit findings and follows the procedures in LMS-CP-8530, "*Facility Multi-media Environmental Audit Process,"* (http://lms-r.larc.nasa.gov/admin/documents/8530.pdf) to ensure the correction of any noncompliance issues. An audit report is forwarded to the FEC who has 30 days to correct the findings and notify EMT. If the FEC cannot correct the findings within the 30-day deadline, the FEC shall prepare a corrective action plan including a timeframe for completion and submit the plan to EMT. If the FEC fails to correct the findings by the deadline, EMT notifies, in writing, the FEC's Organizational Unit Manager (OUM) of the outstanding compliance issue(s) and sets a 30-day compliance deadline. If the compliance issue is still unresolved after the 30-day deadline and EMT decides that all reasonable efforts to achieve compliance have been unsuccessful, then EMT may notify, in writing, the Center Director of the violation and request that he/she intervene to resolve the issue. EMT's decision to alert LaRC's senior management is dependent upon the nature of the noncompliance finding.

C. When information affecting environmental compliance matters at the Center must be communicated to all personnel, EMT publishes an article on the LaRC intranet homepage. An email notice alerts all LaRC employees of the environmental article, which then links users to the EMT website for more information.

2 NATIONAL ENVIRONMENTAL POLICY ACT (NEPA)

2.1 GENERAL

A. The purpose of this chapter is to provide information on applicable regulatory requirements and procedures related to the environmental impact assessment of proposed programs or projects. In addition, it provides procedural requirements to ensure that environmental impact analysis is part of new projects during the conceptual study phase. The procedures are applicable to all LaRC employees and contractors (as specified in their contracts) who participate in the development of projects or the management of operations that may have an impact on the environment.

B. Environmental impact analysis must be a part of the earliest thinking on any proposed action or project. It requires continued evaluation and update as the proposed action develops. Environmental evaluations, environmental assessments (EA's), and where necessary, environmental impact statements (EIS's) are used throughout the decision-making process of new or changed actions.

2.2 REQUIREMENTS

A. The National Environmental Policy Act (NEPA) of 1969 as amended establishes national policy concerning the protection and the enhancement of the environment. It requires Federal agencies to prepare detailed documentation on any action undertaken that could result in a significant impact on the environment. NPR 8580.1, "*Implementing the Provisions of the National Environmental Policy Act and Executive Order 12114*," formalizes NASA policy in this area.

B. NEPA procedures insure that environmental information is available to public officials and citizens before decisions are made and actions are executed. The NEPA process is intended to help public officials make decisions that are based on the understanding of environmental consequences, and take actions that protect, restore, and enhance the environment.

2.3 ENVIRONMENTAL DOCUMENTATION

A. LaRC personnel or offices initiating actions covered by NEPA shall prepare environmental evaluations, assessments and impact statements in accordance with the requirements of this chapter, NPR 8580.1, and other relevant Federal environmental laws, regulations, and Executive Orders. Preparation of these documents shall be coordinated with EMT early in the process. Figure 2-1 provides a general overview of the NEPA review and documentation process at LaRC.

2.3.1 Review and Documentation

A. As depicted in Figure 2-1, the first step of the process is to review the action or project using the Environmental Checklist provided in Langley Form 461, "*NEPA Environmental Checklist*." The checklist is designed to assist the initiator in determining if the action has the potential to produce any type of environmental effect or impact.

B. The checklist provides a series of "YES-NO" type questions spanning all possible areas of activities that might result in an environmental impact. If, after having completed the checklist, all of the questions are answered "NO", the action is considered to have no potential to produce an environmental impact and is excluded from further environmental review. However, the initiator shall document his/her review via a Record of Environmental Consideration (REC). An example of a REC is shown in Figure 2-2. After completing the REC and obtaining concurrence from the Head of the Environmental and Engineering Compliance Branch the initiator should place the REC in the project files with the completed checklist. No further documentation is required. The REC should be reviewed for verification at the Preliminary Design Review and in the Preliminary Engineering Report, if one is prepared.

C. If, however, one or more of the questions on the checklist are answered with a "YES", the project initiator shall prepare a detailed environmental evaluation. EMT may be contacted at extension 43500 for assistance in preparing the evaluation. The initiator shall gather information to determine the nature and extent of the impact(s). For example, if the question concerns the discharge of substances into the environment, the initiator must determine: the type of discharge, its volume, the duration and point of discharge, and any other pertinent information.

D. This information is used to determine whether or not the action will, or has the potential to, produce environmental impacts. If a review of the information in the environmental evaluation shows that there will be no environmental impact, the review is complete. The initiator shall then complete and sign a REC (Figure 2-2) and obtain the concurrence of EMT. The REC shall then be placed in the project file with the data and documentation compiled during the analysis and the completed checklist. This REC must also be verified at the Preliminary Design Review and in the Preliminary Engineering Report, if one is prepared.

E. If the detailed environmental evaluation shows that the action might have a significant impact on the environment, the project initiator shall prepare an EA. In some cases during completion of the environmental checklist, it will become apparent that the action will produce a significant environmental impact. In these cases the detailed environmental analysis step may be skipped. The initiator should proceed to the EIS. This is particularly true for actions that deal with wetlands, floodplains, or cultural resources, which are each covered in detail in later chapters.

2.3.2 Environmental Assessment (EA)

A. Table 2-1 lists specific NASA actions that require an environmental assessment. For these actions, project initiators shall proceed directly to the EA. The EA must comply with the format and content required by NPR 8580.1. In addition to these actions, under the Council of Environmental Quality (CEQ) regulations (40 C.F.R. § 1500-1599), any action that is not specifically considered to require an EIS (Table 2-2) or which is not specifically a categorical exclusion, must be treated as environmental assessment-type activity. Table 2-3 lists the activities that are categorically excluded from the requirements for an EA.

B. If the environmental evaluation indicates that the proposed action will have an impact (either adverse or beneficial) on the environment, an EA is required. The EA will evaluate the possible environmental impact in terms of its short and long-term significance. The complexity of an assessment will vary according to the subject matter and the significance of the impact.

C. The EA and the determination as to whether an EIS is required shall be made **prior** to the decision to proceed from the conceptual study phase to the detailed planning/definition phase of the proposed action.

D. Once the EA is completed, it is then sent to NASA Headquarters for review and concurrence. **Early involvement by EMT in preparation of the EA is imperative.**

E. If it has been determined that an EIS is not required, EMT will prepare a "Finding of No Significant Impact" (FONSI) and coordinate the required review and approval in accordance with NPR 8580.1. The FONSI will summarize the assessment and include reasons why an EIS is not required. Upon approval and signature from the LaRC Center Director, the FONSI is published in a local paper.

2.3.3 Environmental Impact Statement (EIS)

A. NASA actions expected to have a significant effect on the quality of the environment shall require an EIS. Table 2-2 is a listing of NASA actions that require an EIS. An EA is not required for these actions. When it has been determined that an EIS is required, a "Notice of Intent to Prepare an EIS" is also required. EMT staff will coordinate the preparation and processing of the EIS in accordance with the provisions of NPR 8580.1 and the provisions of the CEQ Regulations. Table 2-3 lists the activities that are categorically excluded from the requirements of an EIS.

B. NASA Headquarters must agree that an EIS is or is not required for any major project at LaRC. EMT will establish external and internal processing for each EIS on a case-by-case basis.

C. The final EIS shall be completed and distributed in accordance with the CEQ regulations prior to the decision to proceed from the detailed planning-definition phase to the development-construction phase (or implementation) phase of the proposed project or action.

2.4 RESPONSIBILITIES

2.4.1 Environmental Management Team (EMT)

A. Prepare and maintain the LaRC Environmental Resource Document (ERD) as prescribed in NPR 8580.1, "*Implementing the National Environmental Policy Act and Executive Order 12114*."

B. Assist the Program Manager/Initiator as required.

C. Serve as the point of contact for all required off-Center coordination (NASA Headquarters, other Federal agencies, State, and local agencies).

D. Process the EA or EIS in accordance with NPR 8580.1 to include the following actions:

1. Coordinate internal review of the EA or EIS and plan for coordination with State, and local agencies or organizations.

2. Coordinate review of the EA or EIS by other Federal, State, and local agencies, organizations, and interested parties.

3. Provide for public availability of the EA and EIS and prepare responses to comments.

4. Ensure that necessary actions are taken to meet the applicable requirements of environmental laws and regulations.

2.4.2 Program Managers/Initiators

A. Coordinate with EMT in identifying programs and projects that may affect the environment and activities related to environmental quality.

B. Prepare, or fund the preparation of, the required NEPA documentation as described in this chapter.

C. Complete the Langley Form 461, "*NEPA Environmental Checklist*," and forward to EMT for review.

D. Maintain project documentation as required in Section 2.3.

Figure 2-1

Overview of the NEPA Process

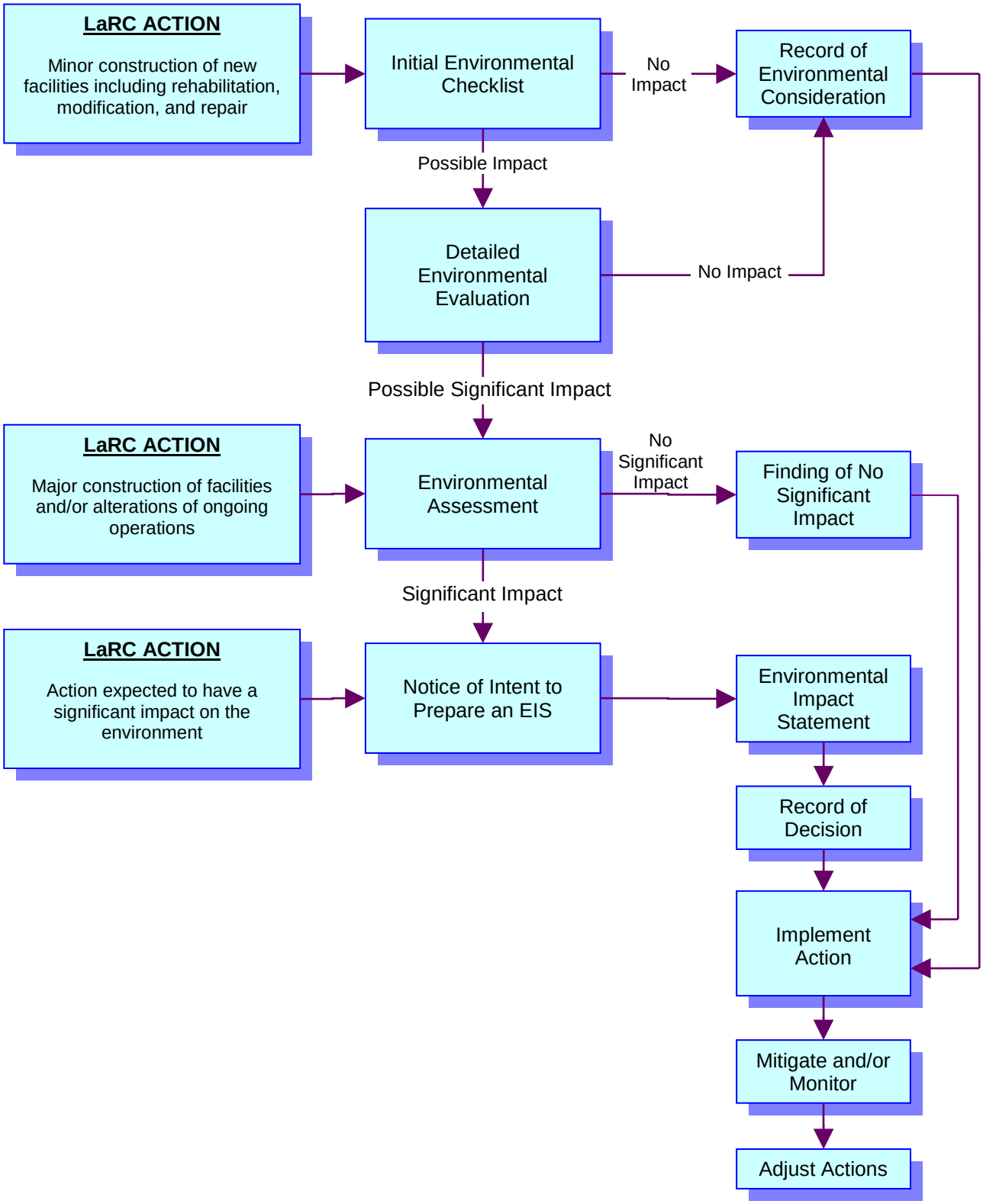

Figure 2-2

Record of Environmental Consideration (Example)

1. Project Title.

2. Description of proposed action.

3. Anticipated date and/or duration of proposed action.

4. It has been determined that the above action (choose one).

   a. Is adequately covered in an existing EA_____EIS_____ entitled _____ and dated _____.

   b. Qualifies for Categorical Exclusion # _____, (Table 2.3) and has no special circumstances which would suggest a need for an environmental assessment.

   c. Is exempt from NEPA requirements under the provisions of (cite superseding law).

   d. Has no environmental impact as indicated by the results of the NEPA Environmental Checklist and/or a Detailed Environmental Evaluation. (Attach Checklist or Environmental Evaluation as applicable).

SIGNED: _____ DATE: _____
(Office responsible for proposed action)

SIGNED: _____ DATE: _____
Head, Environmental and Engineering Compliance Branch

Table 2-1

LaRC Actions Requiring an Environmental Assessment

Specific LaRC actions that normally require an EA include, but are not limited to the following:

1. Specific spacecraft development and flight projects in space science.
2. Specific spacecraft development and flight projects in space and terrestrial applications.
3. Specific experimental projects in aeronautics and space technology and energy technology applications that may have substantial effect on the human environment.
4. Development and operation of new space transportation systems and advanced development of new space transportation and spacecraft systems.
5. Reimbursable launches of NASA spacecraft or payloads.
6. Major Facility Construction and rehabilitation projects.
7. Actions to alter ongoing operations at LaRC which could lead, either directly or indirectly, to natural or physical environmental effects.
8. Disposal or acquisition of real property (may require an EA).

Table 2-2

LaRC Actions Requiring an Environmental Impact Statement

Specific LaRC actions which require an EIS include the development and operation of:

1. New launch vehicles.
2. Space vehicles likely to release substantial amounts of foreign materials into the earth's atmosphere or into space.
3. Nuclear systems, including reactors and thermal devices used for propulsion and/or power generation.

Disposal and acquisition of real property may require an EIS. In addition, a space mission involving the return to earth of materials gathered from extraterrestrial sources may require an EIS.

Excluded from the presumption that an EIS is needed are nuclear devices having limited numbers of millicurie or less quantities of radioactive materials used as instrument detectors, and small radioisotope heaters used for local thermal control, provided they are properly contained and shielded.

Table 2-3

NASA EA/EIS Categorical Exclusions

The following activities are categorically excluded from the requirements for EA's and EIS's:

1. Research and Development (R&D) activities in –

   a. Space science, other than specific spacecraft development and flight projects,

   b. Space and terrestrial applications other than specific spacecraft development and flight projects,

   c. Aeronautics and space technology and energy technology applications, other than experimental projects that have the potential for substantial environmental impacts, and

   d. Space transportation systems engineering and scientific and technical support operations, routine transportation operations, and advanced studies.

2. Enhanced space tracking and data systems.

3. Facility planning and design (funding).

4. Minor construction of new facilities including rehabilitation, modification, and repair.

5. Continuing operations of a NASA facility at a level of effort, or altered operations, provided the alterations induce only social and/or economic effects, but no or minimal natural or physical environmental effects.

NOTE: Even though an action may be categorically excluded from the need for a formal environmental assessment or EIS, **it is not excluded from the requirement for an environmental evaluation conducted during the earliest planning phases**. If that evaluation shows that the action deviates from the criteria for exclusion and it is concluded that there may be significant environmental effects, an environmental assessment must be completed. Based on that assessment, a determination must then be made whether or not to prepare an EIS.

For more detailed flowcharts of NEPA guidance, refer to NPR 8580.1.

3 WATER QUALITY

3.1 GENERAL

A. The purpose of this chapter is to provide information on applicable regulatory requirements and procedures related to the Clean Water Act (CWA). The CWA regulates discharge of pollutants into waters of the US from any point source including industrial facilities and sewage treatment plants. It also regulates storm water runoff from certain industrial sources and requires reporting and cleanup of oil and hazardous substance spills in waterways. The objective of the CWA is to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters." Section 313 (a) of the CWA requires Federal agencies to establish pollution controls. Under the CWA it is illegal for any person, including Federal agencies, to discharge pollutants from a point source without a permit. The Environmental Protection Agency has granted the Commonwealth of Virginia Water Control Board authority to issue these permits under the Virginia Pollutant Discharge Elimination System (VPDES). NASA LaRC has discharges from most facilities onsite and must comply with all aspects of the CWA and VPDES for permitting.

3.2 REQUIREMENTS

A. NASA LaRC operates under three water discharge permits: one Hampton Roads Sanitation District (HRSD) permit and two VPDES permits. These permits limit the types and quantities of pollutants discharged, and establish monitoring and record keeping requirements. Any discharge not allowed under these permits is a violation of the CWA. To assess compliance with permit conditions the regulatory agencies conduct periodic inspections at the Center. Copies of LaRC's water discharge permits can be viewed at EMT's Water Program website located at: http://osemant1.larc.nasa.gov/water/index.cfm.

3.2.1 VPDES State Permits

A. VPDES Permit No. 0024741 allows LaRC to discharge effluent to surface waters and specifies the allowable discharges, the pollutant limitations, and the monitoring requirements. NASA LaRC has outfalls that are permitted to discharge industrial process waste water and storm water runoff. Information regarding monitoring locations and the permit authorized discharges can be obtained by calling EMT at extension 43500.

B. VPDES Permit No. VAR040092 is a general permit for Small Municipal Separate Storm Sewer Systems (MS4). This permit requires that NASA LaRC develop, implement and enforce a storm water management program to reduce the discharge of pollutants from the Center to the maximum extent practicable. LaRC's storm water management program must include minimum control measures as specified in the permit, and best management practices must be implemented to meet the control measures.

3.2.2 HRSD Permit

A. HRSD Permit 0085 allows LaRC to discharge nonhazardous industrial wastewater and sanitary sewage to the HRSD sanitary sewer system. HRSD does not provide treatment for hazardous wastes. The HRSD Permit specifies the allowable discharges, the pollutant limitations, and monitoring requirements.

3.3 RESPONSIBILITIES

3.3.1 Facility Environmental Coordinators (FEC's)

A. Have knowledge of materials and operations that may result in potential release of water pollutants.

B. Be aware of applicable permit requirements and act to prevent unpermitted discharges.

C. Assist EMT by providing information and data required to comply with water permit requirements and compliance inspections.

D. Contact EMT at extension 46912 to determine alternative disposal options in situations where surface water or sanitary discharge is not permissible.

E. In the event of a permit violation, participate in the investigation to determine the cause of the discharge and recommend remedial action to prevent reoccurrence.

3.3.2 Environmental Management Team (EMT)

A. Monitor and report as required by the permits and maintain all related files.

B. Serve as the point of contact for LaRC with regulatory agencies. In the event of a permit violation, coordinate the investigation and submit findings to the permitting agency, as necessary.

C. Approve or disapprove discharges from operations not included on the Center's water discharge permits to include on-site contractor operations.

3.3.3 Program Managers/Initiators

A. Obtain approval from EMT before the start of any operations that have discharges not covered under the Center's water permits.

3.3.4 Contracting Officer's Technical Representatives (COTR's)

A. Ensure that contractors:

1. Comply with Center's water discharge permit requirements.
2. Perform operations in a manner that prevents unpermitted water discharges.

3.3.5 Center Personnel and On-site Contractors

A. Perform operations in a manner that prevents unpermitted water discharges.

B. Assist FEC's, as needed, with the preparation of the required information for permit applications and compliance inspections.

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4 AIR QUALITY

4.1 GENERAL

A. The purpose of this chapter is to provide information on applicable regulatory requirements and procedures related to air quality at NASA LaRC. Federal and State laws regulate air pollutant emissions from NASA LaRC facilities and operations. The Clean Air Act of 1970 and its Amendments of 1990 set forth the requirements for air quality control programs. The objective of air quality control programs is "to protect and enhance the quality of the Nation's air resources so as to promote public health and welfare and the productive capacity of its population." The U.S. Environmental Protection Agency has granted the Virginia Department of Environmental Quality (DEQ) authority for oversight and enforcement of Clean Air Act provisions.

4.2 REQUIREMENTS

4.2.1 NASA LaRC Air Operating Permit

A. The Center has a Federally enforceable, State operating permit for its stationary sources of air pollution. The permit limits emissions from specific sources of air pollutants as well as from the entire research facility. It also specifies operating, monitoring, and record-keeping requirements. To assess compliance with the permit conditions, DEQ conducts annual air inspections at the Center. A list of facilities regulated under the air permit is maintained by EMT and is available by calling extension 43500. A copy of the current LaRC air permit is posted on the EMT website at http://oee.larc.nasa.gov/air/index.cfm.

4.2.2 Compliance Requirements of the Air Operating Permit

A. The air permit is designed to limit the quantity of air pollutants that NASA LaRC facilities and operations may emit. Specific permit requirements vary according to the air pollution source but they generally fall into one of four categories:

1. Physical:
   - Requirement for air pollution controls to limit emissions. Examples include low nitrogen oxide (NOx) burners on boilers and filters on paint booths.
   - Requirement for monitoring equipment to measure emissions or process rates.

2. Operational:
   - Limits on the amount of fuel burned or materials processed.
   - Limits on frequency and duration of operations.
   - Limits on the types and amounts of product that can be used, such as paints and solvents.

3. Record Keeping:
   - Documents that physical and operational requirements are met.

- Documents the quantity of products, fuel, and materials used.
- Documents the frequency and duration of operations.

4. Reporting and Inspections:
   - Requirement for Monthly and Quarterly Reports.
   - Requirement for Annual Inventory and Emissions Statement.
   - Allowance for periodic Compliance Inspections by DEQ.

4.3 RESPONSIBILITIES

4.3.1 Facility Environmental Coordinators (FEC's)

A. Know the facilities and operations that are, or have the potential to be, sources of air pollution.

B. Be familiar with the permitted sources of air pollution and the applicable permit requirements for those sources.

C. Notify EMT prior to moving, changing, or installing an air emission source.

D. Consult with EMT to evaluate operations of concern and to ensure compliance with air pollution regulations and permit requirements.

E. Provide data, as required by the permit, to EMT in a timely manner for air emissions monitoring and inventory.

F. Whenever possible, minimize or eliminate sources of air pollution through the use of feasible engineering and administrative controls. Substitution of nonpolluting materials shall be required when practical to use them.

4.3.2 Environmental Management Team (EMT)

A. Monitor and report on air pollutant emissions and prepare air permit applications as required by regulatory agencies.

B. Serve as the point of contact for LaRC for communications with regulatory agencies regarding air emissions and permitting issues.

C. In the event of discovering a potential permit violation, contact the appropriate facility personnel and develop a solution/plan for correcting the problem. The solution/plan may include establishing a temporary fix and/or procuring the necessary funds to achieve full compliance.

D. Prepare and maintain emission inventories, summary reports, and a list of permitted air sources.

4.3.3 Logistics Office, Environmental and Logistics Branch

A. Provide EMT with monthly reports on the amount and type of chemicals and the quantity of fuel issued from stock. Reports for the previous month shall be provided to EMT in a timely manner, but not later than five working days into the new month.

4.3.4 Program Managers/Initiators

A. Notify EMT prior to moving, changing, or installing an air emission source.

4.3.5 Center Personnel and On-site Contractors

A. Be aware of and comply with the air permit requirements.

B. Assist FEC's with the preparation of the required information for permit conditions, monthly monitoring, and annual updates.

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5 WASTE MANAGEMENT & MINIMIZATION

5.1 GENERAL

A. The purpose of this chapter is to provide information on regulatory requirements and procedures regarding the proper management of various hazardous and nonhazardous wastes at NASA LaRC. The procedures comply with the regulations established by the Environmental Protection Agency (EPA), the Occupational Safety and Health Administration (OSHA), the Virginia DEQ and EMT.

5.2 REQUIREMENTS

A. The disposal of waste is strictly regulated under the Resource Conservation and Recovery Act (RCRA) of 1976. RCRA gives EPA the authority to control hazardous waste (HW) from "cradle-to-grave," which includes the generation, transportation, treatment, storage, and disposal of HW. Under this concept, the HW generator is ultimately responsible for the waste from the time it becomes a waste until it is properly disposed of and no longer poses a threat to human health or the environment. RCRA also sets forth a framework for the management of nonhazardous wastes. In 1984, the Federal Hazardous and Solid Waste Amendments to RCRA increased the EPA's enforcement authority and established a more stringent HW management standard.

B. RCRA regulations prohibit a wide variety of materials and substances from disposal in the municipal trash system. LaRC manages several categories of these prohibited wastes, and each category is subject to specific requirements and management procedures. The types of prohibited wastes that LaRC manages are outlined below:

1. Hazardous Waste. HW is a waste with properties that make it dangerous or potentially harmful to human health or the environment. Although the criteria for identifying and classifying HW are complex, HW often exhibits at least one of four characteristics – ignitability, corrosivity, reactivity, or toxicity. Common LaRC wastes that may be classified as HW include, but are not limited to, acids/caustics, adhesives, cylinders, fuels, paints, lead solder, and solvents. At LaRC, HW is accumulated by generating facilities at Satellite Accumulation Areas and collected for disposal by EMT. Management and disposal procedures are described in Section 5.2.2.

2. Universal Waste. Universal Waste is a subcategory of HW that is subject to less stringent management requirements than other HW. Universal Waste consists of certain batteries, pesticides, mercury-containing equipment, and lamps (e.g., fluorescent light bulbs). Section 5.2.3 describes Universal Waste management procedures.

3. Oils. Oil, lubricants, oily water and oily debris are prohibited from trash disposal although they are categorized as "nonhazardous waste" under RCRA. Procedures for the management of oils are described in Section 5.2.4.

4. Metals. Many metals naturally contain trace amounts of hazardous constituents that may leach into the environment if disposed in the landfill. Lead solder is considered a HW and shall be managed according to the requirements in Section 5.2.2. Other metals are recycled following procedures described in Section 10.2.3.5. Completely empty aerosol cans or spray paint cans may be recycled, with prior approval from EMT. However, if any product remains in the metal cans, they shall be managed as HW.

5. Polychlorinated Biphenyls (PCB's). Materials containing PCB's are prohibited from trash disposal, as described in Chapter 6.

6. Asbestos. Asbestos containing materials are prohibited from trash disposal as described in Chapter 8.

5.2.1 Solid Waste Management

A. Solid waste refers to nonhazardous, non-liquid wastes that do not fall into any of the above prohibited categories. The Center manages solid waste through an integrated approach incorporating recycling, composting, energy recovery and landfilling. LaRC strives to implement projects and business practices that minimize the amount of solid waste generated and disposed. The preferred hierarchy of solid waste reduction and disposal is source reduction, reuse, recycling, incineration, and finally landfilling.

B. LaRC collects numerous items for recycling, as described in Chapter 10. Recyclables should not be disposed as trash. Exec. Order No. 13,423, "*Strengthening Federal Environmental, Energy and Transportation Management*," requires Federal agencies to maintain waste prevention and recycling programs in their facilities.

5.2.2 Hazardous Waste Management

A. RCRA dictates specific HW management requirements based on the total amount of HW generated. LaRC is categorized as a Large Quantity Generator, which makes it subject to the following RCRA requirements:
   1. LaRC may only store HW at its central HW Storage Area for 90 days.
   2. LaRC must have a contingency plan for handling emergencies.
   3. LaRC must submit a biennial HW report.
   4. LaRC must have in place a waste minimization program to reduce the volume and toxicity of waste generated.
   5. LaRC may not transport HW offsite or dispose of HW onsite - these functions can only be performed by permitted contractors.

B. Certain Department of Transportation (DOT) security requirements enacted after September 11, 2001, also affect LaRC as a generator of HW. DOT has worked closely with Federal, State, and local government agencies to improve the security

of hazardous substances in the transportation system. DOT requires that shippers and carriers of certain highly hazardous items develop and implement security plans. In accordance with these requirements, LaRC has developed a Hazardous Material and Hazardous Waste (HM/HW) Security Plan. The plan includes measures to verify background information for personnel with access to hazardous materials and wastes; measures to address unauthorized access to hazardous substances; and measures to address the security risks of shipments while in transit. The plan is available by contacting EMT at extension 43500.

C. RCRA dictates the specific HW procedures as described below in Section 5.2.2.1 through 5.2.2.4.

5.2.2.1 Waste Minimization

A. Waste minimization is required by RCRA, and LaRC strives to minimize the volume and toxicity of wastes generated at the Center. Source reduction, reuse, and recycling shall be utilized whenever possible. Additional information on waste minimization concepts can be found in Chapter 17, Pollution Prevention.

B. One avoidable source of HW results from the poor management of hazardous materials. LaRC requires hazardous materials to be managed in accordance with Federal, State and local regulations and Langley Procedural Requirements such as LPR 1710.12 and Chapter 18 of this LPR. Poorly managed hazardous materials may result in expired, spoiled or contaminated materials that are unsuitable for their intended purpose. In these cases, the items would require disposal as HW, resulting in additional disposal costs. If an organization fails to follow the above requirements resulting in unnecessary HW disposal costs, the responsible organization will be charged for the disposal.

5.2.2.2 Training

A. All personnel who handle HW or oil, or personnel who oversee the handling of HW or oil (including FEC's), shall attend training on management procedures relevant to the tasks they are performing. The training also includes emergency response procedures and familiarization with equipment and systems where applicable. Training is mandatory and shall be attended annually or whenever new or different hazards are introduced into the workplace. The Waste Management Training course is offered by EMT and proof of this training (e.g., sign in sheet) shall be kept on file by the FEC.

5.2.2.3 Facility Accumulation Procedures

A. A Satellite Accumulation Area (SAA) is a specific location at a facility that is designated to accumulate HW. Below are specific requirements for managing SAA's.

1. SAA's shall be located at or near the point of waste generation and be under the control of the operator of the process generating the waste. HW from one SAA may not be moved to another SAA.

2. Pre-labeled drums/containers with unique identification numbers are issued by EMT for accumulating waste (available by calling 5-DRUM). The use of product containers for accumulating waste is prohibited. The drums that EMT issues shall stay at the receiving facility and contain only the waste for which they were issued.

3. Each HW container located at an SAA shall be marked with the words "Hazardous Waste" and the identity of the waste.

4. Each container at an SAA shall be closed at all times (unless adding waste), and shall be maintained in good condition (non-leaking).

5. SAA inspections shall be performed weekly and documented. An example inspection sheet is available at: http://osemant1.larc.nasa.gov/cmts/hazwaste/.

6. A one-page Spill Plan shall be posted at each SAA and, where appropriate, there shall be adequate spill supplies to clean up small spills or contain large spills (Facilities must purchase their own supplies). A facility-specific Spill Plan can be generated at: http://osemant1.larc.nasa.gov/cmts/hazwaste/. Accumulation of solvent rags, aerosol cans and solder are exempt from this requirement.

7. No more than 55 gallons TOTAL of HW or 1 quart of acute HW can be accumulated at an SAA. Acute wastes are specifically listed by the EPA. A copy of the list is available at http://oee.larc.nasa.gov/cmts/hazwaste/acute.htm or by calling EMT at extension 44232. Users should leave headroom in containers to allow for expansion (3 inches for 55-gallon drum, 1 inch for 5-gallon container).

5.2.2.4 Facility Disposal Procedures

A. A HW container must be removed from an SAA within 3 days of when the 55-gallon limit is reached, or when the container is full, regardless of size. The Accumulation Start Date on the HW label is not filled in until the container is full or the 55-gallon limit of HW is reached.

B. HW generators use the Waste Disposal Tracking System available at http://hazwaste.larc.nasa.gov/ to request the removal of HW by EMT. The Waste Disposal Tracking System contains the electronic Waste Material Data Sheet (Langley Form 163) which is filled out for each HW that requires pickup and disposal. Pickup of aerosol cans may also be requested using the simplified electronic form at: http://osemant1.larc.nasa.gov/rapp/bflac.htm or by calling 5-DRUM.

5.2.2.5 Disposal Cost Responsibilities

A. Hazardous material management is discussed in Chapter 18 of this LPR, and proper procedures for managing a hazardous material that becomes a hazardous waste are defined in Chapter 5 of this LPR. LAPD 8800.1 requires that each Organizational Unit Manager appoint, in writing, Facility Environmental Coordinators (FEC's) for facilities and operations under their cognizance. The LaRC EMT provides annual mandatory training for FEC's, hazardous waste handlers, and Hazardous Material Inventory Managers in the proper management of hazardous materials and hazardous waste. EMT is responsible for the disposal cost of hazardous waste generated by LaRC personnel and on-site contractors that has been managed properly in accordance with this LPR. However, in the event that EMT determines that hazardous material has not been properly managed, the responsible organization will be billed for all disposal related costs.

5.2.3 Universal Waste Management

A. Universal Waste is a subset of HW, so the accumulation and disposal procedures are similar. The requirements for Universal Waste management differ from the requirements for other HW in the following respects:

1. Containers are labeled with a "Universal Waste" label.

2. The start date is filled in when the waste *begins to be accumulated* (as opposed to the HW requirement of when the container is full).

3. Universal Waste can be accumulated at LaRC for up to 1 year, at which point it must be shipped off-Center for disposal. In order for LaRC to meet this requirement, generators must have their Universal Waste picked up by EMT within 270 days of the start date to allow EMT sufficient time to ship it off-site for disposal.

4. Facilities' battery accumulation areas are exempt from the SAA requirement for weekly inspections, spill plans and spill materials. Battery terminals shall be taped to prevent fire/sparks and accumulated in non-metallic containers. Generators may request pickup electronically at: http://osemant1.larc.nasa.gov/rapp/bflac.htm or by calling 5-DRUM.

5. Facilities' fluorescent light bulb accumulation areas are exempt from the SAA requirements to maintain spill plans and spill materials. In most cases, the LaRC lighting contractor replaces the bulbs at Center facilities. Facilities that change their own bulbs should accumulate them in the original box (to prevent breakage) and label it as "Universal Waste." Generators may request pickup electronically at: http://osemant1.larc.nasa.gov/rapp/bflac.htm

B. Aside from these differences, all other HW management requirements apply to Universal Wastes (e.g., annual training, labeling, maintaining closed containers).

5.2.4 Used Oil Management

A. Used oils, used lubricants, oily debris, and oily water are accumulated at locations convenient to the generating facility, and stored in containers labeled with "Nonhazardous Waste" and the identity of the substance. Accumulation containers can be requested from EMT. Used oils are not subject to the SAA requirements in Section 5.2.2, but the following requirements apply:
   1. Containers shall be kept closed and in good condition.
   2. Outdoor oil storage areas shall include adequate spill containment (e.g., spill containment pallets), and shall have a spill plan posted if the storage area contains more than 220 gallons (e.g., four 55-gallon drums).
   3. Generators and handlers of used oils are required to attend Waste Management Training as described in Section 5.2.2.2.
   4. To dispose of used oils, generators should request pickup electronically through the Waste Disposal Tracking System at http://hazwaste.larc.nasa.gov/ or call 5-DRUM.

5.2.5 Soil Excavation

A. If a proposed LaRC project will involve the excavation or removal of soil, the project initiator shall coordinate with EMT to ensure that appropriate sampling is performed prior to project startup. The number of samples and the sample parameters shall be determined according to the volume of soil excavated and the requirements of the facility to be used for disposal (e.g., local landfill). Soil that has not been sampled shall not be removed from LaRC without written approval from EMT.

5.3 RESPONSIBILITIES

5.3.1 Facility Environmental Coordinators (FEC's)

A. Ensure that facility personnel follow the waste management and disposal procedures outlined in this chapter.

B. Notify EMT at extension 44232 prior to establishing or modifying an SAA.

C. Review and approve completed Waste Material Data Sheets in the Waste Disposal Tracking System.

D. Ensure all personnel who handle or oversee the handling of HW/oil obtain the mandatory annual training and maintain training files.

E. Assist facility personnel in minimizing HW. Review operations to ensure that they are conducted efficiently, reducing hazardous material use whenever possible.

F. Contact EMT at least 2 weeks before starting work on large waste-generating projects (e.g., lead paint removal, wash-down of tunnel walls, maintenance activity that will generate oil discharges). Failure to do so could result in work stoppage or additional costs.

5.3.2 Environmental Management Team (EMT)

A. Oversee the Center's HW management operations, including issuing labeled waste accumulation containers and removing full HW containers within the 72-hour notification time limit.

B. Prepare the HW Generators Biennial Report.

C. Dispose of waste through a qualified off-site contractor in accordance with all Federal, State and local requirements. Review audit information for Transfer, Storage and Disposal Facilities used for HW disposal.

D. Provide periodic HW Management training to FEC's and facility personnel.

E. Coordinate with Program Manager/Initiator or COTR to determine if environmental sampling will be required for any proposed projects.

5.3.3 Organizational Unit Managers

A. Ensure that facility personnel follow the waste management and disposal procedures outlined in this chapter. If mismanaged hazardous materials result in additional HW disposal costs, the responsible organization will be charged for the disposal.

5.3.4 Program Managers/Initiators

A. Contact EMT at least 2 weeks before starting work on large waste-generating projects (e.g., lead paint removal, wash-down of tunnel walls, maintenance activity that will generate oil discharges). Failure to do so could result in work stoppage or additional costs.

B. Ensure that all projects include provisions for compliance with the waste management requirements described in this chapter.

5.3.5 Center Personnel and On-Site Contractors

A. Attend the mandatory Waste Management training at least annually if you handle or oversee the handling of HW or oil.

B. Call the LaRC Dispatcher at 911 (cell 864-2222) in the event of a spill/ leak of HW or oil.

C. Comply with all applicable waste management requirements and procedures as outlined in this chapter. As a reminder, the following list contains some common examples (list is not all-inclusive) of LaRC wastes that require special consideration and/or management procedures for disposal, as described in this chapter. If unsure of proper disposal procedures, personnel should contact EMT at 43500.

Acids/caustics
Adhesives
Aerosol cans
Asbestos-containing materials
Automotive fluids
Batteries
Capacitors
Chemicals
Cleaners
Cylinders
Fluorescent light bulbs
Fuels
Light ballasts
Mercury-containing equipment
Metals
Oil/lubricants
Oily debris
Oily water
Paints
Paint cans
PCB's
Pesticides
Photographic fluids
Recyclable items
Spill debris
Solder
Solvents
Solvent wipes/swabs

6 POLYCHLORINATED BIPHENYL (PCB) MANAGEMENT

6.1 GENERAL

A. The purpose of this chapter is to provide information on applicable regulatory requirements and procedures regarding Polychlorinated Biphenyls (PCB's) and PCB containing equipment. It also outlines LaRC procedures for proper identification, management, and disposal of PCB and PCB containing items.

B. PCB's are a class of chlorinated hydrocarbons that were developed in the 1940's and used in a variety of applications because of their chemical stability, low flammability, and low electrical conductivity. Use as a coolant in transformers, capacitors, and ballasts has been a major application. PCB fluids have been sold under various trade names, such as "Askeral," "Inerteen," "Chlorexol," "Noflama," and "Pyranol." Because of their extreme stability, they do not break down in the environment and tend to bioaccumulate through the food chain. Manufacturing of PCB's in the United States was discontinued in 1977.

6.2 REQUIREMENTS

A. PCB's are regulated under the EPA's Toxic Substances Control Act (TSCA). The regulations include procedures for proper labeling, storage, use, servicing, decontamination, and disposal of all fluids containing greater than 50 parts per million (ppm) PCB's; electrical equipment containing such fluids; and cleanup debris from spillage or leakage of such fluids. Items containing fluids that have a PCB concentration between 2 ppm and 50 ppm are considered non-PCB and are excluded from certain Federal regulations with the exception of disposal practices.

B. Some facilities at the Center may still have PCB light ballasts or capacitors that have high levels of PCB's, or older electrical equipment that have very low levels of PCB's. Limited access areas containing large high voltage PCB capacitors (2,000 volts or greater) and individual PCB items must be posted with a large PCB sign. All PCB storage areas must also be posted. Items that have been retrofilled (fluids containing PCB's are removed and replaced with non-PCB fluid) shall be labeled with a non-PCB label. PCB signs and labels can be obtained by calling LaRC EMT at extension 43500.

6.3 RESPONSIBILITIES

6.3.1 Facility Environmental Coordinator (FEC's)

A. Label and post signs on each PCB item and area in the facility. A list of items that require labeling can be obtained by calling EMT at extension 43500.

B. Contact EMT at extension 43500 for sampling of possible PCB items or for removing PCB items for disposal.

C. In the event of a PCB spill, immediately call the LaRC Dispatcher at 911 (cell 864-2222). Notify EMT at extension 43500.

6.3.2 Environmental Management Team (EMT)

A. Provide PCB labels and signs to LaRC operators and custodians.

B. In the event of a spill, serve as the PCB Spill Coordinator and follow the procedures outlined in the LaRC PCB Management and Spill Prevention, Control, and Countermeasure Plan.

C. Review/approve disposal requests and sign PCB shipping documents.

D. Approve or reject the use of PCB disposal facilities.

E. Manage the Center's PCB Storage Facility, Facility 1167, in accordance with LaRC waste management and TSCA requirements.

F. Inspect all PCB items to ensure proper labeling and packaging prior to being placed in storage at Facility 1167.

G. Perform sampling and analyses of PCB items as needed.

6.3.3 Program Managers/Initiators

A. Notify EMT prior to work that will involve the removal of equipment and items containing fluids with any concentration of PCB's.

B. Ensure that contracts for the removal of PCB's include requirements for complying with all PCB removal procedures outlined in 6.3.4.

6.3.4 Contracting Officer's Technical Representatives (COTR's)

A. Ensure that contractors/subcontractors performing PCB removal operations comply with the following requirements:

1. Conduct all PCB operations, including storage, disposal and record-keeping, in accordance with applicable provisions of 40 C.F.R. § 761.

2. Temporarily store PCB items (e.g., transformers, capacitors), for a period of time, not to exceed 30 days, from the date of removal from service. Storage shall be coordinated with EMT to assure proper storage practices. A notation shall be attached to the PCB item or PCB container housing which indicates the date of removal from service, its weight, and PCB content.

3. Package all PCB items for transportation according to applicable DOT regulations.

4. Include an Emergency Spill Plan in the operational procedures.

5. NOTE: All transformers and electrical equipment that have fluids containing any concentration of PCB's must be drained before being transported off the Center for disposal. The only exception to this is transformers or capacitors that can be contained without modification in a drum or other leak proof container. EMT must be notified prior to draining any equipment to ensure that proper accumulation containers are used.

6. At least 5 working days prior to transporting any PCB items or transformer oil off LaRC property, the following information shall be submitted to EMT:

   a. Name and location of the ultimate disposal facility. Only LaRC-approved facilities may be used for the disposal of PCB items.

   b. A completed manifest that fulfills all statutory and regulatory requirements. EMT will review the manifest prior to approval and signature.

7. NOTE: Oil containing greater than 2 ppm PCB's shall be disposed of at incinerators or burners or at an EPA-approved chemical treatment facility.

8. In the event of a spill:

   a. Immediately call the LaRC Dispatcher at 911 (cell 864-2222). Notify the EMT at extension 43500.
   b. Perform cleanup as required under 40 C.F.R. § 761.

9. All personnel, including supervisors, involved with PCB spill prevention and cleanup shall be trained in accordance with Federal/State regulations. No PCB site operations shall be performed if spill materials and qualified personnel defined under the Emergency Spill Plan are not at the site prior to starting any PCB operations.

6.3.5 Center Personnel and On-site Contractors

A. If a spill or leak of PCB's is detected, immediately call the LaRC Dispatcher at 911 (cell 864-2222). Notify EMT at extension 43500.

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7 ENVIRONMENTAL REQUIREMENTS FOR CONSTRUCTION PROJECTS

7.1 GENERAL

A. This chapter provides information and procedures regarding the minimum environmental requirements for all construction projects performed at NASA LaRC. Construction projects addressed in this chapter include activities involving renovation, excavation and demolition at NASA LaRC.

7.2 REQUIREMENTS

A. All construction projects shall be conducted in accordance with this LPR, NASA's Specifications Kept Intact (SpecsIntact) requirements, the Unified Facilities Guide Specifications (UFGS), and all applicable environmental regulations. The SpecsIntact System is an automated, on-line system for preparing standardized facility construction specifications. The system is available at: http://specsintact.ksc.nasa.gov/Index.asp. The UFGS are for use in specifying construction for the military services and NASA. The UFGS are available at http://www.wbdg.org. These requirements are applicable to all LaRC personnel and contractors performing construction activities at NASA LaRC.

B. Construction projects shall be coordinated with EMT early in the planning stages. Specific requirements governing the preparation and review of assessments of the environmental impact of LaRC activities are contained in Chapter 2, National Environmental Policy Act (NEPA).

C. Construction projects at NASA LaRC shall include sustainable design and green building principles in accordance with Exec. Order No. 13,423, "*Strengthening Federal Environmental, Energy and Transportation Management*," and the 2006 *"Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings"* Memorandum of Understanding. Sustainable design and green building principles call for facilities that are designed, constructed, renovated, operated and reused in a resource and energy efficient manner. Beginning in 2006, NASA mandated a minimum of Silver rating under the Leadership in Energy and Environmental Design (LEED) program issued by the US Green Building Council.

7.3 RESPONSIBILITIES

7.3.1 Environmental Management Team (EMT)

A. Conduct a review of construction permits, plans, and specifications to ensure compliance with applicable regulations and requirements. Attend pre-construction meetings as requested.

B. Coordinate with the Contracting Officer's Technical Representative (COTR) regarding new equipment that may require environmental permits. Examples include but are not limited to: fuel-burning equipment, solvent degreasers, storage

tanks, equipment discharging to the sewer or surface water, and paint booths. Prepare and submit permit applications or modifications/amendments as necessary.

C. Coordinate with the COTR to determine if pre-construction and/or post-construction sampling is required.

D. Review and/or sign waste manifests and shipping documents as required by the construction project.

7.3.2 Program Managers/Initiators

A. Coordinate with EMT early in the planning stage of projects involving renovation, excavation and demolition. Coordinate with EMT to arrange pre-construction sampling as needed, to evaluate the impacts of the project on the environment, to provide estimates of contaminated volumes of materials, and to assist in determining disposal options.

B. Ensure that contracts for construction projects include requirements for contractors to comply with the procedures outlined in Section 7.3.3.

C. Ensure EMT reviews project specifications for projects.

7.3.3 Contracting Officer's Technical Representative (COTR's)

A. Ensure that contractors performing construction projects at LaRC adhere to the following requirements:

1. Conduct project activities in a manner that protects water and air quality, conserves resources, and minimizes the use of toxic chemicals and hazardous materials. All contractor personnel shall be appropriately trained regarding the environmental aspects of work performed at LaRC. Contact EMT at extension 43500 for training information.

2. Unless otherwise specified in the project specifications, obtain all necessary environmental and operating permits prior to performing any on-site work.

B. Where applicable, the following additional requirements apply:

1. <u>Soil Excavation</u>
   a. Perform soil excavation activities in accordance with NASA LaRC SpecsIntact Section 01011, "*On-site Clean Up and Disposal of Materials*," or UFGS equivalent, and Section 5.2.5 of this LPR.
   b. Coordinate with EMT to ensure that appropriate sampling is performed prior to project startup. NOTE: Soil that has not been sampled shall not be removed from LaRC without written approval from EMT.
   c. Excavated soil that is stockpiled on LaRC property pending sampling and/or disposition shall be covered at all times.

d. NOTE: The requirements above do not apply to construction projects involving small-scale excavation. In most cases, an excavation is considered small when all excavated soil is to be returned to its original location. Examples of small-scale excavation include, but are not limited to: installation of fence posts, planting of shrubs, grounds maintenance, and underground pipe repairs. Where applicable, EMT makes the determination of what constitutes a small-scale excavation.

2. Asbestos Removal
   a. Perform asbestos removal in accordance with NASA LaRC SpecsIntact Section 01060, "*Disposal of Asbestos Waste*," or UFGS equivalent; and with Chapter 8 (Asbestos Management) of this LPR.

3. Transformer and Capacitor Removal
   a. When applicable, perform transformer and capacitor removal operations in accordance with the NASA LaRC SpecsIntact Section 01060, "*PCB Operations*," or UFGS equivalent; and with the procedures contained in Chapter 6 (Polychlorinated Biphenyl (PCB) Management) of this LPR.

4. Hazardous and Other Regulated Wastes
   Examples of wastes potentially generated from construction projects at LaRC include, but are not limited to, fluorescent light bulbs, light ballasts, mercury switches, paints and solvents, and used oil.
   a. Manage all HW in accordance with the NASA LaRC SpecsIntact Section 01060, "*Disposal of Hazardous Waste Material*," or UFGS equivalent; and with Chapter 5 (Waste Management and Minimization) of this LPR.
   b. Handle and store all hazardous and nonhazardous wastes in a manner that minimizes the potential for releases.
   c. All liquid hazardous materials and wastes shall have secondary containment and adequate spill response equipment shall be readily available.

5. Sustainability and Pollution Prevention
   a. Conduct activities in a manner that conserves resources and minimizes pollution in accordance with:
      i. Exec. Order No. 13,423, "*Strengthening Federal Environmental, Energy, and Transportation Management"*
      ii. Chapters 10 and 17 of this LPR.
   b. Minimize the amount of energy required during construction and operation by using resource efficient construction techniques, building systems (including HVAC, heating, electrical, water, lighting, heat-pumps and boilers), insulation, fixtures, appliances, and controls.
   c. Whenever possible, utilize energy efficient office equipment through the Environmental Protection Agency's Energy Star labeling program (http://www.energystar.gov).
   d. Maximize the reuse, recycling, or composting of construction and demolition (C&D) debris. On a quarterly basis throughout the length of the contract,

contractors shall provide EMT with documentation of type and quantity of C&D debris that is reused, recycled, or composted.

e. Follow Federal EPA Comprehensive Procurement Guidelines (www.epa.gov/cpg) for building materials and products and select: materials that have a long life cycle; the least toxic materials; recyclable materials; materials that are resource-efficient; materials with the maximum recycled content; materials harvested on a sustained yield basis; and products causing the least pollution during their manufacture, use and reuse. (See Section 10.3.)

f. Follow the US Department of Agriculture guidelines for the purchase of biobased products under the Federal Biobased Products Preferred Procurement Program. (http://www.biobased.oce.usda.gov/fb4p/)

8 ASBESTOS

8.1 GENERAL

A. This chapter provides information and establishes procedures at LaRC for proper identification, management, and disposal of asbestos. The information is to be used in conjunction with the procedures contained in LPR 1740.2, "*Facility Safety Requirements"* (Chapter 4.5, "*Facility and Structures Safety, Asbestos"*), applicable Unified Facilities Guidance Specifications (UFGS); and NASA LaRC SpecsIntact Section 01060, "*Disposal of Asbestos Waste*."

B. Asbestos is a naturally occurring family of fibrous mineral silicates. Prior to 1980, asbestos materials were incorporated into a variety of building materials (asbestos containing building materials or ACBM) because they exhibit commercially desirable properties such as fire resistance, insulation against heat, cold, noise and electricity, high tensile strength and acid resistance. Examples of ACBM include:

Sprayed or troweled on surfacing material	Ceiling tile
Pipe insulation	Roofing felts
Textiles	Floor tile and mastic
Concrete-like materials	Caulking putty and spackle

C. Since the late 1970's, manufacture and distribution of many types of asbestos containing materials have either been banned or fallen under more stringent regulation, although asbestos has been detected in building materials installed in the 1980's and 1990's.

D. ACBM can be divided into friable and non-friable categories. Friable materials can be crumbled, pulverized, or reduced to powder by hand pressure and are therefore more likely to release fibers when disturbed or damaged. Non-friable materials can also be a source of fiber release when cut, sanded or drilled.

E. The presence of asbestos in a facility does not necessarily mean the health of the occupants is endangered. If asbestos-containing material remains in good condition and is unlikely to be disturbed, exposure will be negligible; however, when ACBM is damaged or disturbed, asbestos fibers can be released and present a potential health hazard to facility occupants.

F. LaRC does not remove or implement other abatement techniques simply because asbestos is present in a facility. Removal or other abatement is undertaken only if the condition of the asbestos is such that the health of facility occupants is jeopardized or the material will be disturbed by renovation or maintenance activities.

8.2 REQUIREMENTS

8.2.1 Regulations

A. The EPA regulates the emission of asbestos into the environment primarily under the Clean Air Act (CAA) and the Toxic Substances Control Act (TSCA).

B. The Occupational Health and Safety Administration (OSHA) regulates the exposure of personnel to asbestos in general and construction industries involving renovation and demolition operations.

C. The Commonwealth of Virginia Regulations parallel the Federal regulations but are more restrictive with regards to renovation notification requirements. State licensing of personnel involved with asbestos work (e.g., inspectors, abatement workers) is required for LaRC asbestos operations. Landfills that accept asbestos containing material must also be licensed by the State.

8.2.2 Asbestos Disposal

A. Disposal of friable asbestos waste is regulated under 40 C.F.R. § 61, and should be managed in accordance with NASA LaRC SpecsIntact Section 01060, "*Disposal of Asbestos Waste"* or UFGS equivalent. Disposal is permissible only in State licensed landfills. Transportation of open containers of asbestos waste is prohibited under Department of Transportation Regulations (49 C.F.R § 173). Disposal of asbestos waste is the responsibility of the contractor performing the removal/abatement activity.

8.2.3 Configuration Management On-Line (CMOL)

A. Records of LaRC facilities that have friable ACBM are included in the Center's Configuration Management On-Line (CMOL) system (http://cmol.larc.nasa.gov), in the form of Asbestos Configuration Management Reports. The CMOL system is used by LaRC's Safety and Industrial Hygiene personnel, as well as FEC's and FSH's. Access to CMOL requires a user identification and password to obtain any documentation. The Asbestos Configuration Management Reports are used to document changes in ACBM condition, asbestos removal projects, and overall, to minimize exposure of facility occupants to asbestos. Additional information can be found in LPR 1740.4, "*Facility System Safety Analysis and Configuration Management*."

8.2.4 Posting and Labeling

A. Warning signs and labels are required to inform facility occupants of the presence of ACBM. Labeling and posting procedures can be found in OSHA's regulation, 29

C.F.R. § 1910.1101. Signs and labels are available from the LaRC Industrial Hygiene personnel at extension 43205.

8.3 RESPONSIBILITIES

8.3.1 Environmental Management Team (EMT)

A. Review work requests involving asbestos removal and remediation.

B. Arrange for asbestos disposal when appropriate.

C. Review and sign asbestos manifests for both contractor and LaRC disposal.

8.3.2 Facility Safety Heads (FSH)

A. Have access to the CMOL system if the facility has ACBM.

B. Ensure asbestos materials/areas are properly labeled and facility personnel are properly trained.

C. Notify SFAB of changes to the facility's ACBM inventory or condition.

8.3.3 Safety and Facility Assurance Branch (SFAB)

A. Conduct inspections to identify ACBM and assess condition. Recommend remedial action as necessary; periodically re-inspect and reassess.

B. Provide signs and labels to facility personnel.

C. Approve Asbestos Safety Permits and contractor removal procedures.

D. Monitor and inspect abatement operations as appropriate.

8.3.4 Research Operations, Maintenance, and Engineering (ROME)

A. Use the CMOL system to maintain/access LaRC's ACBM location inventory.

B. Review work requests, facility renovation/demolition plans, and other projects for asbestos involvement. Refer to SFAB as appropriate.

C. Prepare Asbestos Safety Permits for asbestos work and forward to SFAB.

D. Notify SFAB and FSH's of changes of ACBM inventory and condition.

8.3.5 Program Managers/Initiators

A. Ensure that contracts involving asbestos removal/abatement include requirements for the contractors to comply with the procedures outlined in Section 8.3.6 below.

8.3.6 Contracting Officer's Technical Representatives (COTR's)

A. Ensure that contractors/subcontractors performing work involving asbestos follow the requirements listed below:

1. Perform work in accordance with LPR 1740.2, "*Facility Safety Requirements*," and with LaRC SpecsIntact Section 01060, "*Asbestos Disposal*," or UFGS equivalent.

2. Submit job-specific procedures to EMT at Mail Stop 213 before starting work. No work shall begin without prior approval from EMT.

3. Provide to EMT the name and physical location of the disposal site. Only facilities approved by the Commonwealth of Virginia may be used for asbestos disposal.

4. Notify the appropriate regulatory agencies in accordance with 16 Virginia Administrative Code (VAC) § 25-20-30. Notification is required as follows:
   a. Twenty days prior to beginning work, notify the Virginia Department of Labor and Industry for operations that involve removal of 10 or more linear feet of friable thermal insulation or any other ACBM that becomes friable during handling
   b. Ten days prior to beginning work, notify the EPA for operations that involve the removal of 160 or more square feet of ACBM or 260 or more linear feet of ACBM.

5. At least 2 days prior to shipment of asbestos off LaRC property, submit a completed asbestos waste manifest to EMT at Mail Stop 213, Facility 1229. (See example form at Figure 8-1.) EMT only signs complete manifests.

6. **NOTE:** Asbestos removed from LaRC removal/abatement sites remains Government property throughout the removal activity and shall be processed as such on the Waste Shipment Manifest.

7. Transport the asbestos material off site in accordance with 49 C.F.R. § 173.216.

8. Dispose of the asbestos in accordance with 40 C.F.R. § 61 and State regulations.

9. Provide EMT with the waste shipment record signed by the owner of the disposal facility indicating receipt of the asbestos waste from the transporter. This record

shall be received by the EMT within 35 days from the date the transporter accepted the asbestos waste.

Figure 8-1

EXAMPLE WASTE SHIPMENT MANIFEST

WASTE SHIPMENT RECORD

BEFORE COMPLETING, CAREFULLY READ INSTRUCTIONS ON REVERSE

Generator

1. Work site name and mailing address Work site: _____
NASA Langley Research Center
MS 429 B-1162T Hampton, Va 23681-0001

Owner's Name: SAME

Phone No.: (757)864-4232

2. Operator's Name and Address: REMOVAL CONTRACTOR NAME & ADDRESS

Phone No.:

3. Waste disposal site (WDS) name, mailing address, and physical site location: DISPOSAL SITE ADDRESS

WDS Phone No.:

4. Name and address of responsible agency
COMMONWEALTH OF VA DEPT. OF AIR POLLUTION CONTROL
P.O. BOX 10089
RICHMOND, VA 23240

5. Description of materials: RQ ASBESTOS, 9,NA2212 PGIII (FRIABLE ASBESTOS)

6. Containers: No. Type

7. Total Quantity (yd^3)

IF Friable (enter required information in blocks 6 & 7) →

IF Non-Friable (check one): ☐ Category I ☐ Category II →

NOTE: Category I includes asphalt roofing products, resilient floor covering, packing, gaskets, BUT NOT TRANSITE. (See Instructions)

8. Special handling instructions and additional information
IF SPILLED, CONTAIN IMMEDIATELY; MUST WEAR RESPIRATOR AND PROTECTIVE CLOTHING.

9. OPERATOR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable international and government regulations.

Printed/typed name & title: OFFICE OF ENVIRONMENTAL ENGINEERING

Signature

Month Day Year

Transporter

10. Transporter 1 (Acknowledgment of receipt of materials)

Printed/typed name & title:

Address:

Phone:

Signature

Month Day Year

11. Transporter 2 (Acknowledgment of receipt of materials)

Printed/typed name & title

Address and telephone no.

Signature

Month Day Year

Disposal Site

12. Discrepancy indication space

13. Waste disposal site
Owner or Operator: Certification of receipt of asbestos materials covered by this manifest except as noted in item #12.

Printed/typed name & title

Signature

Month Day Year

WHITE & BLUE - Transporter's Copy GREEN - Disposal Facility Copy YELLOW - Generator's Copy PINK - Generator's Copy

GOLDENROD - Generator's Copy (TO BE LEFT AT JOB SITE ON PICK-UP)

9 ENVIRONMENTAL NOISE ABATEMENT

9.1 GENERAL

A. The purpose of this chapter is to provide information on applicable regulatory requirements and procedures related to environmental noise abatement. Noise can be defined as any loud or undesirable sound. The loudness of a sound is measured using a logarithmic scale expressed in decibels (dB) and the measurement is further refined by using an A-weighted decibel (dBA) scale that emphasizes the range of sound frequencies that are most audible to humans. Zero on the decibel scale represents the lowest limit of human audible perception of sound. The level of normal conversation is approximately 60 dBA. Studies have shown that exposure to excessive and even moderate noise intensities for extended periods of time can cause irreparable damage to the human ear.

B. The aircraft operating from Langley Air Force Base (LAFB) are the dominant and most widespread noise source at the Center. Noise levels at LaRC resulting from the LAFB flyovers typically range from 65 to 85 dBA. Primary noise sources located at LaRC include wind tunnels, compressor stations, and substations. Most of the wind tunnels are closed-loop, the noise generated is contained largely within the facility, and many operate intermittently for short periods of time. Noise level surveys conducted on the various wind tunnels at LaRC during peak operating mode have identified noise levels ranging from 45 to 80 dBA.

9.2 REQUIREMENTS

A. The goal of the Noise Control Act of 1972 is to protect all Americans from noise that jeopardizes their health and welfare. This legislation was designed to establish noise standards and to regulate noise emissions caused by commercial products such as transportation and construction equipment. The Act also specifies that Federal agencies should comply with Federal, State, and local requirements regarding the control and abatement of noise. Military weapons and combat-use equipment are exempt from regulation.

B. Many State and local governments have developed their own environmental noise regulations as a result of the Quiet Communities Act of 1978. This statute amended the Noise Control Act by providing State and local governments with funds to promote the development of noise control programs on a local level, as long as the actions at the local level are consistent with Federal regulations.

C. The Occupational Safety and Health Administration (OSHA) Noise Standards establish regulations and guidelines for workplace noise pollution. The OSHA standards are 90 dB measured for a duration of 8 hours, 95 dB for 4 hours, 100 dB for 2 hours, and 140 dB maximum for impulse noises.

9.3 RESPONSIBILITIES

9.3.1 Facility Environmental Coordinators (FEC's)

A. Know the facilities and operations in their areas of responsibility that are, or have the potential to be, sources of high noise levels.

B. Consult with the LaRC Safety and Facility Assurance Branch (SFAB) and as needed, EMT regarding operations that generate, or have the potential to generate, high noise levels.

9.3.2 Environmental Management Team (EMT)

A. Provide guidance and feedback to Center personnel, as needed, regarding the control and abatement of environmental noise at LaRC.

B. Serve as point of contact for regulatory agencies for projects or issues related to environmental noise control and abatement.

9.3.3 Safety and Facility Assurance Branch (SFAB)

A. Provide assistance as needed to EMT regarding environmental noise issues at the Center.

B. Perform additional responsibilities as defined in LPR 2710.1, "*Langley Research Center Noise Control and Hearing Conservation Program*."

9.3.4 Center Personnel and On-site Contractors

A. Maintain noise levels at an acceptable level.

B. Address concerns about environmental noise levels to EMT at extension 43500.

10 RECYCLING AND AFFIRMATIVE PROCUREMENT

10.1 GENERAL

A. This chapter provides information, procedures, and responsibilities regarding the recycling and Affirmative Procurement programs at NASA LaRC. EMT keeps metrics on the quantity of materials collected, the funds recovered or disposal costs associated with recycling, in addition to information for purchasing environmentally preferable products. Funds collected from the sale of recycled goods are reinvested in the recycling program or used to support the pollution prevention program. The LaRC recycling and Affirmative Procurement information webpage is located at http://osemant1.larc.nasa.gov/rapp/. The requirements of this chapter apply to all personnel and contractors performing work at LaRC.

10.2 RECYCLING PROGRAM

10.2.1 Background

A. The LaRC recycling program began in 1991 with the collection of mixed paper and scrap metal. LaRC currently recycles white and mixed paper, cardboard, toner cartridges, scrap metal, used oil, batteries, fluorescent light bulbs, and used tires. Section 5.2.3 of this LPR describes the procedures for handling batteries and fluorescent light bulbs, and Section 5.2.4 describes the management procedures for used oil. Used tires are collected for recycling by the Logistics Office, Environmental and Logistics Branch. The procedures for handling the other recyclable items are described below in Section 10.2.3.

10.2.2 Requirements

A. Recycling at Federal facilities is mandated by Exec. Order No. 13,423, "*Strengthening Federal Environmental, Energy, and Transportation Management*." LaRC is committed to reducing solid waste and diverting waste from landfills. The agency set a solid waste diversion rate of 25 percent by 2005 and a 35 percent diversion rate by 2010.

10.2.3 Management of Recyclable Items

10.2.3.1 White Paper

A. White paper is collected in facilities throughout the Center in small blue containers provided by EMT. When an individual container is full it is emptied into the large blue recycling container located at the facility's central collection area. Central collection containers are emptied by EMT on a regular schedule or on a call-in basis, based on the facility's generation rate (the schedule is available on the EMT website:

http://osemant1.larc.nasa.gov/rapp/). Personnel may call EMT at extension 48058 to schedule a pickup.

B. The following lists clarify which paper items can be recycled as white paper:

Recyclable White Paper Items:	Items Not Recyclable as White Paper:
Computer Paper	Food Wrappers or Cups
White Letterhead	Laser Print Labels
White Typing Paper	Overheads
White Photocopy Paper	Paper of any color other than white
Fax Paper	
White Memos	
White Paper with colored ink	

10.2.3.2 Mixed Paper

A. EMT also collects and recycles "mixed paper," i.e. paper of mixed colors other than white. Center personnel designate and label containers in their facilities for the collection of mixed paper. When a container is full it is emptied into the large green container located at the facility's central collection area. These containers are provided by EMT and are emptied on a regular schedule or on a call-in basis, based on the facility's generation rate (the schedule is available on the EMT website: http://osemant1.larc.nasa.gov/rapp/). Personnel may call EMT at extension 48058 to schedule a pickup.

B. The following lists clarify which paper items can be recycled as mixed paper:

Recyclable Mixed Paper Items:	Items Not Recyclable as Mixed Paper:
Colored Paper	Food Wrappers or Cups
Glossy Paper	Laser Print Labels
Post-it Notes	Carbon Paper
Manila Folders	Overheads
Staple-Bound Catalogs/ Magazines	**Glue-Bound** Catalogs/ Magazines
	Newspaper

10.2.3.3 Cardboard

A. Large generators of cardboard have special collection bins to accommodate the larger volume of cardboard. Personnel break down the cardboard and place it in the large collection bins for pickup by EMT. FEC's can make arrangements for a facility to receive a large generator collection bin or establish regular pickups by calling extension 48058.

B. Small or infrequent generators of cardboard break down the cardboard and place it next to the recyclable paper collection bins. It is picked up when EMT collects paper for recycling (the schedule is available on EMT website: http://osemant1.larc.nasa.gov/rapp). Personnel may also call EMT at extension 48058 to schedule a special cardboard pickup.

C. The following lists clarify which items can be recycled as cardboard:

Recyclable Cardboard Items:	Items Not Recyclable as Cardboard:
Corrugated Cardboard (any color or thickness)	Paperboard (e.g., cereal boxes) Cardboard with food contamination (e.g., pizza boxes)

10.2.3.4 Toner Cartridges

A. EMT collects and recycles toner cartridges used in printers. Used toner cartridges are placed inside the bag and the box that the new replacement cartridge came in. The box is taped closed, and placed next to the paper bins at the facility's central collection area. Small laser jet ink cartridges are also recycled. They should be placed in a plastic bag/container and placed at the same site as the toner cartridges.

B. For facilities with weekly paper pickup, cartridges are picked up when the paper is collected. For facilities that are on an on-call basis for paper pickup, personnel may call EMT at extension 48058 to schedule a toner cartridge pickup.

10.2.3.5 Scrap Metal

A. Scrap metal includes all metal bars, frames, mounting brackets, models, metal chips, shavings and grindings generated from any metal cutting operations. Scrap metal is collected in separate containers (where practicable) designated as aluminum, copper and copper wire, and mixed metals (including steel). Personnel should call the Property Disposal Warehouse at extension 46339 to request pickups or a recycling container. Facilities that generate small amounts of scrap metal may use any type of collection container that is labeled as "Scrap Metal for Recycling." Disposal of scrap metal in the trash is strictly prohibited.

10.2.4 Responsibilities

10.2.4.1 Facility Environmental Coordinators (FEC's)

A. Ensure facility personnel follow established recycling procedures.

B. Post copies of the relevant recycling procedures and updates in a prominent location and/or near recyclable material collection areas.

C. Monitor recycling collection areas and arrange for pickup, if necessary. Ensure collection containers are not contaminated with non-recyclable materials.

D. Educate facility employees about the recycling program or contact EMT at extension 48058 to arrange for specific training.

E. Inform EMT of additional items that could be recycled or suggest improvements for the Center's recycling program.

10.2.4.2 Environmental Management Team (EMT)

A. Manage and oversee the Center's recycling program.

B. Collect recyclable items in a timely manner throughout the Center.

C. Prepare and mail monthly billing invoices to contractors.

D. Act as the Center's official representative with government and private parties on recycling related matters.

E. Track the Center's progress in meeting established goals.

F. Provide support, guidance, training, and assistance to Organizational Units in implementing the recycling program in order to meet or exceed established goals.

G. Collect monthly metrics on the recycling program and make these available to Center personnel on the recycling webpage through the EMT homepage.

H. Seek out new items to recycle and new commodity markets to maximize proceeds to LaRC from the sale of LaRC recyclable materials.

10.2.4.3 Logistics Office, Environmental and Logistics Branch

A. Provide day-to-day management of the collection of scrap metal and tires.

B. Remove scrap metal from facilities in a timely manner.

C. Provide EMT with monthly detailed estimates of usage categories for each metal collected.

D. Monitor recycling activities to ensure compliance with established recycling procedures.

E. Provide copies of the scrap metal delivery order tickets to EMT within 3 working days of the end of each month.

F. Maximize the collection of these recyclable materials and maximize the proceeds to LaRC from the sale of the recyclable materials.

10.2.4.4 Program Managers/Initiators

A. Ensure that contracts for construction, demolition or renovation projects include:

B. requirements for the reuse, recycling or composting of construction and demolition (C&D) debris; and

C. requirements for contractors to provide EMT with a quarterly report of the type and quantity of C&D debris that is reused, recycled, or composted.

10.2.4.5 Contracting Officer's Technical Representatives (COTR's)

A. Ensure that contractors performing construction, demolition or renovation projects:

1. maximize the reuse, recycling or composting of C&D debris; and

2. provide EMT with a quarterly report of the type and quantity of C&D debris that is reused, recycled, or composted.

10.2.4.6 Center Personnel and On-site Contractors

A. Participate in the LaRC recycling program.

B. Keep abreast of the Center's recycling program information that is distributed by the FEC or on the EMT recycling homepage http://osemant1.larc.nasa.gov/rapp/.

C. Ensure collection containers are not contaminated with non-recyclable materials.

D. Inform the FEC or EMT of additional items that could be recycled or improvements for the Center's recycling program.

10.3 AFFIRMATIVE PROCUREMENT PROGRAM

10.3.1 Background

A. Affirmative procurement is the process of purchasing environmentally preferable products. Affirmative procurement procedural requirements state that the government and its contractors are to purchase recycled content, environmentally preferable, and biobased products to the maximum extent possible in order stimulate their use. Environmentally preferable products are products and services having a lesser or reduced effect on human health and the environment when compared to competing products or services serving the same purpose. In addition, the government and its contractors should promote the purchase of biobased products, which are commercial or industrial products, other than food or feed, which utilizes biological products or renewable domestic agricultural (plant, animal and marine) or forestry materials.

10.3.2 Requirements

A. In Section 6002 of the Resource Conservation and Recovery Act (RCRA), Congress directed the Federal government to promote recycling by increasing its purchases of products containing recovered materials. RCRA requires EPA to designate products that can be made with recovered materials and to recommend practices for buying these products. EPA promotes this initiative through the EPA Comprehensive Procurement Guidelines (CPG) available at http://www.epa.gov/cpg/. Affirmative Procurement requirements are also found in Federal Acquisition Regulation, 48 C.F.R. § 23.4, "*Use of Recovered Materials*."

B. Exec. Order No. 13,423, "*Strengthening Federal Environmental, Energy and Transportation Management*," requires in agency acquisitions of goods and services:
   - Use of sustainable environmental practices, including acquisition of biobased, environmentally preferable, energy-efficient, water-efficient, and recycled-content products, and
   - Use of paper of at least 30 percent post-consumer fiber content.

C. NPR 8530.1, "*Affirmative Procurement Plan for Environmentally Preferable Products*," establishes the framework for NASA's Affirmative Procurement program. It requires each Center to develop and implement an Affirmative Procurement program in conformance with RCRA Section 6002 and other applicable requirements. The NPR assigns responsibilities and describes implementation and reporting requirements to be followed by each Center.

10.3.3 Responsibilities

10.3.3.1 Environmental Management Team (EMT)

A. Understand the requirements of NPR 8530.1.

B. Maintain an Affirmative Procurement awareness program and update the program as necessary to include newly designated items. The Affirmative Procurement program includes all designated EPA Comprehensive Procurement Guideline items and biobased products designated by the US Department of Agriculture (USDA).

C. Review and approve Request for Waiver documentation.

D. Compile the Center's Annual Affirmative Procurement Progress Report.

E. Provide support, guidance, and assistance to the Center in interpreting and implementing the EPA and applicable Agency guidelines for recovered materials and other environmentally preferable purchases.

10.3.3.2 Program Managers/Initiators

A. Understand the requirements of NPR 8530.1. Be knowledgeable of the EPA designated materials list and the Request for Waiver process.

B. Consult early in the procurement process with appropriate parties (e.g., environmental specialists, contract specialists) to facilitate the process of procurement planning.

C. Utilize statements of work or specifications which include elimination of virgin material requirements, reuse of products, use of recovered materials, energy and water efficiency, recyclability, use of biobased products, and the use of other environmentally preferable products or services.

10.3.3.3 Contracting Officer’s Technical Representatives (COTR’s)

A. Collect the necessary information for the annual Affirmative Procurement Report or other required reports and provide to EMT in a timely manner.

10.3.3.4 Organizational Unit Managers

A. Collect the necessary data for the annual Affirmative Procurement Report or other required reports. Provide this information to EMT in a timely manner.

B. Review specifications and amend the specifications, as appropriate, to encourage the Affirmative Procurement.

10.3.3.5 Office of Procurement

A. Understand the requirements of NPR 8530.1. Be knowledgeable of the EPA designated materials list and the Request for Waiver process.

B. Ensure that the acquisition of products and services covered by applicable EPA guidelines are conducted in accordance with the requirements of RCRA, the FAR, and NASA.

C. Ensure statements of work or specifications include: elimination of virgin material requirements, use of recovered materials, reuse of products, life cycle analysis, energy and water efficiency, recyclability; and the use of EPA/USDA designated items or other environmentally preferable products. These factors should be considered in acquisition planning for all procurements and in the evaluation and award of contracts, as appropriate.

D. Collect the necessary information for the annual Affirmative Procurement Report or other required reports and provide to EMT in a timely manner.

E. Provide guidance and facilitate acquisition planning with respect to environmentally preferable goods and services, including those available through Federal sources of supply.

F. Assist in any market research necessary to determine the availability of environmentally preferable goods and services.

G. Ensure that solicitations and contracts contain the appropriate provisions and FAR Part 23 clauses to implement Affirmative Procurement.

10.3.3.6 Center Personnel and On-site Contractors

A. Be knowledgeable of the EPA designated materials list and utilize these items whenever practical.

B. Prepare Request for Waiver if the guideline item is not available within a reasonable time frame, does not meet appropriate performance standards, or is not available at a reasonable price.

11 WETLANDS

11.1 GENERAL

A. The purpose of this chapter is to provide information on applicable regulatory requirements and procedures related to wetlands at NASA LaRC. Wetlands are defined as "areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." Wetlands generally include swamps, marshes, bogs, and similar areas.

B. NASA LaRC is located in an area of low topographic relief surrounded by a shallow estuarine environment. The predominant wetland areas in the vicinity of LaRC are the tidal marsh wetlands associated with Brick Kiln Creek and Tabbs Creek.

11.2 REQUIREMENTS

A. Section 404 of the Clean Water Act requires a permit from the U.S. Army Corps of Engineers (ACOE) for all activities involving dredging or filling of U.S. waters, including wetlands. The EPA is the permitting authority and the U.S. Fish and Wildlife Service (USFWS) is a reviewing agency.

B. Exec. Order No. 11,990, "*Protection of Wetlands*," requires each Federal agency to "take action to minimize the destruction, loss, or degradation of wetlands, unless there is no practicable alternative, and then the proposed action must include all practicable measures to minimize harm to wetlands." Federal agencies must provide an opportunity for early public review of any plans or proposals for new construction in wetlands.

C. NASA regulations on wetlands management specified in 14 C.F.R. § 1216.2, require NASA Centers to include wetland protection in their master planning activities and consult with the ACOE, USFWS and the Federal Emergency Management Agency.

D. The Virginia Tidal Wetlands Act requires a permit from the Virginia Marine Resources Commission for any activity that would use or develop a tidal wetland.

11.3 RESPONSIBILITIES

11.3.1 Environmental Management Team (EMT)

A. Maintain an accurate inventory of all Center wetlands, including maps and appropriate descriptions.

B. Serve as point of contact with external regulatory agencies regarding wetlands issues at LaRC.

C. Validate the need for permit applications.

D. Prepare wetland permit applications and maintain wetlands permits on file.

E. Ensure wetland inventories are included in the Center Master Plan.

11.3.2 Program Manager/Initiator

A. Review proposed projects to determine if activities may affect wetlands.

B. Complete an environmental permit checklist and environmental analysis checklist for each proposed action.

C. Coordinate with EMT for wetland permit applications.

12 ENDANGERED AND THREATENED WILDLIFE AND PLANTS

12.1 GENERAL

A. The purpose of this chapter is to provide information on applicable regulatory requirements and procedures related to endangered species at NASA LaRC. Many species of terrestrial wildlife have become rare or endangered within the Virginia peninsula due to continuing intensive development. Of major concern are the reptiles and amphibians that are unable to migrate to and from suitable habitat due to the region's natural topography, manmade infrastructure, habitat fragmentation, and the organism's own limited mobility.

12.2 REQUIREMENTS

A. The Endangered Species Act of 1973 was enacted "to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved and to provide a program for the conservation of such endangered species and threatened species." The Act states "all Federal departments and agencies shall seek to conserve endangered species and threatened species and utilize their authorities in furtherance of this Act." In addition, 50 C.F.R. § 17.11-12, which was implemented in 1983, addresses endangered and threatened wildlife and plants and provides a listing by name.

12.3 ENDANGERED AND THREATENED SPECIES IN OR NEAR NASA LaRC

A. Old Dominion University (ODU) conducted fish, wildlife, and plant surveys facility-wide in 1995. The general findings are included below. A more detailed listing of the endangered and threatened species at NASA LaRC can be found in Chapter 6 of the Environmental Resource Document which is available by calling EMT at extension 43500. The ODU study is also available through EMT.

12.3.1 Reptiles and Amphibians

A. Sixteen species of reptiles and amphibians were identified from NASA LaRC and 19 additional species should occur in the area, but were not encountered during the study. Several State and Federally listed reptile and amphibian species are found within the City of Hampton, however only one, the northern diamondback terrapin (*Malaclemmys terrapin terrapin*), a Federal species of concern has been located at LaRC. (ODU, 1995).

12.3.2 Mammals

A. Fourteen species of mammals were encountered at NASA LaRC during the ODU (1995) survey, and 12 additional species are expected to occur. None of these mammals are listed as threatened or endangered; however, three of the species

found to inhabit NASA LaRC are listed as species of special concern by the Commonwealth of Virginia: the river otter (*Lutra canadensis*), the marsh rabbit (*Sylvilagus palustris*), and the small star-nosed mole (*Condylura cristata parva*).

12.3.3 Birds

A. A total of 118 species of birds were observed at NASA LaRC during the survey (ODU 1995). Of these, 7 are listed as threatened or endangered by the State or Federal government and 17 more are listed as species of special concern in the Commonwealth of Virginia. The bald eagle (*Haliaeetus leucocephalus*), gull-billed tern (*Sterna nilotica*), and the Henslow's sparrow (*Ammodramus henslowii*) were determined to be transient migrants who use the NASA LaRC facility solely as a foraging stop. The northern harrier (*Circus cyaneus*), brown creeper (*Certhias americana*), winter wren (*Troglodytes troglodytes*), hermit thrush (*Catharus guttatus*), and the purple finch (*Carpodacus purpureus*) have the potential to nest at NASA LaRC, though currently none of them do. In addition, the brown pelican (*Pelicanus occidentalis*), least tern (*Sterna antillarum*), and great egret (*Ardea alba egretta*) are unlikely to nest at NASA LaRC due to lack of suitable nesting habitat.

12.3.4 Finfish

A. Thirty-three finfish species were collected at NASA LaRC during the ODU study. All species were common to the lower Chesapeake Bay and its tributaries. No endangered, threatened, or special concern species inhabit or use the NASA LaRC community.

12.3.5 Plants

A. No plants listed as threatened or endangered were found in any of the habitat types at NASA LaRC.

12.4 RESPONSIBILITIES

12.4.1 Environmental Management Team (EMT)

A. Monitor updates and/or changes to endangered and threatened wildlife and plant listings to determine if LaRC is impacted.

B. Update findings in the LaRC Environmental Resources Document.

C. Assist the project initiator as required with issues related to endangered and threatened wildlife and plants.

D. Serve as the point of contact with external regulatory regarding endangered and threatened species issues at LaRC.

12.4.2 Program Managers/Initiators

A. Coordinate with EMT early in the project development for activities that could potentially affect endangered and threatened wildlife and plants.

B. Prepare, or fund the preparation of, endangered species surveys or studies as directed by EMT.

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13 OIL AND HAZARDOUS MATERIAL SPILL CONTROL

13.1 GENERAL

A. The purpose of this chapter is to provide information on applicable regulatory requirements and procedures related to oil and hazardous material spill control at LaRC. Implementing engineering and administrative controls in order to minimize spill potential is an important goal for the Center. The Center's Hazardous Materials Spill Contingency Plan and its Oil Spill Prevention Control and Countermeasure (SPCC) Plan have been combined into one document called the NASA LaRC Integrated Spill Contingency Plan (ISCP). The Plan is available by contacting EMT at extension 43500.

B. Most spills are caused by equipment failure or operational errors. Spills can be minimized by implementing practicable and good engineering practices such as employee training, appropriate personnel selection, regular equipment maintenance and inspections.

13.2 REQUIREMENTS

A. Spill prevention, control and contingency plans are required by several laws and regulations including:

1. EPA's Oil Pollution Prevention Regulations (SPCC and Facility Response Plan Requirements) – 40 C.F.R. § 112

2. EPA's Resource Conservation and Recovery Act (Contingency Planning Requirements) – 40 C.F.R. § 264, 265, and 279.52

3. National Oil and Hazardous Substance Pollution Contingency Plan – 40 C.F.R. § 300

4. EPA's Emergency Planning and Community Right-to-Know Act (EPCRA) – 40 C.F.R. § 355

5. OSHA's Hazardous Waste Operations Emergency Response (HAZWOPER) Regulations – 29 C.F.R. § 1910.120

6. Virginia State Water Control Board Regulations – 9 VAC §25

13.3 SPILL RESPONSE

A. A spill can be detected by visual inspection by personnel, or by automated detection systems such as with underground storage tanks. Immediate action is necessary in the event of an oil or hazardous material spill of any size. Any LaRC personnel or on-site contractors that discover a release of material from a container, tank, or operating equipment shall respond by calling the LaRC Dispatcher at 911 (cell 864-2222). More detailed spill response procedures are described in the LaRC ISCP.

13.4 SPILL CHARACTERIZATION

13.4.1 Class I Spill

A. A Class I spill is relatively small in volume and presents low hazard potential to personnel or the environment. It can be contained and cleaned up with only minor difficulty by the user/custodian. Outside support is not necessary. A class I Spill results in:

1. No discharge of oil or hazardous materials to adjacent waters at LaRC and no violation of applicable water quality standards
2. No sheen upon or discoloration of surface waters at LaRC
3. A release of material that is *below* the Hazardous Substance Reportable Quantity

13.4.2 Class II Spill

A. A Class II spill involves a large volume of material and may present significant hazard to personnel or the environment. Any spill reportable under EPA Regulations, 40 C.F.R. § 302, 355, or 372 shall be considered a Class II spill. A Class II Spill results in:

1. Discharge of oil or hazardous materials to adjacent waters at LaRC and/or is a violation of applicable water quality standards
2. Discoloration of or sheen upon surface waters at LaRC
3. A release of material that is above the Hazardous Substance Reportable Quantity

B. Other than initial containment, area control and notifications, full-scale containment and clean up of a Class II spill shall be conducted in accordance with the NASA LaRC Integrated Spill Contingency Plan.

C. Operations in which a Class II spill may occur, shall be conducted under a Potentially Hazardous Materials Safety Permit as provided for under LPR 1710.12. The Safety Permit shall identify spill potential and specify appropriate response.

13.5 RESPONSIBILITIES

13.5.1 Facility Environmental Coordinators (FEC's)

A. Oversee proper management of the facility's oil and/or hazardous materials storage sites.

B. Ensure that personnel are aware of the facility's oil and/or hazardous materials storage areas and that appropriate personnel are familiar with spill control and response procedures.

13.5.2 Environmental Management Team (EMT)

A. Notify appropriate regulatory agencies of spills as required.

B. Maintain complete documentation for all Class I and Class II spills.

C. Conduct investigations into the causes of the incident and submit recommendations to prevent reoccurrence.

D. Coordinate disposal of HW generated by spills.

E. Maintain/update the NASA LaRC ISCP as needed and submit to applicable regulatory agencies for approval.

F. Participate in spill events as specified in the ISCP.

13.5.3 Contracting Officer's Technical Representatives (COTR's)

A. Ensure that contractors:

1. Properly manage the facility's oil and/or hazardous materials storage sites.

2. Make facility personnel aware of oil and/or hazardous materials storage areas and familiarize appropriate personnel with spill control and response procedures.

3. Use spill containment pallets for any oil or hazardous materials stored outside.

4. Post a Spill Plan at each outside site that contains 220 gallons (4 x 55-gallon drums) or more of oil and/or hazardous materials. Examples of a Spill Plan can be obtained at http://osemant1.larc.nasa.gov/cmts/hazwaste/spill/spill_response.htm

5. Dispose of spill debris properly (See Chapter 5, Waste Management and Minimization).

13.5.4 Center Personnel and On-site Contractors

A. Follow the procedures below if working with oil or hazardous materials:

B. Ensure that all drain lines near indoor oil or hazardous material storage areas are plugged. This includes Hazardous Waste Satellite Accumulation Areas (SAA's).

C. Ensure adequate spill containment (e.g., spill containment pallets) for <u>any</u> oil or hazardous materials stored outside of the facility.

D. Post a Spill Plan at each outside site that contains 220 gallons (4 x 55-gallon drums) or more of oil and/or hazardous materials. Examples of a Spill Plan can be obtained at:
http://osemant1.larc.nasa.gov/cmts/hazwaste/spill/spill_response.htm.

E. In the event of a spill, call the LaRC Dispatcher at 911 (cell 864-2222).

F. Ensure that spill debris is managed properly (See Chapter 5, Waste Management and Minimization).

14 EMERGENCY PLANNING AND COMMUNITY RIGHT TO KNOW ACT

14.1 GENERAL

A. The purpose of this chapter is to provide information to LaRC personnel on the regulatory requirements and procedures of the Emergency Planning and Community Right-To-Know Act (EPCRA). EPCRA was enacted in October 1986 in response to a growing concern about the effect of chemical releases on communities. EPCRA encourages and supports emergency planning efforts at the State and local level, and provides citizens and local governments with information concerning potential chemical hazards present in their communities.

14.2 REQUIREMENTS

14.2.1 Emergency Planning

A. The Emergency Planning section of EPCRA is designed to help communities prepare for and respond to emergencies involving hazardous substances. Under Sections 301-303, facility owners or operators are required to notify the State Emergency Response Commission (SERC) and Local Emergency Planning Committee (LEPC) if their facility has on site, at any given time, a quantity of an Extremely Hazardous Substance (EHS) that is equal to or greater than its threshold planning quantity (TPQ). The facility must notify the SERC and LEPC within 60 days of first meeting this qualification. The list of EHS's and TPQ information can be obtained at the following website: http://www.epa.gov/ceppo/pubs/title3.pdf. The facility must designate a facility emergency response coordinator and provide the name of that individual to the LEPC.

14.2.2 Emergency Release Notification

A. EPCRA Section 304 requires the owner or operator of a facility to notify the LERC and SERC if there is a release into the environment of an EHS or CERCLA-defined hazardous substance equal to or greater than its reportable quantity (RQ). The consolidated chemical list that includes chemicals subject to reporting requirements under EPCRA is available at the following website: http://www.epa.gov/ceppo/pubs/title3.pdf. This notification must be made immediately by the owner or designated representative.

B. As soon as practical after the release, EPCRA requires a written follow-up report to be submitted to the SERC and the LEPC. The follow-up notice must update information included in the initial notice and provide information on actual response actions taken, as well as any known or anticipated health risks associated with the release.

14.2.3 Hazardous Chemical Storage Reporting

A. Facilities that have hazardous chemicals are required by the Occupational Safety and Health Act to maintain Material Safety Data Sheets (MSDS's) for the hazardous chemicals. EPCRA Sections 311-312 require facilities that have MSDS's for chemicals held above certain quantities to:

   1. Submit copies of MSDS's or a list of MSDS chemicals within 90 days after the facility first has on-hand the hazardous chemicals in amounts equal to or greater than their thresholds, and

   2. Submit annually an emergency and hazardous chemical inventory form (Tier II report) by March 1 to the SERC, LEPC, and the local Fire Department that has jurisdiction over the facility.

14.2.4 Toxic Release Inventory

A. EPCRA Section 313 requires facilities that manufacture, process, import or otherwise use a listed toxic chemical in excess of specific threshold quantities to complete the EPA's Toxic Chemical Release Inventory (TRI) Form annually. The form must be submitted by July 1 to the appropriate Federal (the EPCRA Reporting Center), State (VA DEQ), and local organizations (HRSD) and cover releases and other waste management of the listed toxic chemicals that occurred during the preceding calendar year.

14.3 RESPONSIBILITIES

14.3.1 Facility Environmental Coordinators (FEC's)

A. Maintain a hazardous chemicals inventory for the facility. The inventory shall be submitted and updated through the Chemical Material Tracking System (CMTS) (see Chapter 18).

B. Report spills to EMT at 43500.

14.3.2 Environmental Management Team (EMT)

A. Notify the SERC and LEPC within 60 days of meeting the criteria for reporting under EPCRA section 301-303.

B. Document and report spills of EPCRA regulated materials as required to the SERC, LEPC, and the National Response Center.

C. Prepare the annual Tier II Inventory report for LaRC and submit to the SERC, LEPC, and Fire Department by March 1.

D. Prepare the TRI report for LaRC based on inventories submitted by FEC's. The report shall be submitted annually by July 1 to the appropriate Federal, State and local organizations.

14.3.3 Facility Safety Heads (FSH's)

A. Ensure that facility personnel who purchase hazardous chemicals follow the procedures outlined in LPR 1710.12 and maintain quantities at the lowest level consistent with needs.

B. Ensure that MSDS's are obtained for any hazardous material stored or used at the facility (see Chapter 18).

14.3.4 Program Managers/Initiators

A. Ensure that contracts for projects involving hazardous materials include requirements for the contractor to provide hazardous material usage data to EMT.

14.3.5 Contracting Officer's Technical Representatives (COTR's)

A. Ensure that contractors provide EMT with a list of chemicals and hazardous materials used on-site but not recorded in CMTS (e.g., materials used by subcontractors). By January 31 of each year the data from the previous calendar year shall be submitted to the EMT.

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15 UNDERGROUND AND ABOVEGROUND STORAGE TANKS

15.1 GENERAL

A. This chapter sets forth NASA LaRC policies and requirements for the design, construction, operation, maintenance, monitoring and reporting for underground and aboveground petroleum storage tanks.

B. As an owner and operator of Underground Storage Tanks (UST's) and Aboveground Storage Tanks (AST's), LaRC must comply with all Federal and State regulations to ensure protection of health and the environment. The policies and requirements of this chapter apply to all LaRC personnel and on-site contractors involved in the installation and use of UST's and AST's at the Center.

15.2 REQUIREMENTS

15.2.1 EPA Regulations

A. As a result of the Hazardous and Solid Waste Amendments of 1984, the EPA established a National Regulatory Program for the control of new and existing UST's and their associated piping that are used to store liquid petroleum products. In 1988, the EPA issued new performance standards for UST's and associated piping. The requirements were phased in over a ten-year period, with December of 1998 being the deadline for all tanks to be in compliance.

B. The EPA regulations regarding AST's are contained in 40 C.F.R. § 112, Spill Prevention, Control, and Countermeasures (SPCC) Plan, and 40 C.F.R. § 122, the National Pollutant Discharge Elimination System/ Storm Water Permit Regulations.

15.2.2 State Regulations

A. The Commonwealth of Virginia has EPA-approved regulations for UST's and AST's. The Virginia Department of Environmental Quality (DEQ) is the implementing agency for petroleum storage tank activities in the State. Many of Virginia's requirements exceed the stringency or scope of the Federal regulations. The Virginia storage tank program and regulations can be found at: http://www.deq.state.va.us/tanks/stortnks.html

15.2.3 LaRC Requirements

A. All petroleum storage tank systems must meet the following design and maintenance specifications:

1. Tanks must retain structural integrity for their operating life.

2. Tanks must be installed and repaired using nationally recognized standards and industry codes.

3. Owners and operators must follow proper tank filling procedure. New and upgraded storage tank systems must use devices that prevent overfills and control or contain spills.

4. UTSs must be closed by either removing them from the ground or leaving them in place after being drained, cleaned and filled with inert material.

5. AST's must be completely drained of material prior to removal.

6. Any suspected releases must be investigated by tank owners/operators. Call the LaRC Dispatcher at 911 (cell 864-2222) to report leaks and spills.

7. All petroleum tank systems must meet the current regulatory requirements.

8. New tanks must be registered with the State and closed tanks must have closure certification from DEQ.

15.3 RESPONSIBILITIES

15.3.1 Facility Environmental Coordinators (FEC's)

A. Ensure all personnel who operate tank systems attend training in filling, dispensing, and monitoring procedures.

15.3.2 Environmental Management Team (EMT)

A. Report leaks or releases to appropriate State and/or Federal agencies, as required.

B. Maintain and update, when necessary, storage tank registration and notification forms and submit to the State.

C. Review design of storage tank systems to ensure compliance with the latest regulatory requirements.

15.3.3 Program Managers/Initiators

A. Submit design and construction specifications to EMT prior to installation of any petroleum storage tank system.

B. Design or oversee the design of all petroleum storage tank systems to ensure compliance with the latest regulatory requirements.

15.3.4 Center Personnel and On-Site Contractors

A. Report any releases from petroleum storage tanks by calling the LaRC Dispatcher at 911 (cell 864-2222).

B. If handling or storing petroleum products, attend training in spill prevention.

C. If operating tank systems, follow the guidelines below:

1. Attend training in filling, dispensing, and monitoring procedures.

2. In the event of a spill or leak, immediately call the LaRC Dispatcher at 911 (cell 864-2222).

3. Monitor leak detection devices (where installed) and take corrective action if leakage is indicated.

4. Ensure that adequate maintenance on each tank is performed to ensure satisfactory performance.

5. Perform periodic inspections on petroleum tanks and maintain inspections on file.

6. Monitor filling of tanks to prevent spills and overflows.

7. Comply with the Center's Integrated Spill Contingency Plan, which is maintained by EMT.

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16 HISTORIC AND CULTURAL RESOURCES

16.1 GENERAL

A. The purpose of this chapter is to provide information on applicable regulatory requirements and procedures related to historic and cultural resources at NASA LaRC. As a Federal facility, LaRC is required to ensure the protection and proper management of its cultural resources, including historic and prehistoric properties. The Center must survey its properties to determine their significance, nominate eligible properties to the National Register of Historic Places (National Register), and consult with the State Historic Preservation Officer (SHPO) and the National Advisory Council on Historic Preservation, if a proposed or ongoing "undertaking" may affect such properties.

B. NASA LaRC has five facilities and/or structures that are National Historic Landmarks listed on the National Register. They are the 8-foot High Speed Tunnel (Facility 641), the Full Scale Tunnel (Facility 643), the Variable Density Tunnel (located on display next to Facility 1222), the Rendezvous Docking Simulator (located in Facility 1244), and the Gantry (Facility 1297). Additional facilities and structures that are over 50 years old may be eligible for listing on the National Register. In 2007, LaRC plans to complete a center-wide survey of facilities that are 45 years or older. The results of the survey will be used to update LaRC's Cultural Resource Management Plan (CRMP), which is maintained by LaRC's Historic Preservation Officer (HPO).

C. LaRC has one archaeological site listed on the National Register. Site 44HT1, which is identified as the Chesterville Plantation Site, is located adjacent to the Aircraft Landing Dynamics Facility in the northern portion of the Center. Located throughout LaRC are additional archaeological sites, several of which require further surveying to determine if they are eligible for the National Register. Information and survey reports on LaRC's archaeological resources are maintained by the LaRC HPO.

16.2 REQUIREMENTS

A. The National Historic Preservation Act of 1966 (NHPA) requires Federal agencies to establish cultural resource preservation programs and to consider the effects of their actions on cultural resources that are listed or are eligible for listing on the National Register. To evaluate the possible effects of proposed actions, Section 106 of the NHPA requires an agency to identify and evaluate historic properties, assess the effects of the project on the properties, consult with the SHPO, and in some cases, solicit comments from the Advisory Council on Historic Preservation.

B. Exec. Order No. 11,593, "*Protection and Enhancement of the Cultural Environment*," directs Federal agencies to identify cultural resources, nominate qualifying resources to the National Register, and avoid damaging resources that might be eligible for the

National Register. It also mandates that Federal agencies comply with the requirements of the NHPA.

C. Exec. Order No. 13,287, "*Preserve America*," directs Federal agencies to actively advance the protection, enhancement, and contemporary use of the historic properties owned by the Federal Government, and to promote intergovernmental cooperation and partnerships for the preservation and use of historic properties.

D. The Archaeological Resources Protection Act of 1979 protects archaeological sites on Federal land and the Archaeological and Historic Preservation Act requires the preservation of data with respect to historic properties.

E. 36 C.F.R. § 60, "*National Register of Historic Places*," sets forth the criteria for evaluating the significance of resources and their eligibility to the National Register.

F. 36 C.F.R. § 800, "*Protection of Historic Properties*," includes procedures for Federal agencies to meet their obligations under the NHPA and Exec. Order No. 11,593. The regulations define the requirements of the Section 106 process and establish procedures for determining the eligibility of a resource and defining possible adverse effects.

G. Programmatic Agreement among NASA, the National Conference of State Historic Preservation Officers, and the Advisory Council on Historic Preservation stipulates that NASA will consult with and obtain approval from the SHPO prior to dismantling or significantly affecting designated National Historic Landmarks.

H. NPR 4310.1, "*Identification and Disposition of NASA Artifacts*," provides procedures and guidance for the identification, reporting, transfer, or disposal of NASA articles, equipment and hardware of historical interest. It specifies that the National Air and Space Museum (NASM) shall be responsible for the custody, protection, preservation, exhibition, and loan of artifacts received from NASA. Artifacts are offered to the NASM when programmatic utility to NASA has been exhausted.

I. The Virginia Department of Historic Resources (VDHR) is the SHPO. The SHPO assists Federal agencies and others carrying out Federal undertakings to meet their responsibilities under Section 106 of the NHPA. As a Federal agency, LaRC must consult with the SHPO regarding actions that may affect its cultural and historic resources. Additional information on Virginia's historic preservation program is available at: http://www.dhr.state.va.us/home.htm.

J. For Center projects involving facilities that are 50 or more years old or projects involving digging greater than 6 inches, coordination between the LaRC personnel responsible for historic and cultural preservation and the appropriate regulatory agencies is essential. The Center's National Environmental Policy Act (NEPA) program, which is explained in Chapter 2 of this LPR, also requires this coordination early in the planning process.

16.3 RESPONSIBILITIES

16.3.1 Environmental Management Team (EMT)

A. Assist the LaRC HPO in managing the Center's historic and cultural preservation program.

B. Review project design and specification documentation for issues related to cultural and historic preservation.

C. Assist with the preparation of historic and cultural resource surveys and documentation as needed.

16.3.2 LaRC Master Planner

A. Maintain overall responsibility for the Center's historic and cultural resource program.

B. Serve as the LaRC HPO.

C. Identify historic properties and administer them in accordance with applicable regulations.

D. Complete and submit appropriate forms and nomination packages to the SHPO and other agencies as required.

E. Prepare and maintain cultural and historic surveys and documentation as needed to ensure LaRC's historic resources are maintained in accordance with the NHPA.

F. Maintain and update LaRC's CRMP.

G. Review projects and consider the impact of actions and decisions on the Center's historic resources, and where feasible, take steps to avoid or reduce any adverse effects.

H. Ensure that artifacts recovered during archaeological survey work are properly curated and sent to VDHR for archiving.

16.3.3 Logistics Office, Environmental and Logistics Branch

A. Ensure that disposition of LaRC property is carried out in accordance with NPR 4310.1.

B. Notify the LaRC HPO regarding potential historic artifacts that are turned in for disposal.

16.3.4 Program Managers/Initiators

A. Coordinate with the HPO and EMT for the following:

   1. Projects involving major modification and/or demolition of facilities or structures that are 50 years or older.

   2. Projects that involve digging and excavation greater than six inches deep.

B. Submit to HPO and EMT the design and specification documentation regarding any projects that may affect historic and cultural resources at the Center.

17 POLLUTION PREVENTION

17.1 GENERAL

A. The purpose of this chapter is to provide information on applicable regulatory requirements and procedures related to pollution prevention at NASA LaRC. Pollution prevention is a multimedia approach to environmental management. It extends to air emissions, wastewater, and solid and hazardous wastes.

B. The Pollution Prevention Act of 1990 established pollution prevention as the preferred approach to environmental protection and waste management. The Act specifies a hierarchical strategy as follows:

1. Pollution should be prevented or reduced at the source whenever feasible;

2. Pollution that cannot be prevented should be recycled in an environmentally safe manner whenever feasible;

3. Pollution that cannot be prevented or recycled should be treated in an environmentally safe manner whenever feasible; and

4. Disposal or other releases into the environment should be employed only as a last resort and should be conducted in an environmentally safe manner.

C. Under this strategy, source reduction is defined as any practice that reduces the amount of hazardous substance, pollutant, or contaminant entering any waste stream or otherwise released into the environment prior to recycling, treatment, or disposal. Source reduction includes equipment or technology changes, process or procedure modifications, reformation or redesign of products, substitution of materials, and improvements in housekeeping, maintenance, training, or inventory control.

D. In order to maintain source reduction and compliance with laws and regulations LaRC is in the beginning stages of its sustainability program. Sustainability is meeting the needs of the present without compromising the ability of future generations to meet their own needs. Sustainability drives us to search for ways to eliminate dependence on nonrenewable resources, eliminate harmful releases to the environment, and respect and maintain life-sustaining natural systems, while ensuring that NASA's mission needs are met.

17.2 REQUIREMENTS

A. Exec. Order No. 13,423, "*Strengthening Federal Environmental, Energy and Transportation Management*," sets the following sustainability goals for Federal agencies:

1. Reduce the quantity of toxic and hazardous chemicals and materials acquired, used or disposed.
2. Increase the diversion of solid waste.
3. Maintain cost-effective waste prevention and recycling programs.

17.3 CENTER GOALS

A. LaRC is committed to an active policy of protecting the environment in all Center research and support activities. The Center has the following goals:

1. Reduce the quantity and toxicity of generated wastes.

2. Provide a clean and safe environment for our community.

3. Ensure a safe and healthy workplace for LaRC personnel.

4. Comply with all applicable laws and regulations while efficiently accomplishing our mission.

5. Reduce future waste disposal liability.

6. Reduce waste generation, hazardous material usage, and management costs.

B. To meet these goals, LaRC seeks out and implements opportunities to reduce or eliminate waste generation through pollution prevention methodologies. There are also other important benefits related to pollution prevention. These include reduced process operation and waste management costs, reduced waste and emissions, and reduced waste toxicity.

C. When applying pollution prevention methodologies to LaRC activities, source reduction technology is given priority. Where source reduction is infeasible, other pollution prevention methods such as material substitution, reuse, or recycling shall be used. Remaining wastes, for which no pollution prevention option is warranted, shall be treated to decrease volume or toxicity and managed responsibly to minimize effects on human health and the environment.

17.4 RESPONSIBILITIES

17.4.1 Facility Environmental Coordinators (FEC's)

A. Minimize the volume and toxicity of generated waste to the extent technically possible and economically feasible.

B. Propose operations or projects for pollution prevention opportunity assessments.

C. Schedule training to familiarize personnel with pollution prevention practices.

D. Participate with EMT in conducting pollution prevention opportunity assessments.

E. Develop and implement pollution prevention projects.

F. Provide EMT with data to evaluate the effectiveness of pollution prevention projects.

17.4.2 Environmental Management Team (EMT)

A. Understand the requirements of Exec. Order No. 13,423.

B. Update the LaRC Pollution Prevention/Sustainability Plan annually.

C. Prepare and submit the annual pollution prevention progress report to NASA Headquarters.

D. Review LaRC specifications and standards and, where possible, recommend reducing the acquisition and use of products containing extremely hazardous substances.

E. Prepare metrics to document the Center's pollution prevention activities.

F. Conduct pollution prevention opportunity assessments and recommend implementation of projects as appropriate.

G. Request funding to support pollution prevention activities.

H. Provide pollution prevention training to LaRC personnel as needed.

17.4.3 Organizational Unit Managers

A. Support personnel participating in pollution prevention projects.

B. Utilize pollution prevention and sustainability concepts in operation and management activities.

17.4.4 Logistics Office, Environmental and Logistics Branch

A. Advise EMT of property disposal and resale requirements.

B. Provide EMT with data to evaluate the effectiveness of pollution prevention projects.

17.4.5 Center Personnel and On-site Contractors

A. Minimize the volume and toxicity of generated waste to the extent technically possible and economically feasible.

B. Understand the concepts of pollution prevention and sustainability.

C. Participate in the Center's pollution prevention program and propose new pollution prevention projects.

D. Attend pollution prevention training courses when provided.

18 HAZARDOUS MATERIALS MANAGEMENT

18.1 GENERAL

A. The purpose of this chapter is to provide information on applicable regulatory requirements and procedures related to hazardous materials management at NASA LaRC. As part of its mission, LaRC uses a wide variety of hazardous materials and chemicals. A hazardous material is any substance that because of its quantity, concentration, physical or chemical characteristics, poses a hazard to human health and safety or to the environment if released into the workplace or the environment. By law and by necessity, hazardous materials must be carefully managed to prevent harm to the public, employees, equipment and the environment. This chapter includes information on chemical inventory management, storage, and transportation security requirements. The requirements of this chapter apply to all personnel performing work on site at LaRC.

B. All Center personnel and on-site contractors are required to use the web-based Chemical Material Tracking System (CMTS) when managing their hazardous material inventories. Proper use of CMTS provides EMT with significant data necessary for regulatory reporting. Improved record keeping and better management of hazardous materials help avoid compliance problems, reduce waste generation, and cut costs from raw material purchases and disposal activities. The CMTS also has an online Material Safety Data Sheet (MSDS) library to allow employees to understand the hazards of materials they handle or encounter at the Center. The information in the CMTS inventories provides EMT with a master list of hazardous material storage sites. This information is provided to local fire departments to aid them in identifying the storage location of hazardous chemicals in the event of a fire emergency.

C. Since September 11, 2001, the Research and Special Programs Administration (RSPA) of the Department of Transportation (DOT) has worked closely with Federal, State, and local government agencies, to improve the security of hazardous materials in the transportation system. RSPA requires that shippers and carriers of certain highly hazardous materials develop and implement security plans. In accordance with the RSPA requirements, LaRC has developed a Hazardous Material and Hazardous Waste (HM/HW) Security Plan. The plan includes measures to verify background information for employees and contractors with access to hazardous materials and HW; measures to address unauthorized access; and measures to address the assessed security risks of material and waste shipments while in transit. The plan is available by contacting EMT at extension 43500.

18.2 REQUIREMENTS

A. Hazardous materials include any item or chemical that is a "health hazard" or a "chemical hazard" as defined by the Occupational Safety and Health Administration (OSHA) in 29 C.F.R. § 1910.1200. Any item reportable under the Emergency Planning and Community Right-to-Know Act (EPCRA) would also be considered a hazardous material. Additionally, the Clean Air Act requires the Center to keep a current air emissions inventory for activities conducted at the Center (see Chapter 4). The CMTS provides most of the pertinent data to generate both the EPCRA reports and air emissions inventory. The CMTS is required to be used by all LaRC and contractor personnel to comply with the inventory requirements in both environmental statutes and LPR 1710.12, "*Potentially Hazardous Materials."*

B. The MSDS library is a key component in the generation of environmental compliance reports. MSDS's for materials currently used at the Center are maintained and available through the CMTS. MSDS's are required for all hazardous materials on the Center and the MSDS's are required to be submitted to the CMTS online library to ensure proper calculations for environmental reporting as well as to have important health and safety information available. Additional information regarding environmental and safety requirements for managing hazardous materials can be found in the following regulations:
   - 40 C.F.R. § 355, *Emergency Planning and Notification*
   - 40 C.F.R. § 370, *Hazardous Chemical Reporting; Community Right-To-Know*
   - 40 C.F.R. § 372, *Toxic Chemical Release Reporting; Community Right-To-Know*
   - 29 C.F.R. § 1910.1200, *Hazard Communication*
   - 29 C.F.R. § 1960 *Basic Program Elements for Federal Occupational Safety and Health*

A. This section outlines the roles and responsibilities of Center and contractor personnel in order to properly manage hazardous materials. Procedures for the approval, acquisition, and management of hazardous material inventories are outlined in LMS-CP-4759, "*Acquisition of Hazardous Materials*," which is available at: http://lms-r.larc.nasa.gov/admin/documents/4759.pdf. Additional responsibilities for chemical management can be found in LPR 1710.12, "*Potentially Hazardous Materials*," which is available at: http://lms-r.larc.nasa.gov/admin/documents/LPR1710-12.pdf. If hazardous materials are poorly managed, they may have to be disposed as HW (see Chapter 5). If mismanaged hazardous materials result in additional HW disposal costs, the responsible organization will be charged for the disposal.

18.3 RESPONSIBILITIES

18.3.1 Facility Environmental Coordinators (FEC's)

A. Either appoint or serve as the Hazardous Material Inventory Manager and ensure duties are performed as specified in Section 18.3.7 of this chapter.

B. Ensure the facility stores all hazardous materials in accordance with LPR 1710.12.

C. Ensure that facility personnel responsible for hazardous materials management understand the policies and procedures related to CMTS and receive appropriate training.

18.3.2 Environmental Management Team (EMT)

A. Ensure that hazardous material management at the Center is done in an environmentally responsible manner. EMT is the functional proponent of the CMTS and has primary responsibility to update and maintain the CMTS system.

B. Review and approve Langley Form 44's (Hazardous Materials – Procurement, Inventory and Storage Record).

C. Provide support, guidance, policies and procedures, training, and assistance to LaRC personnel using the CMTS.

D. Send all CMTS users quarterly notifications indicating due dates for the inventory certifications.

E. Use the CMTS capability to help compile the annual required regulatory reports.

F. Ensure internal compliance with the LaRC HM/HW Transportation Security Plan and updates as necessary.

18.3.3 Program Managers/Initiators

A. Ensure that contracts for projects involving hazardous materials include requirements for the contractor to provide hazardous material usage data to EMT.

18.3.4 Contracting Officer's Technical Representatives (COTR's)

A. Ensure that contractors provide EMT with a list of chemicals and hazardous materials used on-site but not recorded in CMTS (e.g., materials used by subcontractors). The data shall be submitted to EMT at the end of the project (if a short-term project) or by January 31 of each year (if a longer term project).

18.3.5 Facility Safety Heads (FSH's)

A. Review and approve Langley Form 44's.

B. Ensure that hazardous materials are purchased in accordance with procedures established in LPR 1710.12, to include using the electronic Langley Form 44 approval process as outlined in LMS-CP-4759.

C. Ensure that facility personnel are trained in proper hazardous material management practices.

D. Ensure that MSDS's are obtained for all hazardous materials prior to purchasing or receiving the items.

E. Assist the Hazardous Material Inventory Manager in maintaining an accurate inventory of hazardous materials.

F. Ensure hazardous materials are stored in accordance with LPR 1710.12.

18.3.6 Logistics Office, Environmental and Logistics Branch

A. Provide the following information to EMT on an annual basis for all materials requiring MSDS's issued from stock.
   1. National Stock Number (NSN)
   2. Customer;
   3. Date of issue;
   4. Unit description;
   5. Quantity on-hand, maximum quantity on-hand, and re-order point;
   6. Unit of issue;
   7. Unit conversion code or other description of the unit of issue;
   8. Total quantity (unit of issue) issued for each NSN.

B. Maintain stock cylinder data within the CMTS Cylinder Module.

C. Maintain facility inventory using CMTS and following the policies and procedures within this chapter.

D. Adhere to LaRC's transportation security policies and procedures outlined in the HM/HW Security Plan.

18.3.7 Hazardous Material Inventory Managers

A. Manage hazardous materials in accordance with the CMTS policies and procedures.

B. Certify accuracy of chemical inventories by submitting Quarterly Inventory Update Certifications, found in CMTS Inventory Maintenance. To properly and accurately certify the inventory, the hazardous materials in the facility shall be physically compared to the items listed in the CMTS inventory and reconciled accordingly. At a minimum, reconcile the physical inventory with the CMTS inventory **quarterly** (March 31, June 30, September 30, and December 31).

C. Facilities with no hazardous materials shall submit an annual No Hazardous Materials Certification by January 1 of each year. The form can be found at

http://osemant1.larc.nasa.gov/cmts/instruct/manuals under the Inventory Update Guide.

D. Ensure that each hazardous material is properly identified and labeled with a CMTS label.

E. Ensure that cylinders and bulk containers have been correctly identified in CMTS by verifying that the container identification numbers begin with “C” in the case of cylinders and “B” for bulk containers.

F. Ensure that each hazardous item in the CMTS inventory has a corresponding MSDS and that a copy of the MSDS has been submitted to EMT for entry into the online MSDS library.

G. Manage the chemical inventory stored or used at the facility in accordance with all applicable health, safety, and environmental regulations found in this LPR and in LPR 1710.12.

H. Manage the chemical inventory to reduce waste from shelf-life expiration. Where possible, and in accordance with all health and safety requirements, transfer unused or excess chemicals to other facilities where they can be used prior to reaching shelf-life expiration date. The cost of disposing of expired chemicals as HW will become the responsibility of the organization.

18.3.8 Safety and Facility Assurance Branch (SFAB)

A. Review and approve Langley Form 44’s.

B. Notify EMT of concerns that pertain to hazardous materials management.

C. Provide technical and administrative guidance to LaRC personnel for the safe use of hazardous material.

D. Assist personnel in the interpretation of MSDS technical data.

E. Supply MSDS’s, if available, from MSDS databases or assist in the acquisition and technical interpretation of proprietary or trade secret MSDS information.

F. SFAB’s Langley Form 44 Coordinator has the following responsibilities:

1. Review Langley Form 44’s to ensure the electronic MSDS’s in CMTS correspond to the hazardous materials being requested, and that the MSDS’s are accurate and current.

2. Add new MSDS’s to the CMTS library, as appropriate.

3. Notify EMT of concerns that pertain to the MSDS library in CMTS.

18.3.9 Center Personnel and On-site Contractors

A. Ensure that the FEC, FSH, and Hazardous Material Inventory Manager are notified when hazardous materials are brought into a facility, including Purchase Requisition (PR), credit card purchase, or vendor samples.

B. Ensure that the FEC and Hazardous Material Inventory Manager are notified when hazardous materials are expended or require disposal so the materials can be tracked in CMTS.

C. Use the electronic Langley Form 44 approval process, in accordance with LPR 1710.12 and LMS-CP-4759, to purchase hazardous materials and for sample products received from vendors.

19 ENVIRONMENTAL MANAGEMENT SYSTEM

19.1 GENERAL

A. The purpose of this chapter is to provide information on the applicable requirements and procedures related to the Environmental Management System (EMS) at LaRC. As defined in the NPR 8553.1, "*NASA Environmental Management System*," an EMS is a system that:

1. incorporates people, procedures, and work practices in a formal structure to ensure that the important environmental impacts of the organization are identified and addressed,
2. promotes continual improvement including periodically evaluating environmental performance,
3. involves all members of the organization as appropriate, and
4. actively involves Senior Management in support of the environmental management program.

B. LaRC's EMS provides a systematic approach for evaluating and addressing the Center's most significant environmental impacts and risks to LaRC's mission. It establishes the necessary personnel structure to facilitate communication throughout all levels of Center management, ensuring the Center's most significant environmental issues receive appropriate attention. Continual improvement is the centerpiece of the EMS approach. Environmental risks are regularly and systematically reevaluated to verify progress toward environmental goals and to ensure consideration of LaRC's changing environmental conditions and evolving mission requirements.

C. The LaRC EMS provides the mechanism to verify that the environmental procedures in the previous chapters of this LPR are being effectively implemented. It also ensures that LaRC's environmental procedures are producing the desired results: facilitating LaRC's mission while also fulfilling LaRC's environmental stewardship responsibilities.

19.2 REQUIREMENTS

A. Exec. Order No. 13,423, *"Strengthening Federal Environmental, Energy and Transportation Management,"* mandates the implementation of EMS at all appropriate organizational levels. NPR 8553.1 provides specific guidelines for EMS implementation at NASA Centers and is available at: http://nodis3.gsfc.nasa.gov/displayDir.cfm?t=NPR&c=8553&s=1A. The NPR provides specific procedural requirements for establishing the EMS elements, which are outlined below:

1. **Environmental Policy**

2. **Planning**
   - Environmental Aspects and Impacts
   - Legal and Other Requirements
   - Objectives and Targets
   - Environmental Management Programs

3. **Implementation and Operation**
   - Structure and Responsibility
   - Environmental Training – Awareness, Competence
   - Communication
   - Documentation and Document Control
   - Operational Controls
   - Emergency Preparedness and Response

4. **Checking and Corrective Action**
   - Monitoring and Measurement
   - Nonconformance, Corrective and Preventive Action
   - Records
   - EMS Audit

5. **Management Review**

B. The program's proponent is the EMS Representative, who oversees the implementation and maintenance of the program and reports to Senior Management on LaRC's environmental status. The EMS Representative is assisted by the Core Team, consisting of personnel from all relevant Center organizations including EMT. The Core Team members act as subject matter experts regarding their organizations' current and future mission/ operations. EMT contributes their environmental expertise and provides significant support to the EMS Representative and the Core Team.

19.3 RESPONSIBILITIES

19.3.1 Center Director

A. Provide authority/resources to implement the EMS.

B. Designate the EMS Representative.

19.3.2 EMS Representative

A. Ensure implementation and maintenance of the EMS.

B. Ensure participation of the EMS Core Team.

C. Periodically assess, review, and report on the status of program to the Center Director.

D. Hold regular (e.g., biannual) EMS meetings. Assess the status of environmental program, progress toward previously established goals, and changes to LaRC's environmental risks. Establish new environmental goals as applicable.

19.3.3 Environmental Management Team (EMT)

A. Serve as support staff to the EMS Representative and EMS Core Team during the implementation, operation, maintenance, and continual improvement of the EMS.

B. Serve as the Center's technical experts on environmental issues.

C. Ensure that all required EMS elements are addressed and periodically reviewed by the EMS Representative/Core Team. Maintain and update documentation of the EMS elements.

D. Incorporate the Core Team's recommendations and findings into the LaRC Environmental Program.

19.3.4 EMS Core Team Members

A. Serve as the organizations' representatives and act as subject matter experts regarding current and future mission/operations.

B. Actively participate in implementation, operation, maintenance and continual improvement of the EMS.

19.3.5 Center Personnel

A. Adhere to LaRC's environmental requirements.

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Appendix A - Glossary of Terms

Archeological Resources Protection Act. Protects archeological resources and sites on public lands and Indian lands.

Categorical Exclusion (CE). "Categorical Exclusion" means a category of actions which do not individually or cumulatively have a significant effect on the human environment and which have been found to have no such effect in procedures adopted by a Federal agency in implementation of these regulations and for which, therefore, neither an EA or EIS is required.

Chemical Material Tracking System (CMTS). LaRC's online hazardous material inventory approval and tracking database. CMTS is also used to maintain an online library of Material Safety Data Sheets.

Clean Air Act of 1970. Requires prevention, control, and abatement of air pollution from stationary and mobile sources (also includes asbestos removal and disposal regulations, and greatly reduces the use of ozone depleting substances.)

Clean Water Act of 1970. Regulates discharge of pollutants into waters of the U.S. from any point source including industrial facilities and sewage treatment plants. Regulates storm water runoff from certain industrial sources. Requires reporting and cleanup of oil and hazardous substance spills in waterways. Protects waterways. Requires a permit to dredge, fill, or disturb wetlands. Requires spill prevention plans for sites that store petroleum products.

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980, amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986. Regulates cleanup of abandoned HW sites. CERCLA also known as "Superfund" regulates releases of hazardous substances into the environment.

Construction of Facilities (CoF). Those activities directed toward construction of new facilities; repair, rehabilitation, and modification of existing facilities; acquisition of related facility equipment; design of facilities projects; and advance planning related to future facilities needs.

Emergency Planning and Community Right-to Know Act (EPCRA) of 1986. Provides local governments information concerning possible chemical hazards in the community. Requires emergency planning for releases of extremely hazardous substances. Requires facilities to publicly report releases of toxic chemicals into the environment.

Endangered Species Act (ESA) of 1973. Requires that all actions not jeopardize, threaten, destroy, or adversely impact critical habitats or the existence of endangered species.

Environmental evaluation. The analysis of the environmental effects of proposed actions, including alternative proposals. The analyses are carried out from the very earliest of planning studies for the action in question, and are the materials from which the more formal environmental assessments, environmental impact statements, and public record of decisions are made.

Environmental Assessment (EA). A concise public document prepared by a Federal agency to determine the environmental impact of a proposed action and alternatives. An EA briefly provides sufficient evidence and analysis for determining whether to prepare an EIS or a FONSI.

Environmental Impact Statement (EIS). A document that is prepared for an action which may have significant impact on the quality of the human environment or which has the potential for controversy in environmental effects. The primary purpose of an EIS is to serve as a device for use by officials to plan actions and make decisions. It provides information that must be considered throughout the decision process. An EIS is filed with the EPA and published and distributed widely for public comment.

Exec. Order No. 11,593 (May 13, 1971). ***Protection and Enhancement of the Cultural Environment.*** Mandates that Executive agencies, bureaus, and offices compile an inventory of cultural resources; nominate eligible government properties to the National Register of Historic Places; protect their cultural resources; and insure that agency activities contribute to the preservation of non-federally owned cultural resources.

Exec. Order No. 11,990 (May 24, 1974). ***Protection of Wetlands.*** Directs all Federal agencies to minimize the destruction, loss, or degradation of wetlands; and to preserve and enhance the natural beneficial values of wetlands.

Exec. Order No. 13,287 (March 3, 2003). ***Preserve America.*** Establishes a leadership role for the Federal Government in preserving America's heritage by actively advancing the protection, enhancement, and contemporary use of historic properties owned by the Federal Government.

Exec. Order No. 13,423 (January 24, 2007). ***Strengthening Federal Environmental, Energy and Transportation Management.*** Requires Federal agencies to conduct their environmental, transportation and energy-related activities under the law in support of their respective missions in an environmentally, economically and fiscally sound, integrated, continuously improving, efficient and sustainable manner.

EPA Comprehensive Procurement Guidelines (CPG). Part of EPA's effort to promote the use of materials recovered from solid waste. Buying recycled-content products ensures that the materials collected in recycling programs will be used again in the manufacture of new products. EPA is required to designate products that are or can be made with recovered materials, and to recommend practices for buying these products.

Once a product is designated, procuring agencies are required to purchase it with the highest recovered material content level practicable

Farm Security and Rural Investment Act of 2002. Requires Federal agencies to establish procurement programs for the purchase of biobased products.

Federal Acquisition Regulation (FAR). Establishes requirements for executive agencies when acquiring goods and services.

Finding of No Significant Impact (FONSI). A document prepared by LaRC staff which presents the reasons an action will not have a significant effect on the human environment and for which an EIS will not be prepared. It is typically published in a local newspaper and coordinated with a State point of contact.

Hazardous and Solid Waste Amendments to RCRA. Requires the phasing out of land disposal of hazardous waste. Mandates increased enforcement authority for EPA, more stringent hazardous waste management standards, and a comprehensive underground storage tank program.

National Environmental Policy Act (NEPA) of 1969. Mandates Federal agencies to "utilize a systematic, interdisciplinary approach to ensure the integrated use of the natural and social sciences and the environmental design arts in planning and in decision making which may have an impact on man's environment." Requires detailed statements on the potential environmental impacts of major Federal actions to be included in every recommendation or report on proposals to legislation.

National Historic Preservation Act (NHPA) of 1966. Requires Federal agencies to consider the effects of their actions (e.g., construction, leasing, and land transactions) on cultural and historic resources.

Noise Control Act of 1972. Establishes noise standards, and regulates noise emissions from commercial products, such as transportation and construction equipment.

Notice of Intent. A notice that an EIS will be prepared and considered. It summarizes issues uncovered in the EA, if one was done. The notice shall briefly describe the proposed action and possible alternatives, describe the agency's proposed scoping process including whether, when, and where any scoping meeting will be held, and state the name and address of a person within the agency who can answer questions about the proposed action and the EIS. This notice is required by law to allow interested parties to participate in the EIS development or to review it upon completion.

Pollution Prevention Act of 1990. Mandates a national policy creating a hierarchy of preferred waste management approaches: source reduction, recycling, treatment, and disposal, all to be conducted in an environmentally safe manner.

Quiet Communities Act of 1978. Established a nationwide "Quiet Communities Program," and tightened aircraft noise regulations, setting specific decibel limits for civil aircraft.

Record of Decision. (RoD) A document that describes how environmental considerations, and the EIS itself, entered into the decision. It is not published in the Federal register, but made available upon request.

Research and Development (R&D). Those activities directed towards attaining the objectives of a specific mission, project, or program. All of NASA's aeronautics and space program elements are categorized within the R&D program categories. R&D funds are expended chiefly for contracted research and development and for research grants. Some R&D funds are also expended in support of in-house research (e.g., equipment purchases and other research support, but not civil service salaries).

Research and Development Activity. A discrete research and development activity, with a scheduled beginning and ending, which normally involves one of the following primary purposes:

A. The design, development, and demonstration of major advanced technology hardware items;

B. The design, construction, and operation of a new launch vehicle (and associated ground support) during its research and development phase; or,

C. The construction and operation of one or more aeronautics or space vehicles (and necessary ground support) in order to accomplish a scientific or technical objective. R&D projects are subject to the decision processes in 14 C.F.R. § 1216.304.

Resource Conservation and Recovery Act (RCRA). Establishes guidelines and standards for solid and nonhazardous waste generation, transportation, treatment, storage, and disposal. Requires management of underground storage tanks (UST's) and cleanup of hydrocarbon contamination. Establishes a national policy to minimize the generation of HW and the land disposal of HW by encouraging process substitution, materials recovery, properly conducted recycling and reuse, and treatment. Mandates that HW generators and treatment, storage, and disposal facilities have a HW minimization program in place.

Toxic Substances Control Act (TSCA) of 1976. Prohibits or limits the manufacture, process, distribution in commerce, use, or disposal, of a chemical substance. Regulates the management, disposal, and labeling of materials such as asbestos and PCB's.

Appendix B - Acronyms and Abbreviations

ACBM	Asbestos containing building materials
ACOE	Army Corps of Engineers
AST	Aboveground Storage Tank
C&D	Construction and demolition
CAA	Clean Air Act
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CMOL	Configuration Management On-Line
CMTS	Chemical Material Tracking System
COTR	Contracting Officer's Technical Representative
CP	Center Procedures
CPG	Comprehensive Procurement Guidelines
CRMP	Cultural Resource Management Plan
CWA	Clean Water Act
dB	Decibels
dBA	A-weighted decibels
DEQ	Department of Environmental Quality
DOT	Department of Transportation
EA	Environmental Assessment
EHS	Extremely Hazardous Substance
EIS	Environmental Impact Statement
EMS	Environmental Management System
EMT	Environmental Management Team
EPA	Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-To-Know Act
EPM	Environmental Program Manual
ERD	Environmental Resource Document
FAR	Federal Acquisition Regulation
FEC	Facility Environmental Coordinator
FONSI	Finding of No Significant Impact
FSH	Facility Safety Head
HAZWOPER	Hazardous Waste Operations Emergency Response
HM/HW	Hazardous Material and Hazardous Waste
HPO	Historic Preservation Officer
HRSD	Hampton Roads Sanitation District
HVAC	Heating Ventilating and Air Conditioning
HW	Hazardous Waste
ISCP	Integrated Spill Contingency Plan
LAFB	Langley Air Force Base
LAPD	Langley Policy Directive
LaRC	Langley Research Center
LEED	Leadership in Energy and Environmental Design

LEPC	Local Emergency Planning Committee
LF	Langley Form
LMS	Langley Management System
LPR	Langley Procedural Requirement
MS4	Small Municipal Separate Storm Sewer Systems
MSDS	Material Safety Data Sheet
NASA	National Aeronautics and Space Administration
NASM	National Air and Space Museum
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NOx	Nitrogen Oxides
NPD	NASA Policy Directive
NPR	NASA Procedural Requirement
NSN	National Stock Number
ODU	Old Dominion University
OSHA	Occupational Safety and Health Administration
OUM	Organizational Unit Manager
PCB	Polychlorinated Biphenyl
ppm	Parts per million
PR	Purchase Requisition
R&D	Research and Development
RCRA	Resource Conservation and Recovery Act
REC	Record of Environmental Consideration
ROME	Research Operations, Maintenance, and Engineering
RQ	Reportable Quantity
RSPA	Research and Special Programs Administration
SAA	Satellite Accumulation Area
SERC	State Emergency Response Commission
SFAB	Safety and Facility Assurance Branch
SHPO	State Historic Preservation Officer
SPCC	Spill Prevention, Control and Countermeasures
SpecsIntact	Specifications Kept Intact
TPQ	Threshold Planning Quantity
TRI	Toxic Release Inventory
TSCA	Toxic Substances Control Act
UFGS	Unified Facilities Guide Specifications
USDA	US Department of Agriculture
USFWS	US Fish and Wildlife Service
UST	Underground Storage Tank
VDHR	Virginia Department of Historic Resources
VPDES	Virginia Pollutant Discharge Elimination System