

**DOCUMENT HISTORY LOG**

| <b>Document Revision</b> | <b>Effective Date</b> | <b>Description</b>                                                                                                                                                                                                                                                                                                             |
|--------------------------|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2A-4                     | May 24,2018           | <ul style="list-style-type: none"><li>• Baseline</li></ul>                                                                                                                                                                                                                                                                     |
|                          | MAR 1, 2024           | <ul style="list-style-type: none"><li>• Remove obsolete form references.</li><li>• Add Program Management element.</li><li>• Update Urgent FCR change process.</li><li>• Update Working Master redline process.</li><li>• Rename Chapter 3 from PSCM to High Energy</li><li>• Add HV Electrical Program to Chapter 3</li></ul> |



Langley  
Procedural  
Requirements

LPR 7123.2

Effective Date: May 28, 2024

Expiration Date: May 28, 2029

**Subject: Facility Configuration Management**

**Responsible Office: Center Operations Directorate**

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## PREFACE

### P.1 PURPOSE

The LaRC Facility Configuration Management (FCM) Program exists as one of two major elements of the LaRC Facility System Safety Program (ref: LPR 1740-4 para 1.1.1). The FCM Program administers the appropriate level of facility configuration management to ensure the safe and continuous operation of ground based LaRC facilities.

This document sets forth procedural requirements for the Langley Research Center (LaRC) Facility Configuration Management (FCM) Program for the Center's facility complexes, buildings, and horizontal infrastructure systems. It defines the requirements of the Center's FCM Program

This document incorporates configuration management as per NPR 7123.1C "NASA Systems Engineering Processes and Requirements para 3.3.15" and is part of the Langley Management System (LMS). It also provides guidance for government and contract personnel in defining roles and responsibilities for this program.

### P.2 APPLICABILITY

- a. This LPR is applicable to all Langley employees and contractors.
- b. In this directive, all document citations are assumed to be the latest version unless otherwise noted.
- c. Processes described that contain the words "shall", "required", and "will" are directives to FCM Program and interfaces.

### P.3 AUTHORITY

NPR 8715.3D, NASA General Safety Program Requirements.

NPR 7123.1C, Systems Engineering Process and Requirements.

### P.4 APPLICABLE DOCUMENTS AND FORMS

- a. 36 CFR Part 1220.14, NARA Federal Records
- b. 36 CFR Part 1222.12, NARA Creation and Maintenance of Federal Records
- c. NPD 1440.6, NASA Records Management
- d. NPR 7150.2D NASA Software Engineering Requirements, Appendix D. Software Classifications
- e. NPR 1441.1, NASA Records Management Program Requirements
- f. NASA-GB-8719.13, NASA Software Safety Guidebook
- g. NASA-STD-8719.7, Facility System Safety Guidebook
- h. NASA-STD-8739.8, Software Assurance and Software Safety Standard
- i. LAPD 1700.2, Safety Assignments and Responsibilities

- j. LAPD 7000.2, Review Program for Langley Research Center (LaRC) Facility Projects
- k. LAPD 7150.10, Facility Software Classification Policy
- l. LPR 1710.42, Safety Program for the Recertification and Maintenance of Ground-Based Pressure Vessels and Piping Systems
- m. LPR 1710.6, Electrical Safety
- n. LPR 1740.2, Facility Safety Requirements
- o. LPR 1740.4, Facility System Safety Analysis
- p. LPR 7150.2, LaRC Software Engineering Requirements
- q. LPR 7320.1 Engineering Drawing and Document Requirements
- r. LMS-CP-4710, Facility Change Request Process
- s. LMS-CP-1741.2, Facility Configuration Management Audit Process
- t. LMS-CP-4754, Software Assurance (SA) for Development and Acquisition
- u. LPR-7150.2 LaRC Software Engineering Requirements
- v. LMS-CP-7151, Obtaining Waivers for Langley Management System (LMS) Requirements
- w. LMS-CP-8715, Facility Risk Tier Determination
- x. COD Facility Engineering Standard for Piping Systems and Pressure Vessels
- y. LF 445, LaRC Facility Risk Tier (Webform FRT) Designation Form
- z. LF-599, Facility Configuration Management Audit Form
- aa. LF-491, CMMS Change Request webform
- bb. LF-461, Environmental Project Planning Form

**P.5 MEASUREMENT/VERIFICATION**

None

**P.6 CANCELLATION**

Not Applicable – Version Controlled

Lisa M. Ziehmman  
Center Associate Director

May 28, 2024  
Date

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

## **CHAPTER 1.0 – FACILITY CONFIGURATION MANAGEMENT PROGRAM SCOPE**

### **1.1 INTRODUCTION**

In 2017 the on-line FCMS system replaced the Configuration Management On-Line (CMOL) and the Engineering Drawing File (EDF). FCMS provides an enterprise content management to search and view Configuration Control items (CCIs) and Supporting Facility Documentation as well provide Configuration Management (CM).

FCMS also contains the online workflow to manage revision control and updates for content in FCMS referred to as the Facility Change Request (FCR) process providing Configuration Management (CM).

The FCM Program primary objective is to provide Configuration Management of CCIs. CCIs shall be identified and controlled to ensure personnel and facility safety for ground-based research facilities, buildings, and horizontal infrastructure systems. The FCM Program contributes to mission reliability where accurate configuration-controlled information enables efficient operations and maintenance for facility and related equipment on Center.

CCIs include drawings, documents, and Building Information Models (BIM) that have been designated as configuration controlled to ensure the successful development, maintenance, sustainability, and support of complex systems, equipment, and facilities. The following describe the functional areas and criteria of content.

1.1.1 The FCM Program consists of the following functional areas:

- a. Program Management
  - i. FCM Program Manager
  - ii. COD Chief Engineer
  - iii. COD Chief Inspector
  - iv. SMAO Safety Manager (SFAB Branch Head)
  - v. Facility Configuration Control Management Control Board (FCMCB)  
Reference Section 2.10 for members
- b. Configuration Control Center (CCC)
  - i. CCC Supervisor
  - ii. CCC Lead
  - iii. Auditor/Trainer
  - iv. 2-D, 3-D drafters/modelers
  - v. Technical writer
- c. FCM disciplines:
  - i. Pressure Systems Configuration Management (PSCM)

- ii. Electrical Systems Configuration Management
  - iii. Software Configuration Management (SCM)
  - iv. Computerized Maintenance Management System (CMMS)
  - v. Geographic Information System (GIS)
- d. FCM Owner Teams
- i. FCM Owner
  - ii. Facility Safety Head (FSH)
  - iii. Facility Coordinator (FC)
  - iv. FSH and FC Alternates
  - v. Facility Systems Engineer (FSE)
- e. Technical Authorities
- i. Safety Manager & Facility Systems Safety Engineers
  - ii. Fire Chief
  - iii. Standard Practice Engineers (SPE)
  - iv. Others (e.g., IT, Environmental, Security as needed)
- f. Project Managers
- 1.1.2 FCM program content shall include all LaRC facilities and systems with designated safety and mission risk levels and categorized as High, Medium, or Low Risk Tier facilities or systems (LF-445 records).
- 1.1.3 FCM Program content shall include a safety analysis conducted in accordance with the LPR 1740.4 Facility System Safety Analysis process with a Facility Risk Tier designation per LMS-CP-8715. This information will be contained and updated per LMS guidance.
- 1.1.4 FCM Program content shall include Configuration Controlled Items (CCIs) shall be managed per LMS-CP-4710 Facility Change Request (FCR) Process. The CCIs will be stored and modified using FCRs. The types of CCIs required are dependent on the risk tier assigned to the facility as shown in Table 1 below (reference Appendix A for definitions).

**Table 1 - CCIs Required Depending on Facility Risk Tier**

| <b>Low Risk Tier</b> | <b>Medium Risk Tier</b>       | <b>High Risk Tier</b>         |
|----------------------|-------------------------------|-------------------------------|
| Hazard Analysis      | Hazard Analysis Report        | SAR or Hazard Analysis        |
|                      | Mission Critical Systems List | Mission Critical Systems List |
| Level 1 Drawings*    | SOPs & Check Lists            | SOPs & Check Lists            |
|                      | Emergency Cutoff              | Emergency Cutoff Procedures   |



|  |                  |                                                                |
|--|------------------|----------------------------------------------------------------|
|  | Procedures       |                                                                |
|  | Level 1 Drawings | Level 1 Drawings                                               |
|  |                  | Level 2 Subsystem Drawings                                     |
|  |                  | Critical Component Assembly & Bill of Material (BoM) Drawings* |
|  |                  | Interlock List*                                                |

\*If applicable

1.1.5 CCIs required for facility software, pressure systems, and maintenance are described separately in Chapters 2-4. These include Pressure Systems Documents (PSDs), Weld maps, Inspection Plans, Software, Software Configuration Management Plans, High Voltage (HV) Electrical Schematics and Diagrams and the Computerized Maintenance Management System (CMMS) database.

1.1.6 Details on the FCM Program are found in the remainder of this document as described below,

- a. Chapter 2 addresses the FCM Program elements and requirements.
- b. Chapter 3 addresses the High Energy Configuration Management PSCM & HV Electrical Programs.
- c. Chapter 4 addresses the Facility Software Configuration Management (SCM) and processes.

**1.2 OBJECTIVES**

1.2.1 The FCM Program shall:

- a. Establish and maintain a documented, field verified baseline for all facilities and systems with relevant Configuration Controlled Items (CCIs) which is the Configuration Baseline List (CBL).
- b. Ensure the FCM Owner, all relevant technical authorities and configuration management disciplines are cognizant and review changes to CCIs. These disciplines include:
  - 1. Pressure Systems Configuration Management (PSCM)
  - 2. Electrical Systems Configuration management
  - 3. Software Configuration Management (SCM)
  - 4. Computerized Maintenance Management System (CMMS), currently IBM Maximo.
  - 5. Geographic Information System (GIS)
- c. Ensure that all CCI documents impacted by a change are updated and field verified and current WORKING MASTER CCI documents reside at all

facilities.

- d. Obtain electronic approval of all new and changed facility drawings and documents held in the FCMS repository. This includes Supporting Facility Documents (SFDs) such as “as- built” construction drawings, reference models: e.g., Building Information Model (BIM), and reference documents.

NOTE: Although SFDs are not under Configuration Management, if they are newly created or revised such as for a new construction project then the new or revised documents require approval signatures from FCM owner, technical authorities, and FCM disciplines.

- 1.2.2 The Pressure Systems Configuration Management (PSCM) Program shall maintain the configuration of Pressure System Documents (PSD), Weld Maps, Inspection Plans, and component data to ensure the system is safe for the intended pressure and use.
- 1.2.3 The Facility SCM Program shall:
  - a. Document and maintain configuration control of software.
  - b. Ensure Safety and Mission Assurance Office (SMAO) reviews changes that affect safety.
  - c. Establish and maintain a baseline for computer systems and the relevant documentation such as: Software Assurance Classification Report (SACR), SCMP, drawings, Computer System Inventory List (CSIL). This is a subset of the Configuration Baseline List (CBL).

### **1.3 DEFINITIONS**

- 1.3.1 The glossary in Appendix A lists and defines the terms related to the FCM Program.

### **1.4 WAIVERS**

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

## **END OF CHAPTER ONE**

## **CHAPTER 2.0 – FACILITY CONFIGURATION MANAGEMENT (FCM) PROGRAM ELEMENTS**

The FCM Program utilizes a software application to manage content and a workflow process for version control. It requires personnel with specific roles to ensure content remains complete and current.

### **2.1 FCMS GENERAL INFORMATION**

The FCMS is a content management system that currently operates using opentext™, a COTS software application.

To provide CM, an opentext™ add-on operates to enable a real time workflow. Enterprise Content Management (ECM) for Engineering provides the workflow capability which is referred to as the Facility Change Request (FCR) process.

#### **2.1.1 FCR Initiation/Processing**

- a. At the FCMS homepage, the user selects the Facility Change Request (FCR) to initiate, approve, or view an FCR. The FCR workflow screen displays three options from which to select.
- b. The first option allows the user to create a new FCR, the second allows for searching for a particular FCR that is already in the system, and third option allows the user to view the status of FCR over which the user has authority or that require the user's attention such as review and approval.
- c. Refer to the user guide in FCMS for details on processing an FCR.

#### **2.1.2 Configuration Baseline List (CBL) and Supporting Facility Documents (SFDs).**

- a. A CBL can be generated for a facility using FCMS. The FBL represents a list of all CCIs for the Facility.
- b. Supporting Facility Documents (SFDs) shall also be stored in the FCMS repository but are not part of the CBL. SFDs are documents/drawings that are affiliated with the facility but not under CM control.
- c. The revision of an SFD drawing or document is the responsibility of the facility or a project (i.e., when necessary to communicate a construction scope to a contractor) since they are not CCI. This shall be recorded through the FCR process with a new revision when as built conditions are updated.

#### **2.1.3 Repository for Drawings/Models/Documents**

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

- a. FCMS shall be the repository for all original CCIs and SFDs and for their revision history. FCMS will preserve these historical records and

all subsequent revisions.

- b. Only a CCC Representative or the FCM contractor maintaining FCMS, shall be permitted to withdraw native file versions of CCIs (e.g., AutoCAD dwg or MS Word.doc files) from FCMS.
- c. The FCMS will flag all checked out native CCIs to show what is currently undergoing change. This will be done in order to “check-out” the file for revision per an approved FCR.
- d. Native files of SFDs are available for download, however, an FCR would be required to incorporate any changes (if either the FCM Owner or a Project Manager elected to do so).

#### 2.1.4 Access and Database Maintenance

- a. Access to FCMS shall be by authorized personnel at:  
<https://FCMS.ndc.nasa.gov/>
- b. A NASA Access Management System (NAMS) application account is required for the user to be granted access to FCMS. Log-in is authorized via BroadCom SiteMinder.
- c. CCC shall approve any request for an account that requires authority to approve an FCR.
- d. CCIs undergoing revision will be clearly indicated to all FCMS users. If there is a question concerning the currency of a particular document, contact a representative from CCC for assistance and/or confirmation: e-mail: [LaRC-COD-CCC@mail.nasa.gov](mailto:LaRC-COD-CCC@mail.nasa.gov) or 864-3333.

## 2.2 FCMS REQUIREMENTS

All facility complexes, buildings, and horizontal infrastructure system content in FCMS shall conform to:

- 2.2.1 Maintaining a FBL for all LaRC facilities and systems as defined in Appendix C.
- 2.2.2 Designating CCIs to mitigate both safety and mission risk as defined in the LaRC LMS-CP-8715
- 2.2.3 Identifying mission critical systems that are not defined in the SAR or hazard analysis on a MCSL.
- 2.2.4 Assigning a minimum of one of the four following attributes is associated to all FCMS facility content:
  - a. Building number (e.g., 2103 for Computational Research Facility).
  - b. Horizontal infrastructure real property asset number (e.g., 880-10 for Fire Alarm Systems; 131-60 for Communications Network).
  - c. Effort Codes (see Appendix D) assigned to facilities in previous content management systems.
  - d. Portions of buildings where the function or directorate ownership is different and have different facility personnel assigned than the rest of the

building shall be designated in one of two ways:

1. Individual labs by the building number followed by “-Lab01”, “-Lab02” and so forth.
2. Subsets or groups of labs by the building number followed by “-Sub01”, “Sub02” and so forth.

NOTE: These designations shall be further defined using the room number(s) associated with those areas of the building such as B1247B-Lab01 for the Arc Heated Scramjet test facility; B1250-Sub01 for the Engineering Directorates Systems Integration and Test Laboratories of the building.

- 2.2.5 The FCMS shall function to provide content management and version control for:
  - a. Facility CCIs.
  - b. Supporting Facility Documents (SFDs) which require original release and revision approvals such as for construction, manufacturing, and assembly drawings.
  - c. Other facility historical content such as obsolete drawings and other documents no longer under version control.
  - d. Non-facility drawings such as for Science Directorate, Engineering Directorate, wind tunnel model, and balance drawings, etc. The scope of the repository encompasses all drawings kept in the previous Engineering Drawing File (EDF).
  - e. A searchable index generated based on text embedded within each CCI.
  - f. Tracking of drawing numbers, document numbers, and component location numbers (i.e., LaRC IDs) for the benefit of developing a hierarchy which will be used to fully address a change to a facility such that all associated items are updated and maintained in an accurate condition.
  - g. Content management and version control for all facility CCIs and SFDs in native format e.g., AutoCAD, MS Word, Pro-E, Revit, or other model format.
- 2.2.6 The FCMS shall provide users the capability to manage efficient processing of Facility Change Requests (FCRs) in accordance with LMS-CP-4710 workflow to:
  - a. Revise all facility CCI and SFD.
  - b. Add approved CCI and SFD to the repository.
  - c. Change the status of all CCI and SFD in the repository per FCR:
    1. CCI to SFD and vice versa.

2. "active" to "obsolete".
3. "as-designed" to "as-built".
- d. Track the status of FCR processing to ensure their timely disposition according to requirements.
- e. Ensure compliance relating to Working Master originals and copies for all real property and horizontal structure facilities.
- f. Integrate the FCR process with the FCM disciplines of Pressure Systems Configuration Management (PSCM), HV Electrical, Facility Software Configuration Management (SCM), Computerized Maintenance Management System (CMMS), and Geographic Information Systems (GIS). See section 2.6 FCM System for implementation details of this integration.

### **2.3 LaRC FCM PROGRAM ORGANIZATION**

Successful implementation of FCM Program relies on defined FCM roles and responsibilities.

2.3.1 The FCM Program Manager shall provide oversight to:

- a. The FCMS system functionality and all Configuration Control Center (CCC) activities (para 2.3.4).
- b. Ensure appropriate technical authority reviews are completed for all new or existing CCI's before they are entered into the FCMS repository as part of the FBL for the facility.
- c. Develop and execute a FCM Audit process in accordance with LMS-CP-1741.2.
- d. Coordinate with FCM Owners on priority of FCRs.
- e. Track and support COD Chief Engineer in the review process (LMS 7123.1) as it relates to the FCM Program.
- f. Ensure document upload to FCMS at facility project close out (LMS OP-5695)
- g. Report on FCM Program Status to FCMCB quarterly and to the Executive Safety Council (ESC) annually.

2.3.2 Organizational Directors shall appoint FCM Owners and alternates for each of their LaRC facilities and systems using LF-1 appointment form per LAPD 1700.2.

2.3.3 FCM Owner shall be responsible for the responsibilities per LAPD 1700.2 para 5.1.7 to include:

- a. Integrity of their facility/system CCIs.
- b. Approving/rejecting FCR changes and revisions to CCIs and SFDs in the FCMS repository.
- c. Addressing corrective actions from FCM audits in accordance with LMS-CP- 1741.2.
- d. Coordinating with the FCM Program Manager to prioritize FCRs, resolve system errors or issues relating to an FCM audit if needed.

2.3.4 Configuration Control Center (CCC) shall be responsible for:

- a. Overall administration of the FCM Program.
- b. Oversee FCRs in work and content management within the FCMS.
- c. Approve any request for an account that requires permission to enable approvals for FCR workflows.
- d. Processing FCRs including approval, distribution, status keeping, and making changes (maintaining configuration change management) to CCIs. Exceptions are either in the case of a facility design or construction project or when generated by a FCM discipline. Provide Working Masters as a part of FCR closeout.
- e. Conducting audits of FBL at all facilities and tracking actions to closure in accordance with LMS-CP-1741.2.
- f. Provide development and editing of FCMS related native versions of FCMS CCI and SFD materials i.e., Auto -CAD, Revit, MS Word, Excel.
- g. Providing assistance to FCMS users relating to searching, redlining or uploading of documents or drawings related to FCRs.
- h. Conduct training for FCM stakeholders including FCM Owner teams, CCC staff, technical authorities, FCM discipline leads, Project Managers and others who need to access FCMS or who have a role in the FCM Program.
- i. Evaluating proposed CCIs for approval or rejection based on this LPR's requirements.
- j. Prioritizing FCR processing.
- k. Develop and provide formal and informal training and materials for all personnel involved with the FCM Program.
- l. Manage legacy microfiche files currently maintained at B1195. Retrieve

information from microfiche media on an as needed basis.

## 2.4 CRITERIA FOR DESIGNATING CCI

The criteria for designating documents, drawings, and BIM as a CCI is defined in Table 1, based on the Risk Tier of the facility.

2.4.1 The Risk Tier for the facility is established by SFAB using LF-445, LaRC Facility Risk Tier (FRT) Designation Form in accordance with LMS-CP-8715 "Facility Risk Tier Determination. The following are considered Configuration Controlled Items:

a. CCI drawings / models:

1. **Level 1 drawings/models:** System level drawing or models used to develop hazard analyses and Standard Operating Procedures (SOPs) as well as to isolate energy for Lockout-Tagout (LOTO) procedures. Level 1 drawings are in most cases Piping & Instrumentation Diagrams (P&IDs), one-line power distribution diagrams, and control loop diagrams. These drawings may be for both safety critical as defined in SAR or hazard analysis and mission critical systems as defined in a Mission Critical Systems List (MCSL).
2. **Level 2 drawings/models:** Subsystem drawings/models used to perform troubleshooting and repairs when a system has failed as well as to support LOTO procedures. Level 2 (or subsystem) drawings are typically component wiring diagrams: e.g., Motor Control Center (MCC) or a skid or test stand level P&ID e.g., hydraulic skid.
3. **Assembly or Bill of Materials (BOM) drawings/models:** Drawings/models that could be considered either as Level 1 or 2 drawings depending on whether they are used for SAR and SOP development or only for troubleshooting and repairs. These types of drawings may be for wind tunnel mechanisms such as model injection and support, main drives, and test section movables) or for documenting safety critical materials (e.g., oxygen valves).

**NOTE:** Drawings that will not be considered facility CCI: wind tunnel models, wind tunnel balances, test articles. Although these drawings may be kept in the FCMS repository they will not be maintained by the CCC as FCM Program CCIs.

- b. SARs and Hazard Analysis as required in LPR 1740.4
- c. Mission Critical Systems List
- d. SOP and Checklists as required in LPR 1740.4
- e. Pressure Systems CCIs as required in Chapter 3 and LPR 1710.42
- f. Software CCIs in accordance with Chapter 4 below and LPR 7150.2



- g. Emergency Cutoff Procedures (ECPs)
- h. Facility Risk Tier Designation Form, LF-445 identifies the risk tier level and rationale (maintained in the GIS environment on-line at <https://giswebx.ndc.nasa.gov/ords/apex/f?p=FSPL:1:5726658644794:::>)
- i. Device List

## 2.5 UPDATING AND DISTRIBUTING A CCI

All CCIs shall be updated in accordance with the redlined documents submitted through an approved FCR.

- 2.5.1 Updating CCIs in FCMS shall occur after the approved changes of the FCR have been completed.
- 2.5.2 All updated CCIs shall be distributed as outlined in section 2.8.3 CCI Working Masters.
- 2.5.3 FCR initiator with FCM Owner team approval shall designate whether CCIs will be updated electronically by the CCC, by the project activity, or by the facility personnel.

**NOTE:** In general, CCIs changed as a result of an FCR implemented by the FCM Owner team, will be updated by the CCC or by integrated FCM disciplines (GIS, CMMS, PSCM, or SCM). Changes implemented by a project are expected to be provided by the project including complete, “as built”, field verified changes of both CCIs and any new project drawings/models (e.g., BIM, ETAP, Pro-E) that will be placed into the repository as SFDs.

- 2.5.4 For each FCR completed, a notice shall be sent from FCMS to the FCM Owner Team that includes at least the following information: FCR Number, Description of Change, notice of completion.
- 2.5.5 The facility shall receive a hardcopy of the revised CCI as the “Working Master(s)” for drawings and documents but not for GIS maps/floor plans, CMMS, or Software code.

## 2.6 TYPES OF CHANGE

Modifications to facilities at LaRC under the FCM Program can be one of four types. The FCR process depends upon which of these types of changes are occurring. The methods are discussed in the paragraphs that follow.

- 2.6.1 Facility Implemented Changes:
  - a. Facility changes affecting a CCI shall be submitted as an FCR by a member of the FCM Owner team obtaining approval from the FCM owner team, the CCC, and applicable technical authorities and integrated FCM discipline leads prior to implementing the change.
  - b. Complex changes may be entered as a “conceptual” FCR, with a narrative description and the CCI number of the key Level 1 drawing,

model, or document but without an attached redlined work package. The conceptual FCR allows notification of the technical authorities and FCM discipline leads of the change to obtain their comments and input before expending significant resources on developing the work package.

- c. Conceptual FCRs are also created to manage information from a design or study. It may or may not evolve from an as designed to as built CCI or SFD. In most cases the construction or maintenance project provides the field verification and subsequent updates of as built CCIs and SFDs. As part of project close out. The conceptual FCR created for a project can be closed at various stages of the project lifecycle with the balance to be tracked through a typical FCR.
- d. Once approved by the FCM owner team and the CCC, the work package may be developed by the requestor and submitted to obtain approvals from the technical authorities and FCM discipline leads prior to implementation.
- e. Following completion of FCR implementation, the FCM Owner Team shall ensure that redlined “as-built” field verified CCIs are provided. Revision redlines to SFDs are optional. Obtain needed equipment LaRC location IDs (see Appendix E) from the LaRC ID Registry at:  
<https://gis-dbweb.LaRC.nasa.gov/ords/apex/f?p=LARCID> for CCIs

## 2.6.2 Urgent Changes

- a. The FCM Owner, with the concurrence of the FSH, may verbally authorize urgent changes to a CCI provided that:
  1. Urgent changes are defined as: permanent or temporary.
  2. Urgent changes shall be entered into the FCMS immediately as an Urgent FCR after redlining a Working Master(s). See paragraph 2.8.4 for the specific procedure.
  3. Urgent changes shall be designated on the FCR as “URGENT”.

## 2.6.3 Project Implemented Change

- a. This method is used for major modifications that are governed by LAPD 7000.2, “Review Program for Langley Research Center (LaRC) Facility Projects.” Prior to the Preliminary Design Review (PDR), the PM, in coordination with the FCM Owner Team, shall ensure that the affected portions of all CCIs impacted by the project are field verified (FV) and redlined to reflect the true configuration of the facility.
- b. At the PDR, SFAB System Safety Engineer shall present the results of the preliminary hazard analysis (PHA).
- c. Prior to Critical Design Review (CDR) the PM or designee shall enter a conceptual FCR (no work package required) into FCMS and obtain drawing numbers. Obtain new required device numbers from the FC or

FSH (LaRC IDs ref Appendix E) or create new LaRC IDs using the LaRC ID Registry at <https://gis-dbweb.LaRC.nasa.gov/ords/apex/f?p=LARCID> for CCIs. In all cases Coordinate with FC and FSH to ensure numbering does not conflict with existing facility device numbering.

- d. Following CDR, the PM shall attach the work package (see definition) to one or more FCRs in FCMS with the final post-CDR package of drawings or model including redline CCIs, obsolete CCI/SFD drawings, and new CCI/SFD drawings to initiate the final review and electronic signature by all FCM owner team members, technical authorities, and FCM discipline leads. This FCR shall identify which new drawings are CCI and which are to be SFD.
- e. The PM shall have a Field (or Functional) Verification Plan to ensure all CCI drawings are field verified. The plan shall be provided no later than the Integrated System Review (ISR), if applicable or no later than prior to commissioning.
- f. **IMPORTANT:** Projects that generate drawings / models shall include funds for updating electronically all drawings / models (both CCIs and SFDs created by the project) to “as-built” condition. The CCC will not update CCIs/SFDs from redlines for such projects.
- g. Following the ISR (if applicable) and prior to the Operational Readiness Review (ORR) (if applicable) the PM shall submit in the FCMS a change to the original FCR with the final updated “as- built” documents and field-verified drawings / models including the CCIs. In no case shall commissioning commence without current as built Working Masters on site.
- h. At the ORR (if applicable) or following completion of construction / commissioning the Facility System Safety Engineer (FSSE) shall provide the final redlined SAR (or hazard analysis). If applicable, the Facility Risk Tier Designation Form 445 shall be updated by the FSSE.

#### 2.6.4 Facility Maintenance Change

- a. This method is governed by Computerized Maintenance Management System (CMMS) Change Request LMS-CP-5616. The CMMS Software/equipment change electronic request form located on-line: <https://codnet.ndc.nasa.gov/Forms/viewform.cfm?FormID=1047>.
- b. The LF-491 is utilized to update the CMMS system (MAXIMO). All facility/system CCIs affected by the maintenance change shall be identified and updated in the FCMS repository.

## 2.7 FCMS INTEGRATION WITH FCM DISCIPLINES

The Facility Configuration Management System is an on-line enterprise content management system. The FCR process is integral to the system providing the capability to accomplish and manage revision changes and maintain configuration

control. The FCR workflow process allows for comments, approvals / rejections and content updates by the FCM discipline leads for PSCM, Electrical, SCM, CMMS, and GIS. This integration shall accomplish the following:

**NOTE:** Integration is achieved electronically through workflows which distribute FCRs for review and electronic approval as well as for confirmation that FCM discipline databases (GIS, CMMS, Software, PSCM, electrical) have been updated as a prerequisite for closing an FCR. The FCMS and CCC achieves this integration.

- 2.7.1 Ensures that all equipment on a CCI is assigned unique location numbers, also known as LaRC location IDs. NOTE: See Appendix E for full requirements.
- 2.7.2 Utilize CMMS Change Form LF-491. NOTE: Utilize CMMS Change Form, LF-491. NOTE: This form is used to change the asset database including adding or changing equipment location LaRC IDs and other data related to assets which are configuration controlled either because they are shown or referenced in CCIs or because they undergo Preventive Maintenance. Refer to LMS-CP-5616 for LF-491 processing.
- 2.7.3 Utilize Environmental Form, LF-461. NOTE: This form is used as a tool for evaluating many of the Center's projects and can be used to screen for facility changes that may impact CCIs. Refer to LPR 8500.1 for LF-461 processing.
- 2.7.4 Utilize Facility Work Permit Form, LF-490. NOTE: This form is used to notify facility personnel, safety engineers, and construction inspectors that construction work is about to begin in a facility to which they have been assigned. Refer to LMS-CP-8835 for LF-490 processing.
- 2.7.5 Utilize Dig Permit Form. NOTE: This form is used to obtain approvals prior to digging at the Center to ensure underground utilities are not damaged and that the new underground work is documented in GIS.

## **2.8 CONFIGURATION CONTROLLED ITEMS**

This section identifies requirements unique to drawings or models such as Building Information Model (BIM), Electrical Transient Analyzer Program (ETAP) and documents such as SOPs, SARs, PSDs incorporated into the FCM Program and designated as CCI. Section 2.2, "Criteria for Designating CCIs" provides guidelines for which drawings may be designated CCI.

- 2.8.1 CCI Drawing Field Verification
  - a. All engineering drawings in the FCM Program shall be classified as: field verified (FV), functionally verified, or unverified.
  - b. Electrical systems that are operational are normally functionally verified per LPR 1710.6 rather than field verified because this would require lifting wires/connectors which would create risk for an operational system.

- c. Additionally, no new drawing shall be brought into the FCM program (designated as CCI) unless it is first FV.
- d. The field verification process shall be a hands-on verification of the validity of the drawing conducted by facility personnel, pressure systems recertification personnel (for PSCM documents), or by project personnel.
- e. A drawing which has been verified shall display a “FIELD VERIFICATION” or “FUNCTIONAL VERIFICATION” statement authenticating that action:
  - 1. That statement shall be electronically signed in FCMS by the person attesting to the field verification.
  - 2. It shall also be electronically signed in FCMS and dated as approved by the PM, FSH, FC, FCM Owner, or Pressure Systems Manager (PSM) for PSCM documents.
  - 3. If FV drawings are found to be discrepant, they shall lose their FV or functionally verified status and shall be identified as unverified unless the Working Master redline process in paragraph 2.8.4 is initiated and resolves the discrepancies.
  - 4. All drawings that are currently in the FCM Program and not FV are subject to an audit finding. The FCM Owner is responsible for ensuring their CCIs are FV.

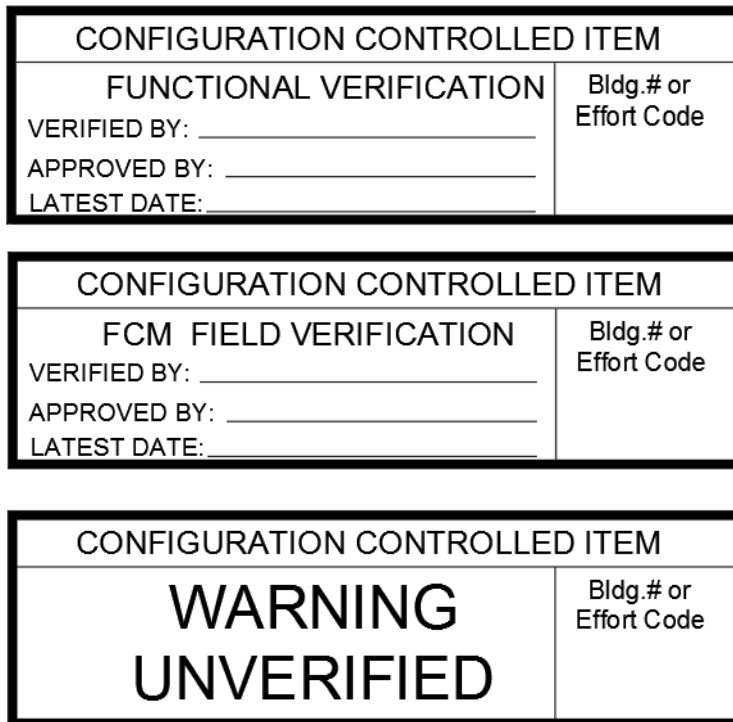


Figure 2-1 DRAWING VERIFICATION STAMPS

2.8.2 Proposed Change to a CCI:

- a. Drawings:
  1. When drawings in the FCMS are proposed for change, an FCR shall be created, and the drawing(s) shall be redlined. Drawings may be redlined manually or electronically:
  2. Drawings that are redlined manually shall be redlined as follows, then scanned and entered as an attachment to the FCR:
  3. New items shall be added in green or black and the cloud highlighted in yellow.
  4. Existing items requiring deletion shall be marked out with red ink.
  5. Drawings that are redlined electronically shall be redlined as follows, and entered as attachments to the FCR:
  6. All items being changed (added or deleted) shall be outlined in a cloud format.
  7. New items shall be added in green.
  8. Existing items requiring deletion shall be marked out with red
  9. Redlined drawings shall be processed using the FCR process.
  
- b. When documents in the FCMS require a proposed change changes may be: manually redlined, scanned, and attached to the FCR, or have annotated changes made in PDF or in MS Word with change tracking "on" to clearly show all changes made to the revision under CM. The CCC shall print new Working Master copies and deliver them to the facility.
  
- c. The CCC shall print new Working Master copies and deliver them to the facility.

### 2.8.3 Working Masters at facilities:

- a. For each CCI in FCMS, the facility shall be provided a current revision print copy marked "Working Master" in red ink.
- b. Where there are CCI's that affect more than one facility, each of the affected facilities (and / or systems) shall be listed on the CCI sticker applied to the drawings.
- c. Only set of Working Masters shall exist at first facilities (and / or systems) listed on the CCI as to location of the WORKING MASTER. The second facilities (and /or systems), will maintain duplicates, stamped "WORKING MASTER COPY".
- d. Where there are CCI's that affect more than one facility, the Facility Coordinator shall ensure all affected facilities (and/or systems) designated

on a WORKING MASTER are notified prior to an FCR being initiated to the as built configuration.

- e. To preclude any adverse impact of changing a drawing with multiple labs or Effort Codes, the FCM Owner shall ensure that a FCR has been approved before any physical modifications to the facility.
- f. Adherence to the following additional guidelines promotes accountability and accuracy in the use of Working Master CCIs:
- g. A Working Master drawing is the single authoritative source which always reflect the true “as-built” configuration of the facility it represents.
- h. A Working Master shall not be redlined with proposed changes. A separate copy of the affected drawing or document, shall be redlined to be included with the FCR.
- i. Proposed changes shall be executed once the affected Working Master CCIs (and copies if applicable) have been updated and delivered to the facility by the CCC. (drawings and documents).
- j. The NASA PM or TPOC for construction project (ref LMS-OP-5686) on Center shall enter a conceptual FCR containing all 100% design completed CCIs. The NASA PM or TPOC shall utilize the construction standard for the applicable contract to manage version control of project Working Masters.
- k. Upon completion of a facility project (post ORR), the CCC shall provide clean Working Masters or copies to the facility as part of project closeout.

#### 2.8.4 Working Master changes (redlines):

- a. For permanent changes (para 2.6.2) discovered which reflect “as-built” configurations such as from field verifications, validations or audits, use the following guidance to redline affected Working Master CCIs (drawings and documents).
  - 1. Only the FCM owner team shall make redline entries to Working Masters.
  - 2. Accomplish redline mark ups using red strike throughs to indicate a removal and black or green to indicate additions. Cloud the area(s) on drawing(s) or documents to identify the change(s).
  - 3. Create an Urgent FCR in FCMS.
  - 4. Enter the date, the FCR number corresponding to the redline change(s). Include a short description.
  - 5. Each clouded area shall be keyed to a redline entry in the revision drawing box by FCR number.
  - 6. FCRs relating to permanent as-built changes shall be completed by the FCM owner team immediately and forwarded for update in FCMS.

7. As part of the FCR close out process, the CCC shall print and deliver updated materials (documents or drawings).
  8. The FCM owner team shall ensure the new Working Masters are annotated with any subsequent redlines which were not captured in the last update.
- b. For temporary changes (para 2.6.2) to Working Masters that will revert back to the current revision of a CCI:
1. Prior to any physical changes, the FCM Owner Team will ensure all requisite analysis and approvals required in support of the temporary change are completed.
  2. Only the FCM owner team shall make redline entries to Working Masters.
  3. Accomplish reline mark ups using red strike throughs to indicate a removal and black or green to indicate additions. Cloud the area(s) on drawing(s) or documents to identify the change(s).
  4. Create an Urgent FCR in FCMS. Identify the temporary condition. Attach requisite analysis and approvals required in support of the temporary change to the FCR.
  5. Enter the date, the FCR number corresponding to the redline change(s). Include a short description of the temporary condition in the drawing revision block.
  6. Each clouded area shall be keyed to a redline entry in the revision drawing box by FCR number.
  7. An FCR for a temporary change will remain in the FCM Owner queue until the temporary change or condition is no longer present.
  8. The FCM Owner Team shall forward FCRs for closure once the temporary changes are no longer present and the system is restored to its previous configuration.
  9. As part of the FCR close out process, the CCC shall print and deliver clean Working Masters.
  10. The FCM owner team shall ensure the new Working Masters contain the same revision number(s) since there was no intent to make permanent changes.

#### 2.8.5 Working Masters storage, organization and retrieval.

- a. All facility CCI Working Master documents shall be controlled separately from other materials used by the facility.
- b. CCI Working Masters shall be organized and labeled for easy retrieval.
- c. Per LPR 1740.2, A note in the facility resume shall indicate the location of the



Working Master within the facility.

- d. Copies of Working Masters are located at facilities when the affected physical equipment resides at a separate facility. Copies of Working Masters are stamped "COPY" in red.

## **2.9 FCM AUDITS**

All facilities and systems shall have their FBL audited in accordance with LMS-CP-1741.2 on a recurring basis with all high-risk tier facilities annually, medium risk tier facilities every two years, and low risk tier facilities every three years. Results of the audits are presented at the next FCMCB and the overall performance of the FCM Program is presented once yearly to the Center Leadership Council, Executive Safety Council, or some other Center Director forum.

- 2.9.1 The CCC Auditor/Trainer shall issue LF-599 summarizing the audit results and delineating "action items".
  - a. LF-599 shall be distributed to the FCM owner team.
  - b. LF-599 shall be stored and tracked to completion in the FCMS.
- 2.9.2 Prior to (or as part of) the audit, the CCC Auditor/Trainer shall conduct training for the FCM Owner team on this LPR, and associated FCM Program LMS documents, and the FCMS.

## **2.10 FCM CONTROL BOARD (FCMCB)**

The FCMCB provides oversight for the FCM Program as detailed in the Charter (ref Attachment X).

- 2.10.1 The purpose of the FCM Control Board (FCMCB) is to:
  - a. Evaluate the overall health of the FCM Program and assign actions or propose changes to LMS documents, software, training, and other elements of the program to address problems or increase effectiveness of the system.
  - b. Resolve disputes on CCIs determinations, FCR prioritization, and other interpretations of this LPR or governing documents between the FCM Program Manager and Owners.
- 2.10.2 The FCMCB shall meet as a minimum quarterly or as needed if required.
- 2.10.3 The FCMCB shall review information prior to an annual presentation to the ESC.

## **END OF CHAPTER TWO**

## **CHAPTER 3.0 – HIGH ENERGY SYSTEMS CONFIGURATION MANAGEMENT**

### **3.1 PRESSURE SYSTEMS CONFIGURATION MANAGEMENT (PSCM) PROGRAM SUMMARY**

- 3.1.1 As part of LaRC's Pressure Systems Recertification Program, a Pressure Systems Document (PSD), Inspection Plans (IPs) and Weld Maps (if applicable) are developed for ground-based high-pressure systems. For additional information about the Pressure Systems Recertification Program, refer to LPR 1710.42, "Safety Program for Recertification and Maintenance of Ground-Based Pressure Vessels and Piping Systems." The Pressure Systems Configuration Management (PSCM) Program maintains the configuration control of all PSDs, IPs, and Weld Maps using the FCR process per LMS-OP-4710.
- 3.1.2 Any change, whether administrative in nature or not, to a high-pressure system covered by LaRC's Recertification Program shall be documented using the FCR process per LMS-CP-4710.
- 3.1.3 After a change has been approved and the work has been completed, all affected documentation shall be field verified and updated in FCMS.
- 3.1.4 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 CCI via an FCR.

### **3.2 HV ELECTRICAL SYSTEMS CONFIGURATION MANAGEMENT PROGRAM SUMMARY**

- 3.2.1 As part of LaRC's Electrical Systems Safety Program (LPR 1710.6), high and medium voltage switching diagrams are developed for the Center's electrical utility distribution system. HV Switching diagrams shall be identified as Effort Code 300 and HV manhole drawings Effort Code 302 with a complete set of Working Masters maintained at the Stratton Substation Bldg. Any redlines shall be reviewed by the Standard Practice Engineer (SPE) for Electrical and the FSH prior to incorporation into the CCI via an FCR.
- 3.2.2 Other high-risk facilities classified as Tier 1 having high or medium electrical voltage devices shall maintain a set of Working Masters used in the day to day operations of a facility.
- 3.2.3 Any permanent changes (to include additions and removals) affecting the as built or field conditions for the electrical utility distribution system shall be captured using the FCR process per the current version of LMS-CP-4710.

- 3.2.4 After an FCR has been approved, all affected documentation shall be updated in FCMS and clean Working Masters shall be provided to the facility by the CCC (see the current version of LMS CP-4710, FCR process).
- 3.2.5 Any temporary changes (to include additions and removals) affecting the as built or field conditions of the electrical utility distribution system (effort code 30x series drawings) shall be annotated as a temporary or provisional redline on the applicable Working Master(s).
- 3.2.6 After an FCR has been approved, all affected documentation shall be updated in FCMS and clean Working Masters shall be provided to the facility by the CCC (see the current version of LMS CP-4710, FCR process).
- 3.2.7 Any discrepancies or updates that require a change to a CCI shall be appropriately redlined and routed for update through the FCR process.

### **END OF CHAPTER THREE**

## **CHAPTER 4.0 – FACILITY SOFTWARE ASSURANCE AND SOFTWARE CONFIGURATION MANAGEMENT**

### **4.1 GENERAL**

- 4.1.1 The use of automated control systems, programmable logic controllers (PLC), standalone controllers and other supported software systems by LaRC research facilities has established the need for configuration control of software.
- 4.1.2 This chapter outlines the requirements for the Software Configuration Management (SCM), Software Assurance Classification, and Computer Inventory programs at LaRC research facilities.
- 4.1.3 This chapter applies to software that resides in hardware (including firmware) and computer systems used in facility operations including PLCs, loop controllers, Facility Automation Systems (FAS), Data Acquisition Systems (DAS), and other facility support systems.
- 4.1.4 The requirements in this chapter apply to High-Risk facilities utilizing safety- critical software. The requirements are recommended for all other facilities.

### **4.2 PROGRAM OVERVIEW**

#### **4.2.1 Software Assurance Classification**

- a. Each research facility using an automated control system with the capability to perform safety-critical functions shall develop a Software Assurance Classification Report (SACR). The report identifies software safety-critical functions prior to and during implementation.
- b. The SACR shall be developed in accordance with NASA-STD-8739.8 and placed under configuration control in FCMS.
- c. If a tier 1 facility does not have a SACR, one is not required until new software is developed/acquired; however, if a facility does not have a process to classify safety-critical systems, a SACR shall be developed as soon as reasonable.

#### **4.2.2 SACR Preparation**

- a. The FCM Owner team shall be responsible for the preparation of a SACR. The SACR may be prepared by the FCM Owner Team, or as delegated.
- b. FCM Owner team shall support this effort on an as-required basis.
- c. Any SACR prepared by a support contractor shall be reviewed and approved by the SMAO Facility Software Safety Engineer (FSWSE).
- d. The approach taken is reflected in Figure 4-1 “SACR Preparation Sequence”.

#### **4.2.3 SACR Phases**

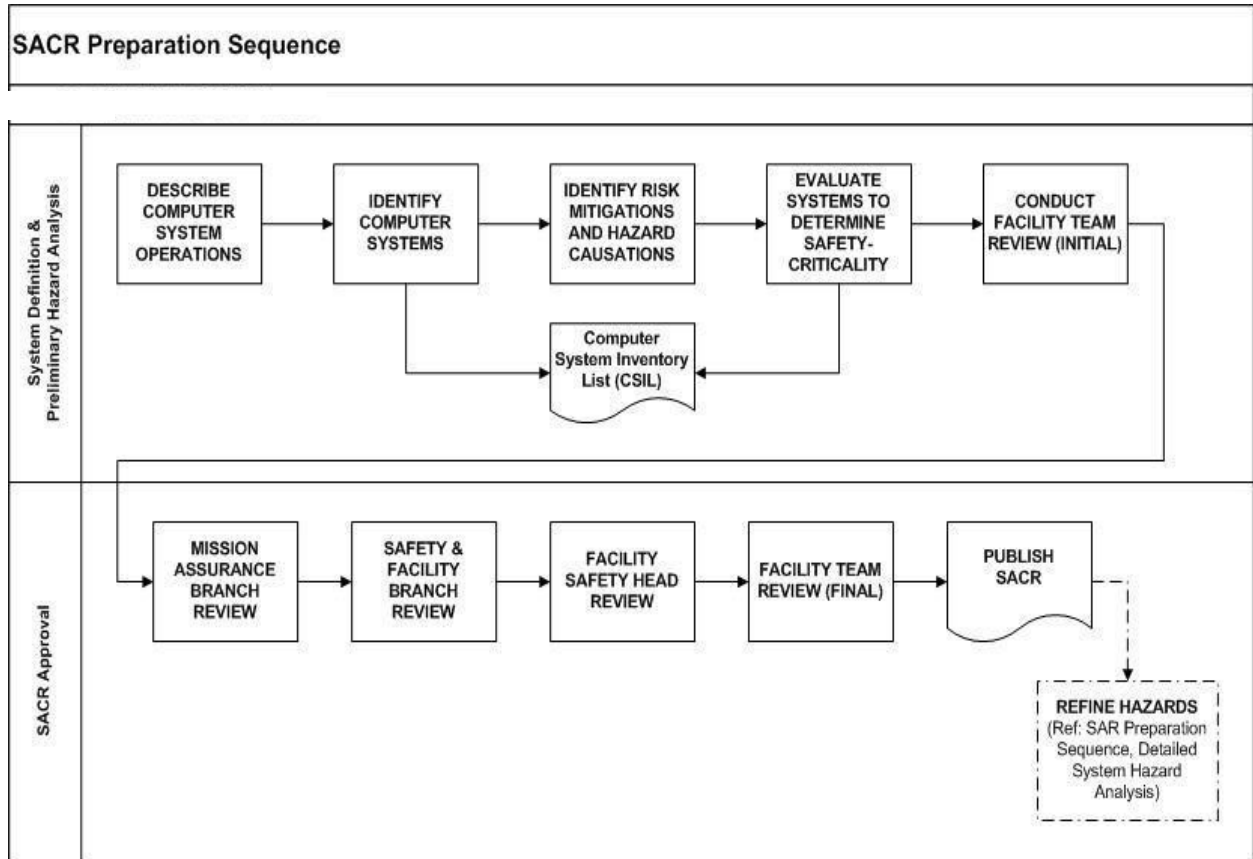
- a. Describe computer systems operation, identify computer systems and subsystems, compile inventory of computer systems (reference section 4.2.8 Computer System Inventory), evaluate computer systems to determine their safety criticality, and identify software risk mitigations and software hazard causations.
- b. Determine software safety criticality using the criteria as specified in the NASA Software Assurance and Software Safety Standard (reference NASA- STD-8739.8 §4.2).
- c. At this point, the SACR is ready for an FSH Review. The SFAB/SMAO FSWSE conducts a thorough and independent review of the SACR.
- d. Once the SFAB/SMAO FSWSE agrees that the SACR is complete, a Final Facility Team Review is conducted. During this phase, the remaining members of the Facility Team review the SACR.
- e. Finally, the SACR is published. After all the issues are resolved and the SACR is prepared in final format, it shall be formally approved by the Mission Assurance Branch, Safety Manager, and FCM Owner team. Finally, it shall be incorporated into the FCMS.

#### 4.2.4 SACR Organization

- a. The SACR is divided into sections; Introduction, Project Background/Function Description, Reference Documents, Software Classification, Software Safety Determination, Software Assurance Effort, and Appendices.
- b. The SACR can be further subdivided into subsections such as Hazard Analysis and Software Configuration Management common to all facilities although, on a case-by-case basis, additional special-item subsections (e.g., Computer System Inventory List) can be added.

#### 4.2.5 SACR Changes and Distribution

- a. The SACR is reviewed and updated on an as-needed basis as in the case when an electromechanical device is replaced with a PLC.
- b. Since SACRs are CCIs, they shall be changed and distributed in accordance with the requirements set forth in Chapter 2 of this document.



LPR 7123.2A-4

**FIGURE 4-1 - SACR PREPARATION SEQUENCE**

4.2.6 Software Configuration Management

- a. The configuration control of software products is performed per a Software Configuration Management Plan (SCMP). The SCMP may be facility-specific or may be general with facility-specific elements.
- b. Each research facility shall develop a SCMP.
- c. When a facility employs a system that includes software that performs safety functions (e.g., correct valve sequencing, shutdown the facility in an over-temperature condition), the SCMP shall define a process to identify and review changes that directly affect safety-critical software prior to implementation and during operation and maintenance.
- d. All changes and modifications made to safety-critical requirements, design, code, systems, equipment, test plans, procedures, simulators, models, test suites, shall be evaluated per the SCMP.
- e. The SCMP shall be developed in accordance with LPR 7150.2 depending

on the software class.

- f. All changes to the baseline safety critical software shall be verified and validated through the SCMP.
- g. Commencing at the ORR, software changes that might affect facility safety and / or a SAR Undesired Event hazard control (e.g., interlocks, valve sequencing) shall be subjected to a review by the FCM Owner team, a SFAB FSSE/FSWSE, and the SPE for Facility Automation Systems.
- h. Additional measures shall be taken when applicable to identify and review changes that directly affect safety prior to implementation, such as:
  - 1. Evaluate hazards for software's contribution (cause, control, etc.).
  - 2. Conduct software safety analyses; coordinate with the system safety analyses.
  - 3. Create software safety requirements.
  - 4. Analyze and report software safety non-conformances to appropriate personnel.
  - 5. Review system hazard analyses for changes that impact the software subsystem.
  - 6. Inform system safety personnel of changes in safety-critical software.
- i. The SCMP shall be placed under configuration control in the FCMS.  
 Note: Some facilities have a facility SCMP which refers to the LaRC FAS Software Configuration Management Plan located on the Virtual Library. The facility SCMP contains facility-specific content and provides link to the LaRC FAS SCMP. These documents are not CCIs and are not required to be contained in the FCMS.  
 Software changes affecting CCI documents (e.g., SAR, SACR) shall be updated as required. The Facility Software Configuration Manager (FSCM) shall initiate the FCR.
- j. If the FSCM has any question about the safety impact of a change, the FSH, a FSE, or a SFAB FSSE/FSWSE shall be consulted.
- k. The FSCM shall be identified in the SCMP.
- l. A new SCMP shall be developed if the existing SCMP does not clearly define a process to review changes that impact safety.
- m. The SCMP is reviewed and updated on an as-needed basis (e.g., changes to NASA or Center processes or procedures for managing safety-critical software, new software is developed and/or acquired).

#### 4.2.7 SCMP Preparation

- a. The FCM Owner is responsible for the preparation and

maintenance of the SCMP but may delegate this duty. The actual preparation may be performed by either the Facility Systems Engineer (FSE) or a FSE from a support contractor.

- b. Any SCMP shall be reviewed and approved by the FCM Owner team, Safety Manager, and SFAB FSWSE.

#### 4.2.8 Computer System Inventory List

- a. Each research facility utilizing safety-critical software systems shall maintain a Computer System Inventory List (CSIL).
- b. The CSIL shall contain an inventory of software that resides in hardware (including firmware) and computer systems used in the facility operations including PLCs, loop controllers, Facility Automation Systems (FAS), Data Acquisition Systems (DAS), and other facility support systems.

**NOTE:** How computer systems and software systems (e.g., software applications) are identified in any given facility will depend on a number of factors including the software development methodology(s) used. Especially for computer systems, each facility might have very unique naming and identification conventions. Whatever identification schema is used, it should facilitate the tracing of safety-critical software between the SACR and the SAR.

- c. For each computer system listed in the CSIL, the computer identifier, the computer model, the configuration control documentation (e.g., drawings), and the software systems (e.g., the application software) shall be identified.
- d. If the required CSIL information is not maintained under FCMS control, it shall be maintained in an appropriate and controlled environment (e.g., COD Virtual Library).
- e. The CSIL shall be reviewed annually and updated as needed (e.g., new software is developed and/or acquired).

#### 4.2.9 CSIL Preparation

- a. The Facility Safety Head shall appoint a Facility Systems Engineer to be responsible for the preparation and maintenance of the CSIL. The actual preparation is performed by either the FSE or a FSE from a support contractor.
- b. Any CSIL shall be reviewed by the SFAB FSWSE.

## END OF CHAPTER FOUR



## APPENDICES

### APPENDIX A. DEFINITIONS

**Bill-of Materials (BoM)** – list of parts of an assembly with materials of construction identified, usually part of an assembly drawing. This might be a CCI for high risk components such as a model injection or support system, a tunnel drive shaft, or an oxygen valve.

**Building Information Model (BIM)** – 3-D model of a building or system with embedded data and analysis tools. Embedded data often includes 2-D construction drawings of the building or system, O&M manuals, materials of construction, commissioning data, etc.

**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 FCM Program.

**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 FCR Form.

**Computer System** – A group of hardware components and associated software designed and assembled to perform a specific function or group of functions.

**Computer System Inventory List (CSIL)** – A CSIL is a listing of Computer Systems for the affected facility.

**Configuration Baseline List (CBL)** – A documented; field verified baseline for a facility to include systems with relevant Configuration Controlled Items.

**Configuration Controlled Item (CCI)** – CBL item considered important to describing how a facility is configured, how it is to be operated, and what risks are associated with its operation. As such, CCIs are revised only through a formal change process under the FCM Program. Examples of CCIs include, but are not limited to, Safety Analysis Reports (SARs), Software Assurance Classification Reports (SACRs), SOPs and checklists, certain Pressure System Documents (PSDs), certain Building Information Models (BIM,) Electrical Transient Analyzer Program (ETAP) Model, Emergency Cutoff Procedure (ECP), Interlock List, Facility Risk Tier (FRT) Designation Form and selected engineering drawings.

**Configuration Control Center (CCC)** – Centralized staff within Center Operations Directorate (COD) that manages the FCMS content, FCR process and audits at LaRC. The staff includes the CCC Lead, the trainer/auditor, 2-D, 3-D drafters, technical writer, and FCMS repository administrator.

**Configuration Management (CM)** – A discipline that establishes a baseline for facilities, selects technical and administrative documents or models (e.g., BIM, ETAP, Pro-E), and exercises administrative control of all approved changes to that baseline.

**Configuration Management Online** – (CMOL) The online drawing content management system preceding FCMS

**Content:** Any materials maintained within the FCMS such as drawings, documents sketches, schematics or other facility or project related information in a digital format.

**Critical Component Assembly and Bill of Materials Drawings** – Used for conducting troubleshooting, maintenance, modifications, and determining material compatibility.

**Device List** – List of all components required to run a test facility and used for troubleshooting by linking the component to the drawing number.

**Effort Code (EC)** – A legacy identification number that identifies a specific facility or group of facilities in the Facility CM Program. For active facilities with an EC this may be used to find that facilities CCI and SFDs. New facilities will be identified by their real property designation and further subdivided with Laboratory space designations.

**Electrical Transient Analyzer Program (ETAP)** – Model of the electrical distribution system switching diagrams and low voltage systems which allows for protective device coordination and arc flash analysis.

**Emergency Cutoff Procedure (ECP)** – Operating procedures used to isolate utility systems from the facility/building in the event of a failure.

**Facility Configuration Management Control Board (FCMCB)** – Board chaired by the COD Chief Engineer and including FCM points of contact from all directorates that own LaRC facilities (COD, RD, ED, SD, RSD, SMAO.) The board meets quarterly to resolve disputes between FCM owners and the FCM Program Manager as well as review status on the health of the FCM program.

**Facility Configuration Management (FCM) Disciplines** – distinct FCM activities that store and update their own unique Configuration Controlled Items (CCIs) using their own systems, procedures, and personnel.

These disciplines are Pressure Systems Configuration Management (PSCM), Electrical Systems Configuration Management, Software Configuration Management, Computerized Maintenance Management System (CMMS, i.e., Maximo), and Geographic Information Systems (GIS).

The Configuration Control Center (CCC) will advise these disciplines via the Facility Configuration Management System (FCMS) when a Facility Change Request is likely to

require their CCIs to be updated and obtain their comment and/or approval on FCRs. The FCM disciplines that need to update their CCIs as a result of an FCR will notify the CCC via FCMS when their CCI has been updated.

**Facility Configuration Management Owner** – Individual who defines the FBL for an assigned facility, building, or system; sets priority for FCR processing in coordination with FCM Program Manager; is accountable for audit corrective actions; approves all baseline changes; may initiate FCRs; and is designated by their Organizational Director LAPD per 1700.4-2.

**Facility Configuration Management Owner Team** – Group of facility personnel that collectively provide FCM program oversight at the facility level. All facilities require a FC, FSH, and FCM owner. Depending on the tier assessment a facility may require additional assignments such as

**Facility Configuration Management (FCM) Representative** – Personnel supporting the LaRC Facility CM Program.

**Facility Configuration Management System (FCMS)** – The on-line system which enables access and configuration control of facility documents, drawings and other electronic data.

**Facility Change Request (FCR)** – Langley Form 605, “Facility Change Request,” prepared by LaRC FCM Owner, FC, FSH, FSE, PM, or TPOC and processed by the Configuration Control Center (CCC.) The FCR is processed electronically via the FCMS. It is used in the LaRC FCM Program to request approval of and record all changes in the affected facility and to its supporting CCIs and integrated FCM disciplines (PSCM, CMMS, GIS, FSCM).

**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 Tier (FRT)** – An overall assessment of the facility risk using both safety and mission risk levels used to determine the types of CCIs required for a facility to adequately mitigate these risks.

**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 CCIs affecting the facility.

**Facility Software Configuration Manager (FSCM)** – A representative of the facility that supports the SCM activity for a particular facility.

**Facility 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. Electrical Distribution System, Compressor Station, Steam System, National Transonic Facility, 8’ High

Temperature Tunnel, and Transonic Dynamics Tunnel have FSEs assigned.

**Facility Software Safety Engineer (FSWSE)** – A representative of SFAB, SMAO, or a support contractor who participates in the development of the initial Facility System Safety Analysis, and/or an upgrade of an existing one, and supports the SCM activity for a particular 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.

**Facility Team** – Personnel assigned to establish and prepare the Configuration Controlled Items (CCIs) for a LaRC facility during the initial Systems Safety Analysis or any subsequent upgrade effort. The team is composed of the FSH, FC, SFAB FSSE, and SFAB FSWSE assigned to the System Safety effort and the Facility Configuration Management (FCM) Representative.

**Field Verified (or Functional Verification)** – The process by which the accuracy of a CCI 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 Functionally Verified relating to electrical work refer to LPR 1710.6, "Electrical Safety," definition.

**Geographic Information System (GIS)** – System designed to capture, store, manipulate, analyze, manage, and present spatial or geographic data.

**Hazard** – A condition that has the potential to result in injury, death, loss of major equipment, or damage to the environment.

**Interlock List** – All software, mechanical, and electrical interlocks to run a facility used for SOP development /modification/troubleshooting/interlock verification.

**Level 1 Drawings** – Drawings required to develop the SAR (or hazard analysis), checklists, lockout tagout procedures, and the SOPs. These are system level schematic drawings such as Piping & Instrumentation Diagrams (P&IDs) one-line power distribution drawings, or control loop diagrams.

**Level 2 Drawings** – Subsystem drawings needed to troubleshoot and repair or maintain a system but not needed for day-to-day operation. These can also be thought of a 2nd level on a drawing tree below the Level 1 (or system) drawings.

**Mission Critical Systems List** – Defines systems required to run test facility that have

low or no safety impact but need to be documented with CCIs to mitigate mission risks such as missed milestones.

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

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

**Redline or 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.

**Research Facility (Facility)** – 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 FCM Program that documents the formal Facility System Safety Analysis of a particular facility.

**Safety-Critical** – Essential to safe performance or operation ref LPR 1740.4.

**Safety-Critical Item** – A safety-critical system, subsystem, condition, event, operation, or process that if not implemented or fails to perform as expected poses an unacceptable level of risk such as RAC 1 to equipment and or personnel.

**Safety-Critical Items List** – A listing of safety-critical items for the affected facility.

**Safety-Critical Software** – Safety-Critical Software - Software is classified as safety-critical, if it meets at least one of the following criteria: a. Causes or contributes to a system hazardous condition/event, b. Provides control or mitigation for a system hazardous condition/event, c. Controls safety-critical functions, d. Mitigates damage if a hazardous condition/event occurs, e. Detects, reports, and takes corrective action, if the system reaches a potentially hazardous state. References: NASA-STD-8739.8, Software Assurance and Software Safety Standard, §4.2; NASA-GB-8719.13 NASA Software Safety Guidebook, §2.1.3 What is Safety-Critical Software?

**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.

**Software** – “Software is defined as the computer programs, procedures, scripts, rules, and associated documentation and data pertaining to the development and operation of a computer system. Software includes programs and data. This definition includes commercial-off-the-shelf (COTS) software, government-off-the-shelf (GOTS) software,

modified-off-the-shelf (MOTS) software, reused software, auto generated code, embedded software, firmware, and open-source software components.”, NPR 7150.2 NASA Software Engineering Requirements, Appendix A.

**Software Assurance Classification Report (SACR)** – A report under the control of the CM Program that documents the formal Software Assurance Classification of a particular research system or facility.

**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 FCM Program.

**Standard Practice Engineer (SPE) for Pressure Systems** – The Pressure Systems SPE serves as the Center expert and final authority on the application of national consensus standards and LaRC requirements concerning ground-based pressure systems. He/she is responsible for reviewing all new designs and all plans for modifications or repairs to LaRC pressure systems.

**Supporting Facility Documents (SFDs)** – Those documents identified on the SFD list that are useful reference drawings, documents, or models, but that do not meet the criteria for CCIs. Examples include previous revisions, obsolete drawings/models, and previous construction/renovation drawings.

**Working Master**– A print version of the latest-revision CCIs (SARs, SACRs, SOPs, drawings, and so forth), which are stamped “Working Master” in red and kept at the facility. A Working Master may contain redline(s) that reflect as built conditions not captured in FCMS.

**Work Package** - All new and revised CCI and SFD drawings, documents (SOP, CL, Device List, SAR, SACR, CIL, ECPs, or other items that define the change to be approved on the FCR

## APPENDIX B. ACRONYMS

|       |                                            |
|-------|--------------------------------------------|
| 2D    | Two dimensional                            |
| 3D    | Three dimensional                          |
| BIM   | Building Information Model                 |
| BoM   | Bill of Materials                          |
| CBL   | Configuration Baseline List                |
| CCC   | Configuration Control Center               |
| CCI   | Configuration Controlled Item              |
| CDR   | Critical Design Review                     |
| CM    | Configuration Management                   |
| CMMS  | Computerized Maintenance Management System |
| CMOL  | Configuration Management On-Line           |
| COD   | Center Operations Directorate              |
| COTS  | Commercial-Off-the Shelf                   |
| CP    | Center Procedure                           |
| CSIL  | Computer System Inventory List             |
| DAS   | Data Acquisition System                    |
| DL    | Device List                                |
| EC    | Effort Code                                |
| ECP   | Emergency Cutoff Procedure                 |
| EDF   | Engineering Drawing Files                  |
| ESC   | Executive Safety Council                   |
| ETAP  | Electrical Transient Analyzer Program      |
| FC    | Facility Coordinator                       |
| FCM   | Facility Configuration Management          |
| FCMCB | FCM Control Board                          |
| FCMS  | FCM System                                 |
| FCR   | Facility Change Request                    |
| FM    | Facility Manager                           |
| FRT   | Facility Risk Tier                         |
| FSCM  | Facility Software Configuration Manager    |

|       |                                           |
|-------|-------------------------------------------|
| FSE   | Facility Systems Engineer                 |
| FSH   | Facility Safety Head                      |
| FSSA  | Facility Systems Safety Analysis          |
| FSSE  | Facility System Safety Engineer           |
| FSWSE | Facility Software Safety Engineer         |
| FV    | Field Verified                            |
| GIS   | Geographic Information System             |
| GOTS  | Government-Off-the-Shelf                  |
| HA    | Hazard Analysis                           |
| HV    | High Voltage (Electrical >600v)           |
| ISR   | Integrated System Review                  |
| LAPD  | Langley Policy Directives                 |
| LaRC  | Langley Research Center                   |
| LF    | Langley Form                              |
| LMS   | Langley Management System                 |
| LN2   | Liquid Nitrogen                           |
| LPR   | Langley Procedure Requirement             |
| MCSL  | Mission Critical Systems List             |
| NPR   | NASA Procedural Requirement               |
| OP    | Operational Procedure                     |
| ORR   | Operational Readiness Review              |
| PDR   | Preliminary Design Review                 |
| PHA   | Preliminary Hazard Analysis               |
| PLC   | Programmable Logic Controller             |
| PM    | Project Manager                           |
| PSCM  | Pressure Systems Configuration Management |
| PSD   | Pressure Systems Document                 |
| SA    | Software Assurance                        |
| SACR  | Software Assurance Classification Report  |
| SAR   | Safety Analysis Report                    |
| SCM   | Software Configuration Management         |
| SCMP  | Software Configuration Management Plan    |
| SFAB  | Safety and Facility Assurance Branch      |



|      |                                     |
|------|-------------------------------------|
| SFD  | Supporting Facility Document        |
| SMAO | Safety and Mission Assurance Office |
| SPE  | Standard Practice Engineer          |
| SOP  | Standard Operating Procedure        |
| TPOC | Technical Point of Contact          |

## **APPENDIX C. RECORDS**

C.1 All Federal employees are required by law and Agency policy to maintain and preserve certain records. Documents listed in C.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) 1440.6, NASA Records Management.

C.2 The following FCMS content types are records:

- a. CCI (Configuration Controlled Items)
- b. SFD (Supporting Facility Documents)
- c. Archived LaRC Real Property or research project related materials.

## APPENDIX D. EFFORT CODES

**TABLE D.1 -ASSIGNED ACTIVE LEGACY EFFORT CODES  
(ECS) RETAINED IN THE REVISED FCM PROGRAM**

| Effort Code | Facility Number | Facility Name                                                     |
|-------------|-----------------|-------------------------------------------------------------------|
| 00          | ---             | All or Multiple Facilities                                        |
| 01          | 890-30          | High Pressure Air System (includes B1247E)                        |
| 03          | 1265            | 8-Foot High Temperature Tunnel                                    |
| 04          | 1267            | Component Verification Facility                                   |
| 05          | 1247D           | Hypersonic Blowdown Tunnels &<br>20-Inch Supersonic Wind Tunnel   |
| 05-01       | 1247D           | 20-inch Mach 6 Tunnel                                             |
| 05-07       | 1247D           | Supersonic Low Disturbance Tunnel                                 |
| 05-08       | 1247D           | High Pressure Air Vacuum Systems                                  |
| 05-09       | 1247D           | 20-inch Supersonic Wind Tunnel                                    |
| 05-10       | 1247D           | Probe Calibration Tunnel                                          |
| 05-11       | 1247D           | Grazing Flow Impedance Tube                                       |
| 05-12       | 1247D           | Curved Duct Test Rig                                              |
| 05-13       | 1247D           | Dielectric Barrier Discharge (DBD) Plasma Actuator Test Apparatus |
| 14          | 1241            | Drive Control Facility                                            |
| 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                                      |
| 22          | 1208            | Acoustics Research Laboratory                                     |
| 23          | 1148            | Structures and Materials Laboratory                               |
| 24          | 1251            | Unitary Wind Tunnel                                               |
| 25          | 1247B           | Arc-Heated Scramjet Test Facility                                 |
| 29          | 1262            | Aircraft Landing Dynamics Facility                                |
| 33          | 1297            | Landing and Impact Research Facility                              |
| 34          | 1242            | 0.3m Transonic Cryogenic Tunnel                                   |

|     |        |                                                                                 |
|-----|--------|---------------------------------------------------------------------------------|
| 36  | 1221A  | Jet Noise Laboratory                                                            |
| 50  | 1295   | Vacuum Sphere Control & 60' Space Simulator                                     |
| 53  | 1268A  | Test Evaluation Simulator                                                       |
| 54  | 1268A  | Development and Test Simulator                                                  |
| 55  | 1268D  | Cockpit Motion Facility                                                         |
| 61  | 644    | Twelve Foot Low Speed Tunnel                                                    |
| 62  | 645    | 20-Foot Vertical Spin Tunnel                                                    |
| 66  | 1268A  | Differential Maneuvering Simulator                                              |
| 71  | 1221D  | Vitiated Heater, Test Cell No. 2                                                |
| 72  | 1221C  | Isolator Dynamics Research Lab                                                  |
| 80  | 1221C  | Combustion Heated Scramjet Test Facility, Test Cell No. 1                       |
| 84  | 1244   | Hangar Complex                                                                  |
| 85  | 1232A  | Hevi-Duty Brazing Vacuum Furnace (HDBVF)                                        |
| 86  | 1293B  | 16-Meter Thermal Vacuum Chamber                                                 |
| 90  | 1267A  | CNT, BNNT, & Autoclaves                                                         |
| 91  | 1238B  | Composite Shop Autoclave                                                        |
| 97  | 1293A  | Space Structures Research Laboratory                                            |
| 98  | 822-10 | West Area Heating Plant and Steam Distribution<br>(includes B1215, 1206A, 1154) |
| 99  | 1236   | National Transonic Facility (NTF)                                               |
| 100 | 1241   | NTF LN2 Plant                                                                   |
| 102 | 1205   | Materials Research Laboratory                                                   |
| 103 | 1220   | Information Systems Research Facility                                           |
| 104 | 1225   | Advanced Development Lab                                                        |
| 105 | 1230A  | Gas Calibration Lab                                                             |
| 110 | 1250   | Engineering Directorate Systems Integration and<br>Test Branch                  |
| 300 | 812-30 | Switching Diagrams                                                              |
| 301 | 812-30 | Manhole Drawings                                                                |
| 302 | 812-30 | Electrical Panel Boards                                                         |
| 303 | 812-30 | Major Electrical Substations                                                    |
| 501 | ---    | Utility Metering Drawings                                                       |

## APPENDIX E. LaRC LOCATION ID

### E.1 GENERAL

This Appendix describes a location identification system for equipment in LaRC facilities. The purpose of this system is to provide a location identification number for equipment for use 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 the "LaRC Location ID," also referred to as "LaRC ID" in this document.

In all cases the LaRC ID uniquely identifies a piece of equipment wherever it may be located.

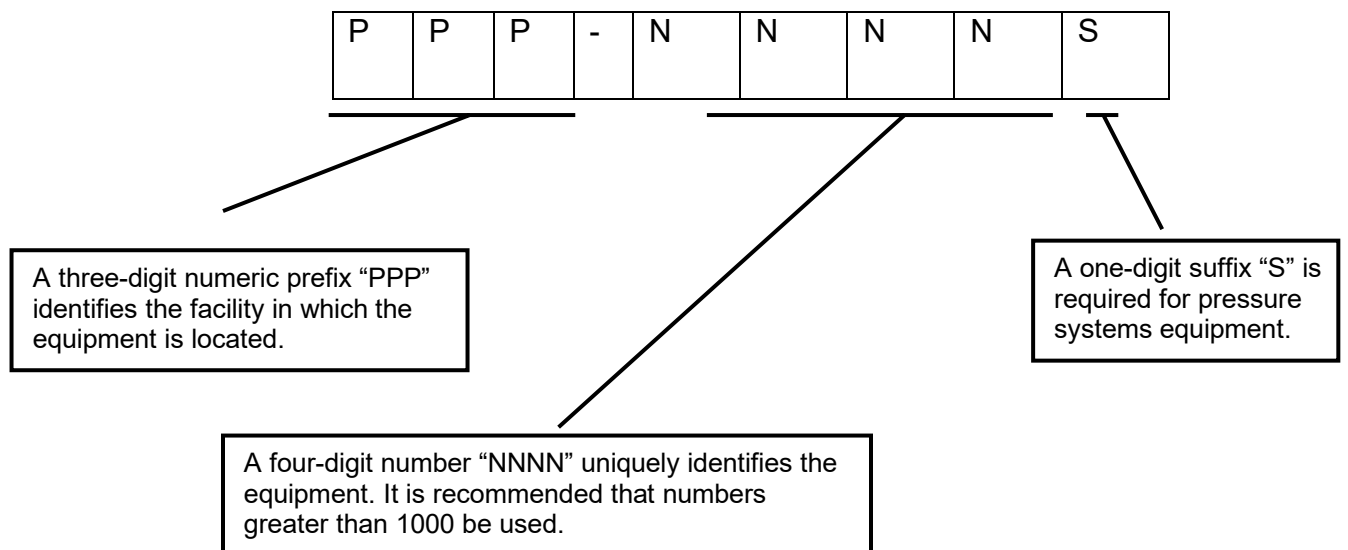
The LaRC ID and asset numbers are two different identifiers. The LaRC ID is generated and maintained in the LaRC ID Registry application hosted within the GIS environment and is used in FCMS documents and drawings as unique device numbers. Asset numbers are generated in the CMMS (IBM Maximo) application and have LaRC IDs as an attribute. Asset numbers shall not be used to reference devices in CCIs.

1. All equipment shown on a CCI drawing or any asset in the CMMS shall have a LaRC ID assigned.
2. The web based LaRC ID Registry tool used to provide the next available LaRC ID for a given facility is accessed at the weblink: <https://gis-dbweb.LaRC.nasa.gov/ords/apex/f?p=LARCID>
  - a. This application is the single official database for LaRC IDs and is used to sustain the location hierarchy for the equipment as well as provide new, unique numbers to facility and project personnel. All equipment within a building must contain the correct building prefix to allow for correct mapping of LaRC ID locations.
  - b. The LaRC ID Registry application is separate from the CMMS Change Request form. All CMMS LaRC IDs originate in the Registry. The Registry prevents the duplication of LaRC IDs.
  - c. The LaRC ID Registry shall assign LaRC IDs automatically to any new component submitted using a four-digit numerical suffix followed by an underscore unless the requestor defines a specific format. While the legacy format follows a suffix with four numbers and sometimes a letter, the current system capability allows for up to 25 characters to accommodate all possible scenarios.
  - d. If a new LaRC ID affects a CCI, FSH approval is required. This is an automated feature contained in the LaRC ID Registry.

## E.2 NUMBERING SCHEMES

There are three numbering schemes: Legacy, Mechanical and Process equipment, and Electrical.

1. Legacy numbering scheme: Non-redundant LaRC ID numbers on existing Configuration Controlled Drawings shall be retained unless changed per Facility Change Request. This includes numbers that are not consistent with the numbering schemes shown below.
  - a. Where the three-digit facility code (Table E-2) is not used on the CCI drawings it will be assumed based on the building or facility number designated on the drawings and will be appended to the equipment identifier on the CCI when entered into the CMMS or other databases such as FCMS and LaRC ID Registry.
  - b. Any legacy component location identifier string is acceptable up to 25 characters. Often the LaRC ID number on older drawings includes prefix letters identifying the type of equipment (e.g., “V” for valve, “PI” for pressure indicator, “F” for filter) and uses the same number for different components in the same region of the drawing.
  - c. Where repeat equipment identifiers (including the prefix) are found, then the repeated instances shall be changed to ensure uniqueness so that a LaRC ID represents a single function associated with a real property location (e.g., building or horizontal infrastructure system).
2. Mechanical and Process equipment: The LaRC location ID system for new locations typically uses eight (8) digits but can contain up to 25 characters. The required format for all new equipment “LaRC Location IDs”:



- a. The three-digit prefixes (PPP) identifying LaRC buildings are shown in Table E-2.
- b. The unique four-digit number (NNNN) is assigned by the equipment owner or his/her designated representative, or automatically by the LaRC ID Registry if not otherwise specified for new equipment per the LF-491 CMMS change form.

Thus, typical LaRC ID would be:067-0155 for an electrical breaker located in Building 1247E, or 040-3025N for a nitrogen system valve in Building 1221, or 144-2510 for a parking lot light.

- c. In some instances, a LaRC ID may not contain a dash after the three-digit prefix. Some electronic data systems and electronically searchable information may not display a dash. Legacy documents and equipment tags also may not include a dash after the three-digit prefix. In such cases a dash is understood to exist. For all LaRC IDs containing a three-digit prefix, the registry will record a dash after the three-digit prefix.
3. Electrical: The numbering scheme for electrical equipment must be in compliance with LPR 1710.6 paragraph 6.2.

### **E.3 APPLICABLE EQUIPMENT TYPES**

#### **1. Mechanical Systems**

- a. All mechanical components shown on a CCI schematic, or assembly diagram shall be assigned a LaRC ID. Examples of mechanical system components that shall have LaRC ID assigned:
  - Drive shaft bearings and couplings
  - Cranes
  - Model support and injection mechanism components
  - Air Handling Units
  - Cooling tower components
  - Blowers
  - Fans
  - Actuators

#### **2. Pressure Systems**

- a. All permanently installed pressure system equipment (or components) at LaRC shall have tags identifying the LaRC ID. These

would normally relate to Piping & Instrumentation Diagrams (P&IDs) but could also appear on control loop and electrical power and wiring diagrams. Reference “COD Facilities Engineering Standard for Piping Systems and Pressure Vessels, Appendix 3 “Requirements for Process and Instrumentation Diagrams (P&ID)”. Exceptions to LaRC ID numbering are as follows:

- Pipe spool pieces
- Pipe fittings (e.g., tees, elbows, reducers, instrumentation bosses)
- Caps
- Plugs

Examples of pressure system components that shall have LaRC ID assigned:

- Valves (all types including drains and checks)
  - Filters
  - Flowmeters
  - Pressure Vessels
  - Tanks
  - Instruments (all types – transducers, gages)
  - Flex hoses
  - Expansion Joints
  - Pumps
  - Motors
  - Heat Exchangers
  - Burst Disks
  - Vacuum Breakers
  - Flow control devices (orifices, cavitating venturis, etc.)
  - Flow Straighteners
  - Accumulators
- b. A complete LaRC ID is comprised of a three-digit building identifier prefix (see Table E-1), and a suffix (normally a four-digit number), determined by the facility. A single alpha character is added at the end is used as a media identifier suffix (e.g., 064- 3142J, 067-3412A, and 041-5484S from table E-1). Under no circumstances shall two pieces of equipment have the same number.
- c. The following list of suffixes shall be used as part of the pressure systems numbering system to identify the gas or liquid flowing through the equipment:



**TABLE E-1 - PRESSURE SYSTEMS SUFFIXES FOR LaRC IDS**

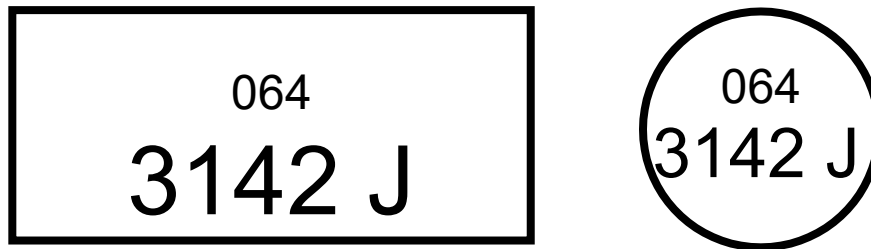
| SUFFIX          | FLOWING MEDIA                         |
|-----------------|---------------------------------------|
| A, B, C, D or E | Air                                   |
| F               | Fuels (except Hydrogen)               |
| G               | Poisonous, Toxic, or Corrosive fluids |
| H               | Hydrogen                              |
| J or K          | Helium                                |
| L, M, or N      | Nitrogen                              |
| P               | Hydraulic Fluids                      |
| Q               | Lubricating Oils                      |
| R               | Other Inert Fluids                    |
| S               | Steam                                 |
| T               | Condensate                            |
| U or W          | Water                                 |
| V               | Vacuum                                |
| X               | Oxygen, Oxidizers                     |
| Y               | Refrigerants (e.g., Freon®)           |
| Z               | Fluid Combinations                    |

**NOTE:** In Table E-1 the letter “Z” designates that more than a single fluid medium can be transported through the pressure system component.

3. Electrical Systems
  - a. All new drawings for electrical system equipment shall have LaRC IDs or “device numbers” assigned as a 4-digit number with the equipment prefix appropriate to the building, substation, or horizontal infrastructure in accordance with Table E-2. Refer to the “300-DL” device list for the equipment types with “assigned device numbers.”
  - b. Existing CCI drawing electrical equipment may use existing identification nomenclature with the equipment prefix appended per Table E-2. This conforms to the “Legacy Numbering Scheme” in E-2.1.

**E.4 LaRC Location ID EQUIPMENT TAGGING**

1. A LaRC location ID number tag shall be affixed to each piece of equipment and should appear similar to the following illustrations:



**FIGURE E-1 - SAMPLE LaRC ID TAGS**

2. LaRC ID new or replacement tags shall be made of a material compatible with the intended service and environment. For example, phenolic tags in the steam utility tunnels have been found to degrade rapidly and are therefore not compatible for that application.
3. It shall be the responsibility of the Facility Coordinator to take corrective action when duplicate numbers are identified. This shall be done through use of the LaRC ID Registry.
4. For new facilities, or the addition or modification to existing facilities, engineering design personnel shall estimate the total LaRC IDs required, and then request a block of numbers from the LaRC ID Registry. All drawings that will become CCI shall contain LaRC ID numbers for all devices.

### **E.5 IMPLEMENTING THE LaRC LOCATION ID SYSTEM**

It shall be the responsibility of the Facility Coordinator or the Project manager, depending on how a change is being executed to use the LaRC ID Registry to have unique LaRC IDs assigned to new equipment on CCIs.

**TABLE E-2 – LaRC ID  
PREFIXES**

| Building No. or Infrastructure Item | Prefix |
|-------------------------------------|--------|
| 641                                 | 010    |
| 642                                 | 021    |
| 644                                 | 015    |
| 645 & 645A                          | 014    |
| 647                                 | 012    |
| 648, 648A & 648B                    | 019    |
| 650                                 | 020    |
| 1101                                | 301    |
| 1122                                | 179    |
| 1146 & 1146 E                       | 022    |
| 1147                                | 082    |
| 1148                                | 023    |
| 1154 & 1154A                        | 083    |
| 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    |
| 1181                                | 180    |
| 1186                                | 176    |
| 1187                                | 181    |
| 1188                                | 173    |
| 1189                                | 174    |
| 1190                                | 170    |
| 1191                                | 172    |
| 1194/1194A                          | 030    |
| 1195, 1195A, 1195B, & 1195C         | 033    |
| 1196                                | 185    |
| 1197                                | 168    |
| 1198                                | 160    |

| Building No. or Infrastructure Item | Prefix |
|-------------------------------------|--------|
| 1199                                | 085    |
| 1200 & 1200A                        | 074    |
| 1201                                | 039    |
| 1202 & 1202A                        | 075    |
| 1205                                | 076    |
| 1206 & 1206A                        | 081    |
|                                     |        |
| 1208 & 1028A                        | 097    |
| 1209                                | 125    |
| 1211                                | 155    |
| 1212, 1212C                         | 043    |
| 1214                                | 165    |
| 1215                                | 041    |
| 1216                                | 169    |
| 1219                                | 037    |
| 1220                                | 049    |
| 1221, 1221A,B,C,D,E, & F            | 040    |
|                                     |        |
| 1222 & 1222B                        | 054    |
| 1225                                | 044    |
| 1227                                | 086    |
| 1228                                | 056    |
| 1230, 1230A & 1230B                 | 047    |
| 1232                                | 055    |
| 1232A                               | 053    |
| 1233                                | 034    |
| 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, 1244A, B, C & D               | 060    |
| 1245                                | 081    |
| 1246                                | 081    |
| 1247B & 1247H                       | 064    |
| 1247A, 1247C & 1247F                | 065    |

| Building No. or Infrastructure Item | Prefix |
|-------------------------------------|--------|
| 1247D                               | 066    |
| 1247E                               | 067    |
| 1248                                | 080    |
| 1250 & 1250A                        | 077    |
| 1251                                | 050    |
| 1251A, B, C, D, & E                 | 150    |
| 1253 & 1253A                        | 089    |
| 1254                                | 158    |
| 1255                                | 137    |
| 1261B                               | 124    |
| 1262                                | 068    |
| 1265A-E                             | 028    |
| 1266                                | 090    |
| 1267, 1267A, 1267B                  | 031    |
| 1268, 1268A, B, C, & D              | 070    |
| 1273A                               | 106    |
| 1274B                               | 069    |
| 1277                                | 145    |
| 1285                                | 139    |
| 1286                                | 110    |
| 1289                                | 096    |
| 1290                                | 084    |
| 1292, 1292A & B                     | 038    |
| 1293A, B, C, D                      | 062    |
| 1295, 1295A, B, C, E                | 250    |
| 1296                                | 031    |
| 1297, 1297A-G                       | 071    |
| 1298                                | 072    |
| 1299, 1299F                         | 073    |
| 1308                                | 130    |
| 2101                                | 251    |
| 2102                                | 252    |
| 2103                                | 292    |
| 2104                                | 293    |
| 2105                                | 294    |
| Link Boxes (GW)                     | 141    |

| Building No. or Infrastructure Item                 | Prefix |
|-----------------------------------------------------|--------|
| Outside Light Poles                                 | 144    |
| 812 Electrical Distribution System                  | 146    |
| 880 Fire and Other Alarm Systems                    | 147    |
| 630-37 Trailer (Tube- Type)                         | 152    |
| 843-10 Water – Fire Protection (including Hydrants) | 154    |
| 411-20 Aviation Gasoline Storage                    | 302    |
| 411-30 Diesel Oil Storage                           | 159    |
| 411-40 Storage Tanks                                | 303    |
| 842-10 Water Distribution System (Potable)          | 164    |
| 822-10 Steam Lines                                  | 304    |
| 890-30 COMPRESSED AIR DISTRIBUTION SYSTEMS          | 305    |
| 872 Security Systems                                | 306    |
| 832 Sewer System                                    | 307    |
| 871 Storm Drainage                                  | 308    |
| 891-70 Utility Tunnels & Manholes                   | 309    |
| 824-10 Natural Gas Lines                            | 310    |
| Lifting Systems                                     | 311    |
| 131-60 Comm. Network                                | 312    |
| Emergency Lights/AEDs                               | 313    |
| Utility Metering                                    | 314    |
| 690 Flag Poles & Monuments                          | 315    |
| 812-20 Exterior Lighting                            | 316    |
| 851 Roads                                           | 317    |
| 852 Sidewalks & Parking                             | 318    |

## **APPENDIX F FCMCB Charter**