 Independent Verification & Validation Program	Software and Hardware Configuration Management	IVV 10 Version: H Effective Date: April 2, 2013
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AUTHORITY		DATE
Jeffrey Northey (original signature on file)	IMS Manager	04/02/2013
Doug Dorrer (original signature on file)	Process Owner	03/29/2013

REFERENCE DOCUMENTS	
Document	Title
IVV QM	NASA IV&V Quality Manual
IVV 11	IT Business Management
IVV 16	Control of Records
NPR 1441.1	NASA Records Retention Schedules
NPR 7150.2	NASA Software Engineering Requirements
S3401	Enterprise Architecture Board Charter
T2401	Sample Configuration Management Plan

If any process in this document conflicts with any document in NODIS, this document shall be superseded by the NODIS document. Any reference document external to NODIS shall be monitored by the Process Owner for current versioning.

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1.0 Purpose

The purpose of this system level procedure (SLP) is to define configuration management (CM), its constituent functions, processes, and procedures, and how NASA IV&V Program Management determines and applies CM to NASA IV&V software and hardware projects. This SLP also provides a basis for tailoring CM for different programs/projects with different life cycles and specific requirements.

2.0 Scope

This SLP defines the CM requirements that apply to internally managed NASA activities and initiatives, as defined by the Enterprise Architecture Board (EAB), Program Management, or Functional Lead. Examples are the Software Assurance Tools (SWAT) Group servers and tools, as well as desktop applications and hardware; the security and badge systems; and tools such as web sites. Approved CM Plans (CMPs) shall be maintained in the Configuration Library of a project.

3.0 Definitions and Acronyms


Official NASA IV&V roles and terms are defined in the [Quality Manual](#). Specialized definitions identified in this SLP are defined below. For CM requirements, the same person may be assigned multiple roles in the process.

3.1 Baseline

A Baseline is a configuration of a hardware, software, or system at a discrete point in its life cycle.

3.2 Change Package

The Change Package consists of the Change Request (CR) and documentation describing the evaluation of the CR by the Engineering Staff.

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3.3 Configuration

A Configuration is the functional and/or physical characteristics of hardware, software, or systems as set forth in technical documentation and realized in a product.

3.4 Configuration Authentication

Configuration Authentication is the process of verifying that a deliverable hardware, software, or system Baseline contains all of the items that are required for delivery. Configuration Authentication also ensures that these items have been verified and satisfy their requirements.

3.5 Configuration Control

Configuration Control is the process of evaluating, coordinating, and deciding on the disposition of proposed changes to the Configuration Items. Configuration Control also governs the implementation of approved changes to baselined, hardware, software, systems and associated documentation.

3.6 Configuration Identification


Configuration Identification is the process of defining each Baseline to be established during the hardware, software, or system life cycle. It describes the Configuration Items and their documentation that make up each Baseline.

3.7 Configuration Item

A Configuration Item refers to each of the locally related components that make up some discrete element of the product.

3.8 Configuration Librarian

The Configuration Librarian is the NASA IV&V civil service or contract employee responsible for maintaining the Configuration Library of a project.

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3.9 Configuration Library

The Configuration Library is the physical or logical location where all CM information for a project is contained.

3.10 Configuration Management (CM)

CM is the process of identifying the configuration of the product at discrete points in time. CM is also the systematic control of changes to the identified configuration for the purpose of maintaining product integrity and traceability throughout the product life cycle. CM consists of four processes:

1. Configuration Identification
2. Configuration Control
3. Configuration Status Accounting
4. Configuration Authentication

3.11 Configuration Management Officer (CMO)

The CMO is the NASA IV&V civil service or contract employee who has responsibility for managing the CM process for the Responsible Manager.

3.12 Configuration Management Plan (CMP)


The CMP is the document written by the Responsible Manager or CMO that demonstrates how the project will follow the CM process.

3.13 Configuration Status Accounting

Configuration Status Accounting is the process used to trace changes to the hardware, software, or system.

3.14 Engineering Staff

The Engineering Staff is a group of NASA IV&V civil service or contract employees designated by the Responsible Manager to design, test, implement, and verify changes to a baselined project.

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3.15 Enterprise Architecture Board (EAB)

The EAB comprises NASA IV&V civil service and contract employees per IVV 11, *IT Business Management*, and S3401, *Enterprise Architecture Board Charter*. The EAB has the responsibility of ensuring that all information technology (IT) assets are purchased or created in accordance with the NASA IV&V Enterprise Architecture (EA) policy.

3.16 Project

A project is an activity or initiative as defined by the EAB in which the primary customer is the NASA IV&V Program. Examples include developing a risk management tool, creating and managing IV&V websites and tools, and procuring a new software package to meet a new business capability.

3.17 Project Initiator

The Project Initiator is anyone who initiates a project within the scope of this SLP.

3.18 Requester

The Requester is anyone who submits a request for a change to hardware, software, systems, or associated documentation within the scope of this SLP.

3.19 Responsible Functional Lead

The Responsible Functional Lead is the NASA IV&V civil service employee who has organizational authority over the Responsible Manager (e.g., Office Lead, PFM Lead).

3.20 Responsible Manager

The Responsible Manager is the NASA IV&V civil service employee who has the responsibility and authority to accomplish/implement a specific activity or process (e.g., organizational line manager, project manager).

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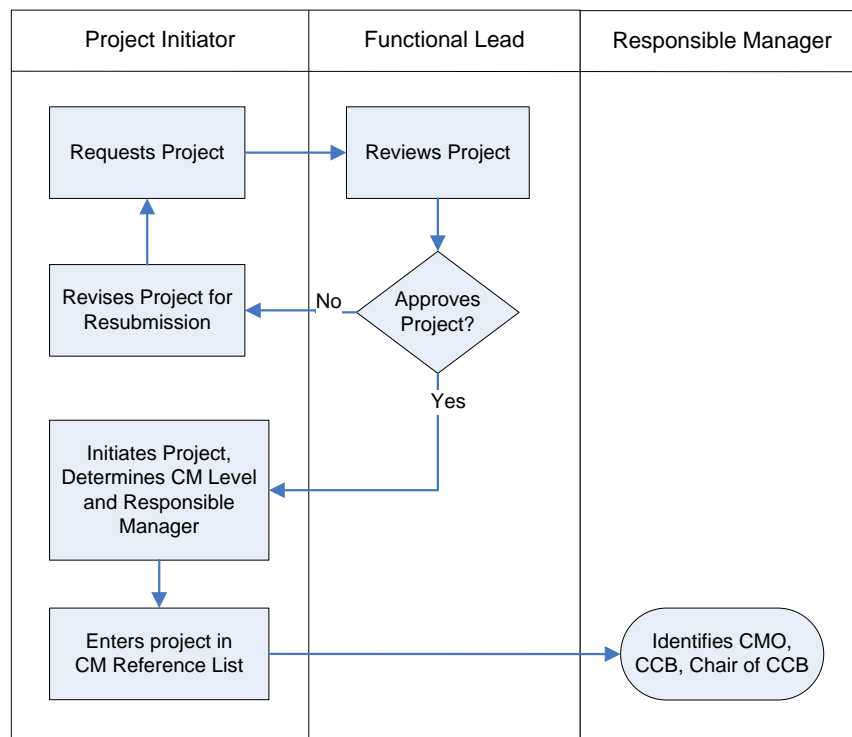
3.21 Acronyms

CCB	Configuration Control Board
CI	Configuration Item
CM	Configuration Management
CMO	Configuration Management Officer
CMP	Configuration Management Plan
CR	Change Request
EA	Enterprise Architecture
EAB	Enterprise Architecture Board
FCR	Functional Configuration Report
IMS	NASA IV&V Management System
IT	Information Technology
NPR	NASA Procedural Requirements
PCR	Physical Configuration Report
QM	Quality Manual
SLP	System Level Procedure
WI	Work Instruction

4.0 Process Flow Diagram

The following diagrams depict processes described in this document, and the responsibilities and actions that shall be performed by process participants. Any information supplemental to a depicted process will appear after the diagram.

4.1 Application of CM to a Project



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4.1.1 Project Initiation

If there is a risk that not performing configuration management would result in failure to achieve desired goals and objectives, then the Project Initiator should follow this process. If the Project Initiator is unsure if CM should be applied to the project, then the Project Initiator should ask the Responsible Functional Lead, EA Board, or Program Management for guidance.

The Project Initiator shall determine the level of CM to be used on the project. NASA Procedural Requirement (NPR) 7150.2, *NASA Software Engineering Requirements*, provides direction for software projects concerning not only CM requirements, but all aspects of a software effort that must be tracked for a NASA project. The minimum requirement is that a CMP will be created and maintained by the project.

4.1.2 Identification of Key Personnel

4.1.2.1 Responsible Manager Identification


The Project Initiator will identify or designate a Responsible Manager for the purposes of CM. Typically, this will be the same person as the Project Initiator. The Responsible Manager shall be documented in the CM Reference List.

4.1.2.2 Responsible Functional Lead Identification

The Project Initiator will identify the Responsible Functional Lead for the purposes of CM. This will depend on the person to whom the Responsible Manager reports for business purposes and requirements. The Responsible Functional Lead shall be documented in the CM Reference List.

4.1.2.3 Configuration Management Officer (CMO) Identification

The Responsible Manager will identify or designate a CMO to direct the CM effort for the project.

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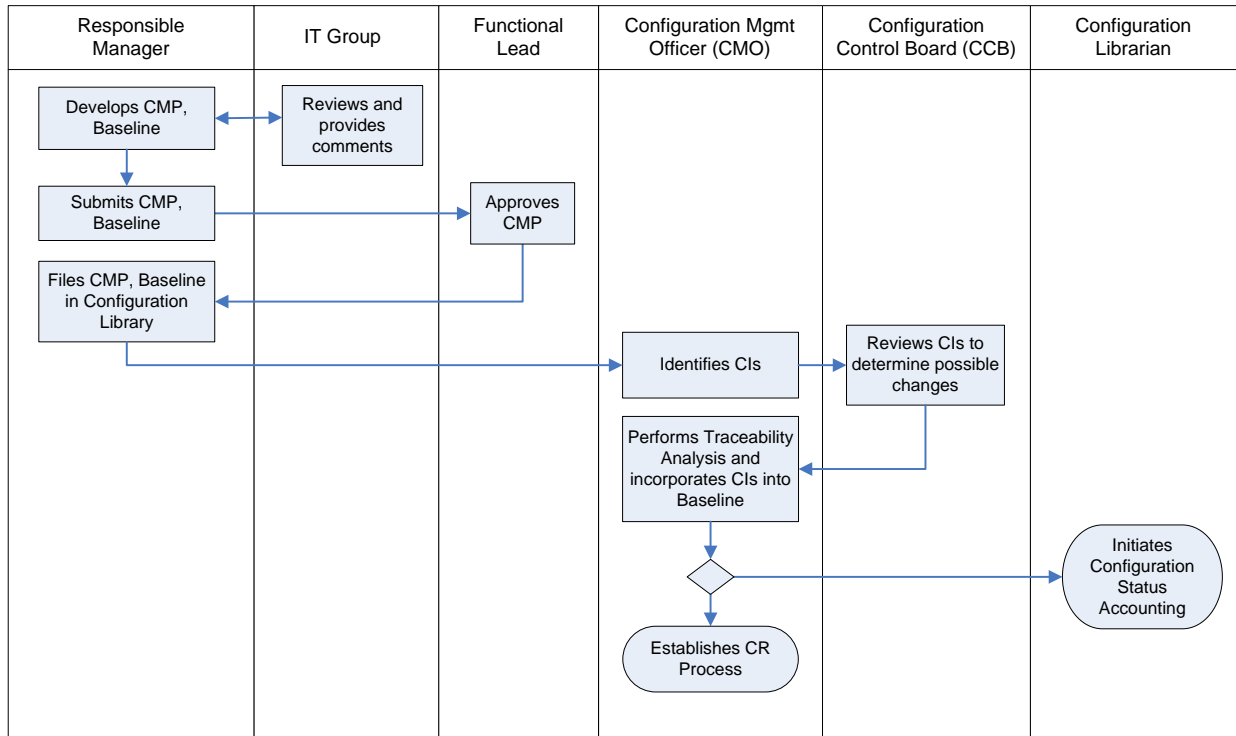
4.1.2.4 Configuration Control Board (CCB) Identification

The Responsible Manager will identify or designate the CCB. The CCB is a working group consisting of representatives from the various disciplines and organizations of the developing project. The Responsible Manager or designee shall be the CCB chairperson.

Initially, the CCB should be made up of all immediate stakeholders, including the Responsible Manager, the CMO, and representatives from affected contractors, if applicable. If necessary, the Responsible Manager may add more personnel to the CCB.




4.2 Configuration Management Plan (CMP)



4.2.1 CMP Development

CM activities for deliverable products shall be documented in a CMP or Project Plan. The Responsible Manager will determine whether a separate CMP is required for aspects of the project. The CMP may be written by either the Responsible Manager or the CMO. The CMP will address the requirements of Configuration Identification, Configuration Control, Configuration Status Accounting, and Configuration Authentication as appropriate and should be tailored to the level of CM chosen during Project Initiation, (e.g., smaller projects do not need as much documentation as large projects). Any boards (e.g., CCB) shall have their roles, responsibilities, and membership defined within either the CMP or procedures referenced in the CMP.

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The first version of the CMP should be written at the beginning of the project. The CMP details the personnel responsible for each role, defines the Configuration Items (CIs) in a Configuration Baseline, and references the guides, SLPs, and work instructions (WIs) to be followed.

The Responsible Manager or CMO shall use a CMP format tailored to their project or T2401, *Sample Configuration Management Plan*, which contains a sample CMP and is located on the NASA IV&V Management System (IMS) web site (<http://ims.ivv.nasa.gov>) so as to meet the intent of documenting the CMP.

4.2.2 CMP Approval and Distribution

New projects and tools CMPs must be coordinated with the IT Group throughout the implementation. The CMP shall be forwarded to the IT Group for review and comments prior to the Go-Live date of the project or tool. The Responsible Manager and Responsible Functional Lead shall have final approval authority for the CMP. Once approved, the CMP establishes the CM requirements for the deliverable hardware, software, or system. The approved CMP establishes the CM Baseline requirements for the deliverable product. If the CMP is approved, the Responsible Manager will file the CMP in the Configuration Library. If it is rejected, the CMP will be returned to the author with suggestions for corrections. The Responsible Manager shall baseline the project, make available the authorized CMP or Project Plan – including CM requirements – to all members of the development effort, and issue detailed plans and tasks to individuals as appropriate. The IT Lead shall document the location of the CMP in the CM Reference List.

4.3 Configuration Identification

4.3.1 Configuration Item Selection

Hardware, software, or systems shall be grouped into Configuration Items for the Baseline according to project requirements as recommended by the CMO. Each Configuration Item will be treated as an independent entity as far as the CM system is

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concerned. As a general rule, a Configuration Item is established for a separable piece of the hardware, software, or system that can be designed, implemented, and tested independently.


The CMO is responsible for ensuring the division of the product into Configuration Items, which may be specified by the Project Initiator, the CMO, or by the developers during requirements definition and analysis. The Configuration Item selection will be complete by the end of the preliminary design phase. The CCB will review the chosen Configuration Items. If the CCB determines that a change needs to be made, it will forward that information to the CMO. If no changes are necessary, the Configuration Items are incorporated into the Baseline by the CMO.

4.3.2 Identification and Traceability

Where appropriate, each product component shall be uniquely identified in the Baseline. This identifier shall be used in tracking and reporting the component's status. Suitable means of identification shall be used throughout all stages of production, delivery, and installation. The designation specifications, drawings, code, parts, and components shall include traceability of individual product or batches. The unique identification of products or batches requiring traceability shall be documented in the CMP by the author of the CMP.

4.3.3 Product Description

Hardware, software, or system components will be described in specifications and drawings in the Baseline by the CMO. The descriptions of the components will become more detailed as the design and development proceeds through the life cycle.

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4.3.4 Configuration Status Accounting Initiated

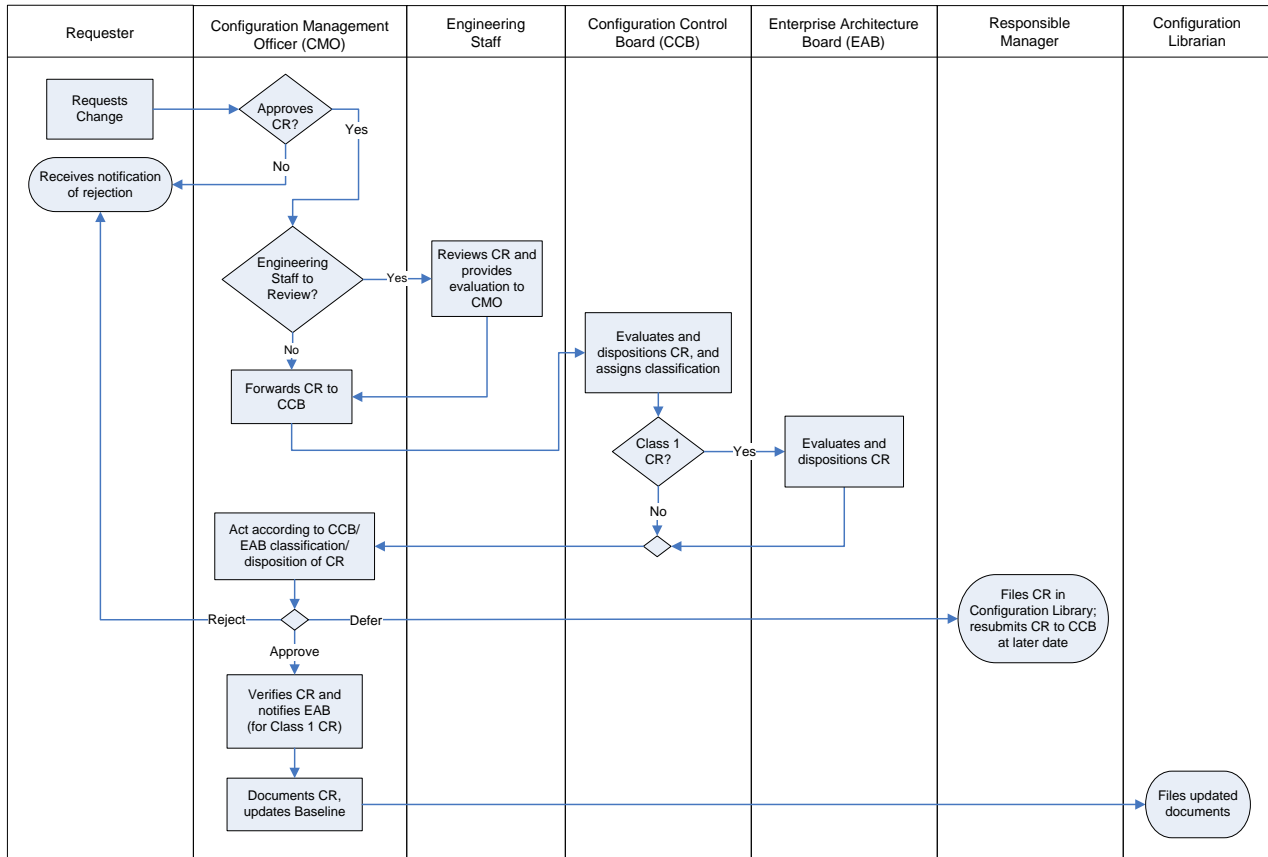
Configuration Status Accounting establishes the record and status of the evolving product throughout its life cycle. It will provide traceability of changes to the baselined requirements, design, code and data, and associated documentation. It documents each version of the product and the changes that lead up to that version. It tracks the changes and contents of products, including their versions and releases. It defines the as-built configuration of the deliverable product.

The Configuration Librarian will initiate Configuration Status Accounting when the first specification (i.e., requirement specification) is baselined, and will continue throughout the hardware, software, or system life cycle. Configuration Status Accounting provides a list of the contents of each product's delivery and associated documentation, which is to be stored in the Configuration Library.

Configuration Status Accounting records will include the identification of the initial hardware, software, or system and associated documents, and the current status, status of evolving Baselines, status of proposed and approved changes, and the implementation status of approved changes. Configuration Status Accounting will provide periodic reports as defined in the CMP. All information will be kept in the Configuration Library.

Although the Configuration Librarian is primarily responsible for controlling and storing Configuration Status Accounting records, the integrity of the Configuration Status Accounting records is dependent upon participants in the CM process maintaining the records associated with their projects. Therefore, all participants in the CM process are encouraged to proactively maintain the Configuration Status Accounting records pertaining to their projects.


4.4 Configuration Control



4.4.1 Change Initiation

The CMO shall establish a method for processing CRs. Project change control will commence for products or their descriptions (e.g., drawings, specifications) after their initial approval, per Section 4.3.1, *Configuration Item Selection*.

The CMO will receive the CRs and review them for clarity and completeness. If the CMO determines that the CR is not complete, the CMO will return the CR to the Requester. Once the CR is complete, the CMO will assign the CR a unique identifier for tracking purposes and will record information about the CR in the CR tracking database or files.


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4.4.2 Change Classification

Changes to hardware, software, or systems and associated documentation shall be classified according to the impact of the change and the approval authority needed. The following is an example of a classification scheme:

- Class 1 is assigned to changes that fall outside the original approved scope as defined by the EAB (e.g., modifying a system to incorporate new business requirements already fulfilled by a current system or levying new requirements on another part of the organization). The EAB shall approve these changes.
- Class 2 is assigned to changes that affect the system level requirements and/or delivery schedule (e.g., making a change that causes the schedule to slip to the right by an unanticipated amount). The CCB and Responsible Manager shall approve these changes.
- Class 3 is assigned to changes that affect the interfaces between Configuration Items and the allocation of functions to Configuration Items, or to changes that affect the component level of cost and scheduling (e.g., changing the scheduled order of deliverables that don't affect the fully loaded schedule of the project). The Responsible Manager may approve these changes with or without the CCB.
- Class 4 is assigned to changes that affect Configuration Item internal design and functionality (e.g., changing class names in a software package). Project personnel may approve these changes.

The Requester may suggest a change classification. The CMO reviews the suggested classification and assigns a working classification.

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4.4.3 Change Evaluation and Disposition

Each change shall be analyzed for its impact on safety, reliability, maintainability, system functionality, interfaces, cost, schedule, impact on processes, and customer requirements in accordance with and to the rigor required in the project's CMP. The CMO may route the CR to the Engineering Staff for evaluation. The documentation becomes part of the Change Package, which is sent to the CCB for final classification and disposition.


If the CR is classified as a Class 1 change, then the CR must be taken to the EAB by the CMO for approval. A decision rendered by the EAB takes precedence over decisions rendered by the CCB, and the same actions will be taken as if the CCB had dispositioned the CR.

Rejected items are returned to the Requester along with the CCB's rationale for rejection. CRs needing further analysis are returned to the Engineering Staff with the CCB's questions or requests attached. Deferred CRs are filed in the Configuration Library by the Responsible Manager and sent back to the CCB at a time specified by the CCB in the deferral notice. Approved CRs are sent to the Engineering Staff.

The CMO is the secretary of the CCB; therefore, the CMO prepares and distributes the meeting minutes and records the current status of the CR. This information will be added to the tracking database or recorded in files.

4.4.4 Change Implementation

Approved CRs are used as change authorization forms. The Engineering Staff schedules the resources to make the change. Official copies of the Baseline components to be changed are obtained from the Configuration Library by the CMO. Associated documentation has to be revised to reflect the change. Once the change has been made and testing is completed, the revised component and documents are returned from the CMO to the control of the Configuration Library.

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4.4.5 Change Verification

The implemented changes shall be verified by the CMO (this will usually occur at the Configuration Item level). This may require the rerun of tests specified in the test plan or the development of additional test documentation. For software changes, regression testing will usually have to be included in the test to assure that errors have not been introduced in existing functions by the change. Once verification is complete, the Engineering Staff shall submit evidence of the change to the Configuration Library. The Configuration Librarian will then include the changed items in the new version of the Baseline.


After the successful implementation and testing of the change described in the CR, the CMO will record the occurrence of this process in the CR tracking database or files.

4.4.6 Baseline Change Control

Changes to hardware, software, or systems are not complete until the changes have been implemented, tested, documented, and verified. In the case of a Class 1 change, the EAB shall be notified upon verification by the CMO so that the “As-Is” Documentation and “To-Be” Documentation can be modified to reflect the current state. All changes, regardless of classification, will be updated in the project’s Configuration Baseline by the CMO.

4.5 Configuration Authentication

Configuration Authentication for hardware shall only be performed when required by the CMP. Section 4.1.6 of NPR 7150.2 establishes Configuration Authentication requirements for software. In addition, the CMP will define what aspects will be reported, and the criteria of the report. Configuration Authentication is accomplished by performing a Functional Configuration Report (FCR) and a Physical Configuration Report (PCR).

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4.5.1 Functional Configuration Report (FCR)


The FCR demonstrates that the actual performance of the Configuration Item complies with the requirements stated in the baselined documentation. The FCR will show the test methods, procedures, reports, and other engineering design documentation (e.g., requirements traceability matrix).

4.5.2 Physical Configuration Report (PCR)

The PCR is the examination of the as-built version of the component against the baselined technical documentation defining the component. The PCR will demonstrate that changes to be included in the version of the delivered product are included, and that all required items of hardware, software, system, data, procedures, and documentation are included.

5.0 Metrics

Any metrics associated with this SLP are established and tracked within the NASA IV&V Metrics Program.

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6.0 Records

The following records will be generated or updated and filed in accordance with this SLP and IVV 16, *Control of Records*, and in reference to NPR 1441.1, *NASA Records Retention Schedules*.

Record Name	Original	Vital	Responsible Person	Retention Requirement	Location
CMP	Y	N	Project Configuration Librarian	Retire to FRC 1 year after discontinuance of the system. Destroy 10 years after discontinuance. (2/14C2)	Configuration Library
Configuration Baseline	Y	N	Project Configuration Librarian	Retire to FRC 1 year after discontinuance of the system. Destroy 10 years after discontinuance. (2/14C2)	Configuration Library
Function Configuration Report	Y	N	Project Configuration Librarian	Retire to FRC 1 year after discontinuance of the system. Destroy 10 years after discontinuance. (2/14C2)	Configuration Library
Physical Configuration Report	Y	N	Project Configuration Librarian	Retire to FRC 1 year after discontinuance of the system. Destroy 10 years after discontinuance. (2/14C2)	Configuration Library
CM Reference List	Y	N	IT Lead	Retire to FRC 1 year after discontinuance of the system. Destroy 10 years after discontinuance. (2/14C2)	ECM



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Software and Hardware Configuration Management

**IVV 10
Version: H
Effective Date:
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VERSION HISTORY

Version	Description of Change	Rationale for Change	Author	Effective Date
Basic	Initial Release		Roger Harris	07/28/2005
A	Conformed to IVV 05-2		Roger Harris	02/07/2006
B	Added references to Enterprise Architecture, supplied corrections to process flow, and changed reference documents		Roger Harris	11/21/2006
C	Update process flow diagrams to align with Facility Management paradigm.		Stephanie Ferguson	05/19/2008
D	Changed "IV&V Facility" to "IV&V Program"		Stephanie Ferguson	02/19/2009
E	Changed Configuration Reporting section		Roger Harris	05/11/2010
F	Updated to reflect changes due to IVV 11		Roger Harris	08/09/2010
G	Added reference to CM Reference List, updated scope, and added guidance to determine if CM should be used on a project		Roger Harris	04/12/2011
H	Change CMP Process and flowchart. Add responsibility for coordinating with IT Group and updating CM Reference List	CAR: 2013-C-386. The CM Reference List (required to identify the existence, location, and responsibility for each CMP) is not actively being used	Doug Dorrer	04/02/2013

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