Configuration Management Plan

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T. Kusel	Program Management Dept., NRAO	2021-01-22

APPROVALS	ORGANIZATION	SIGNATURES
T. Kusel, Systems Engineer	Program Management, NRAO	Digitally signed by Thomas Kusel Date: 2021.01.28 11:27:02 +02'00'
R. Selina, Project Engineer	Electronics Division, NRAO	Digitally signed by Robert Selina Date: 2021.01.29 10:05:23 -07'00'
Rick Farnsworth, Project Manager	Asst. Director for Program Mgmt., NRAO	Richard L Farnsworth Digitally signed by Richard L Farnsworth Date: 2021.02.11 13:24:10 -05'00'
M. McKinnon, Project Director	Asst. Director for NM-Operations, NRAO	Mark McKinnon Digitally signed by Mark McKinnon Date: 2021.02.14 09:47:59 -07'00'

RELEASED BY	ORGANIZATION	SIGNATURE
M. McKinnon, Project Director	Asst. Director for NM-Operations, NRAO	Mark McKinnon Digitally signed by Mark McKinnon Date: 2021.02.14 09:48:17 -07'00'

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1 Introduction

1.1 Purpose

This document describes the Configuration Management (CM) approach that will be applied to the ngVLA project. It defines the CM principles, methods, roles, responsibilities, tools and processes.

CM defines how a system's Configuration Data is managed to enable its orderly storage, baselining, change management and reporting.

1.2 Scope

The CM Plan applies to the entire ngVLA project, including all Configuration Items identified in the Product Breakdown Structure.

CM applies to the entire life of the product and shall maintain conformance between the design domain, production domain, and operational domain of the observatory.

CM activities include CM planning, configuration identification, change control, configuration status accounting, and configuration auditing.

Configuration management supports the Systems Engineering and Project Management processes as defined in [AD05] and [RD01] respectively and is subservient to these processes.

1.3 Verb Convention

"Shall" and "must" are used when a specification or provision is mandatory. The verbs "should" and "may" indicate a specification or provision that is not mandatory. "Will" is used to indicate a future happening/action.

2 Related Documents

2.1 Applicable Documents

The following list of documents is applicable to this document to the extent specified. If not stated otherwise, the latest released version of the document in the repository is valid.

Precedence is indicated in the table below as either "this doc", indicating that this document takes precedence, or "ref doc", in which case the reference document takes precedence.

Ref. No.	Document Title	Precedence	Document Number
AD01	ngVLA Documentation Management Plan	This doc	020.10.10.10.00-0001-PLA
AD02	ngVLA Product Breakdown Structure	Ref doc	020.10.10.05.00-0001-LIS
AD03	ngVLA Assigned Document Log	This doc	020.10.10.10.00-0003-LIS
AD04	ngVLA Document Approval Matrix	This doc	020.10.10.10.00-0002-LIS
AD05	ngVLA Systems Engineering Management Plan	Ref doc	020.10.00.00.00-0001-PLA

2.2 Reference Documents

The following documents are referenced within this text or provide supporting context.

Ref. No.	Document Title	Document Number
RD01	ngVLA Project Execution Plan	020.05.00.00.00-0002-PLA
RD02	ngVLA Engineering Change Request Form	TBD
RD03	ngVLA Engineering Change Notice Form	TBD

3 CM Processes

This section defines the main organizational processes that are required for the effective implementation of a CM system.

3.1 CM Planning

CM planning involves creating the plans, procedures, forms and tools that are required to manage all the CM activities. This document forms the main output of the planning activity and is supported by lower-level detailed plans as necessary, such as the Document Management Plan [AD01].

3.2 Configuration Identification

Configuration identification is the process of defining the naming and numbering attributes of Configuration Items and Configuration Data. It defines the naming and numbering standards that shall be applied consistently throughout the project, including the management of versioning, serialization and modification status. Configuration identification is defined in Section 8. Document Identification is defined in [AD01].

3.3 CM Deployment

Deployment of the CM system includes

1. Creating a structure for the CIs that is in line with the Product Breakdown Structure (PBS).
2. Managing the submission of Configuration Data into the CM system to ensure that submitted Configuration Data complies with the CM requirements.
3. Managing the retrieval of Configuration Data from the CM system to ensure that only authorized persons have access to the Configuration Data and that the latest approved set of Configuration Data is accessible to all authorized project participants.
4. Ensuring that the Configuration Data is safely stored and backed up.
5. Providing the necessary training materials that enable users to use the CM system effectively.

CM deployment is driven by the Configuration Manager and is achieved through clearly defining organizational roles and responsibilities (defined in Section 4) and through the use of an appropriate CM tool (defined in Section 7)

3.4 Configuration Change Control

Change control is one of the most important functions of the CM system. It ensures that:

1. Changes to the structure of the configuration are done in a controlled way.

2. Changes to approved Configuration Data and Baselines are controlled in line with the approved change management procedures.
3. All concessions are managed according to the non-conformance procedures as defined in [AD05].

Change control is achieved through defining and implementing a change control process as defined in Section 5.

3.5 Configuration Status Accounting

Status accounting is reporting of the status of all the Configuration Data associated with a specific Configuration Item, including: approval status (draft, approved or under change); baseline status (baselined or not baselined); revision/version number and modification status. Status accounting is done on an as-needed basis, typically when at project milestones, reviews or product hand-over events. Configuration status accounting is dependent on a good baselining process (see Section 6.4).

3.6 Configuration Auditing

Configuration audits are broken down into functional and physical configuration audits. For the ngVLA project, functional configuration audits will be done as part of the qualification and acceptance test procedures, where the functionality and performance of the items will be verified. Physical Configuration Audits (PCA's) will be performed at the Design Qualification phase, Production phase and Implementation phase as defined in the SEMP [AD05].

4 CM Organization, Roles, and Responsibilities

This section defines the project organizational structure, roles and responsibilities that are required to support an effective CM system.

4.1 Configuration Manager

A Configuration Manager shall be appointed for the ngVLA project who shall assume overall responsibility for the CM processes as defined in Section 3.

Besides the oversight of all the processes, the configuration manager shall specifically be responsible to:

1. Create and maintain the CM management planning documentation.
2. Create and maintain the change management procedures as defined in Section 5, in collaboration with the lead SE.
3. Oversee the Configuration Identification process and ensuring consistent implementation thereof across the project.
4. Create and maintain the structure of the configuration in line with the PBS (Note: the Lead SE is responsible for the PBS).
5. Ensure that all changes to the CM structure are controlled and verified with the lead Systems Engineer and/or the IPT leads.
6. Ensure that the submission of documents and other Configuration Data to the CM system supports this CM Plan. This is achieved by ensuring that only appropriately trained persons have write access to the CM system.
7. Conduct regular audits of the CM system throughout the course of the project to ensure that the CM database complies with this CM plan.
8. Manage read access control to ensure that authorized persons can access all Configuration Data according to access control policies.

9. Provide training materials and support to all users of the CM system.
10. Ensure that the Configuration Data is safely stored and backed up.
11. Ensure that changes to all baseline items are implemented according to the approved change management process as defined in Section 5.
12. Participate as a stakeholder on the Change Control Board. The CM will not be a voting member, but should ensure that the documentation and procedural aspects are in line with the configuration management plan.
13. Ensure that concessions are managed according to the approved concessions management procedures.
14. Report on the configuration status of a CI as/when needed.
15. Assist the Logistics Engineer with Physical Configuration Audits.

4.2 Project Manager

1. The Project Manager shall be responsible to:
2. Ensure that a ngVLA Change Control Board is appointed and regular CCB meetings are conducted.
3. Participate as a key stakeholder on the ngVLA CCB for all changes that impact on scope, schedule or budget.
4. Serve as the Authority to approve Category 5 changes (as defined in Section 5).

4.3 Lead Systems Engineer

The Lead Systems Engineer shall be responsible to:

1. Oversee the implementation of the CM plans and procedures. The Configuration Manager shall report to the Lead SE.
2. Assist the Configuration Manager with creation of the CM planning documentation.
3. Provide a stable PBS for creating the CM structure.
4. Manage the CM structure from the top down to Subsystem level and approve changes to this part of the CM structure.
5. Ensure that the system level configuration items comply with the configuration identification standards.
6. Oversee the implementation of the change management procedures on the project.
7. Review ECRs and ECNs before submission to ensure that they are compliant and complete.
8. Maintain ECR and ECN registers and report on the implementation status of changes.
9. Participate as a key stakeholder on the ngVLA CCB.
10. Oversee the implementation of PCAs on the system and on subsystems.

4.4 Project Engineer

The Project Engineer shall be responsible to:

1. Review all ECRs and supporting analysis prepared by the Responsible Engineer and/or Lead Systems Engineer to determine the technical completeness and accuracy of the proposed change.
2. Serve as a member of the ngVLA CCB.
3. Serve as the Authority to approve Category 3 and 4 changes (as defined in Section 5).

4.5 Responsible Engineer

This person is responsible for the design of a given Configuration Item (system, subsystem, or component) where a change is being considered. Where multiple components are impacted, the integrated level engineer will take responsibility. Responsibilities of the Responsible Engineer include

Deciding when a change is material and whether the change warrants an ECR or an ECN.

1. Drafting the ECR/ECN and in this process assessing the impact of the proposed change on schedule, budget, scope, risk, and cross-functional technical impacts.
2. Consulting with other engineers and stakeholders who may be affected by the change to ensure that the impact assessment is comprehensive.
3. Preparing the ECR/ECN form for review.
4. Driving the implementation of the ECR/ECN and ensuring that all actions are completed by the agreed change deadline.

4.6 Project Scientist

The Project Scientist shall be involved in evaluating the impact of all changes that may impact on the science performance of the system. The Project Scientist will serve on the CCB for Category 1 and 2 changes (as defined in Section 5).

4.7 Change Control Board (CCB)

Change Control Boards shall be appointed to review changes categorized as levels 1, 2, 3 and 5 (as defined in Section 5.2) and make a recommendation to the Authority for approval or rejection. The function of the CCB shall include

1. Review proposed changes to ensure that the ECRs are formulated in line with the approved change control procedures.
2. Review ECRs to ensure that they clearly and accurately reflect the full scope and impact of the proposed change, including a comprehensive list of actions.
3. Make a recommendation to approve or reject ECRs and provide reasons.
4. Oversee the implementation status of all approved changes to ensure that affected persons are notified, changes are tracked and completed in a timely manner.

4.7.1 ngVLA Project Change Control Board

A project-level Change Control Board (CCB) shall be appointed by the Project Director to review and approve Category 2, 3 and 5 ECRs. Board membership may vary according to the change category, but should generally include the Project Manager, Project Engineer, Project Scientist, and Lead Systems Engineer. The ngVLA Project Controls lead should be involved for changes that impact budget and schedule. Other participants may be called by the board to provide specialist inputs. The CCB makes a recommendation to the Authority (see Table 1). The Authority is at liberty to approve or reject the ECR, irrespective of the CCB recommendation but should register reasons for deviating from the recommendation in the ECR form.

4.7.2 NRAO Change Control Board

The NRAO CCB reviews and approves Category 1 changes that affect the overall system baseline, NRAO risk, or may affect other programs or projects outside of ngVLA. Changes at this level are typically within the management purview of the NRAO Observatory Director, who will appoint the members of the CCB as needed.

4.8 IPT Leads

The Integrated Product Team (IPT) leaders shall be responsible to:

1. Ensure that their teams are familiar with the CM plan and change control processes.
2. Define the Product Breakdown Structure for their subsystems in collaboration with the lead SE.
3. Ensure that the Product Breakdown Structure is implemented and maintained in the CM system, in collaboration with the Configuration Manager.
4. Ensure that all subsystem level configuration items comply with the configuration identification standards.
5. Ensure that all changes to baselined documents in their subsystem are implemented through the change management procedures defined in this document.
6. Ensure that IPT subcontractors adhere to sound CM principles and transfer the CIs Configuration Data for delivered products, as defined in Section 4.11.

4.9 Logistics Engineering Manager

The Logistics Engineering Manager shall

1. Ensure that the Support and Maintenance System is developed in line with the CM plan.
2. Lead the execution of PCAs on system and subsystem levels.

4.10 Affected Engineers

Engineers responsible for affected CIs shall assist the Responsible Engineer to assess the scope of the impact and review the completed ECR/ECN form.

4.11 Subcontractor Configuration Management

When placing a subcontract for major development or production work, the subcontractor shall have a mature CM capability that is on par with the procedures defined in this plan. The IPT leader who is responsible for managing the subcontract, together with the configuration manager, shall evaluate the CM system of the contracted party to ensure compliance to suitable standards. During the contracting period, the contractor should do a trial transfer of Configuration Data from their database to the ngVLA CM database to test such transfer process. Before accepting the product, the contracting party shall transfer the Configuration of the delivered product to the ngVLA CM system and verify the successful transfer of the data pack in collaboration with the configuration manager and relevant IPT leader.

5 Change Control Process

Controlling change to the configuration of the system during development and construction is essential to ensure that:

1. The full impact and scope of the change is understood before a change decision is made.
2. The change decision is made by the correct authority and with involvement of all affected parties.
3. The implementation of the change is tracked to ensure that it is implemented to its full extent and within the agreed timescale.

During the development phase, the change control process should ensure that the integrity of the system configuration is maintained with regard to its design, performance, testability, and quality. During the operational phase, the process should ensure that the delivered system is operated and maintained

effectively and that the baseline set of documentation and Configuration Data is maintained in line with the as-built configuration.

Change management will be administered through a configuration management system that provides electronic notification, tracking, and workflows, and retains a history of change activity.

5.1 Applicability

The Change Control Process is applicable to all material changes (see definition below) that impact on Baselined Configuration Data. Configuration Data that has not been baselined is not subject to change management procedures. Baselines are established at formal reviews as defined in the Life Cycle Plan in the SEMP. The baseline set of documents is identified at each formal review in the review plan as described in the SEMP.

Only material changes are controlled. Material changes include

1. A change to the system's end user (scientific) functionality or performance.
2. A change in form, fit, or function that may impact system or subsystem interfaces, requirements or performance budgets.
3. A change to construction scope, schedule or budget.
4. A change in operational or maintenance scope or budget.
5. A change to baselined documentation.

The Responsible Engineer of a Configuration Item shall determine if a change is material in nature. The Configuration Manager shall ensure that all changes to baselined documents are detected and controlled.

5.2 Change Categories

Depending on the impact of a proposed change, it can be categorized using Table 1 below. The categories and approval mechanisms are defined in the paragraphs following Table 1.

Note that the NSF Program Officer must approve changes that exceed the scope, budget or schedule thresholds set in the Cooperative Agreement. Contingency may only be used to support in-scope work for the NSF-approved project baseline.

Change Category	1	2	3	4	5	6
Scope of Change (Impact)	Project (Major)	Project (Minor)	System (Major - technical)	System (Minor - technical)	Subsystem (Major)	Subsystem (Minor)
Authority	Observatory Director	Project Director	Project Engineer	Project Engineer	Project Manager	IPT leader
Approval Board	NRAO CCB	ngVLA CCB	ngVLA CCB	none	ngVLA CCB	none
Change Process	ECR	ECR	ECR	ECN	ECR	ECN
Example	Changes >10% to user performance or cost	Changes <10% to user performance or cost	Changes to the system architecture and L2 requirements	Minor updates to baselined system document	Changes to the budget & schedule of a subsystem	Minor changes to a baselined subsystem document

Table 1 – Summary of change levels and authorities.

5.2.1 Cateogry 1: Major Project Changes

This category refers to major changes to the project's scope, budget, schedule or user performance (L0 specifications). The threshold for major changes is notionally 10% of the project's budget, schedule or scientific capability (L0 specifications). The ECR shall be approved by the Observatory Director with recommendation from the NRAO CCB and approval from the NSF.

5.2.2 Category 2: Minor Project Changes

This category refers to minor changes that have less than 10% impact on the project's budget, schedule or scientific capability (L0 specifications). The ECR shall be approved by the Project Director with recommendation by the project CCB and approval from the NSF if changes exceed the thresholds set in the Cooperative Agreement.

5.2.3 Category 3: Major Technical System Changes

This category refers to significant changes that impact the technical aspects of the ngVLA System, but not impact on the budget, schedule or scientific capability of the project. This includes: System (L1) specifications; System design and architecture; Subsystem (L2) specifications; Interfaces between Subsystems; or any other baselined System level documentation. The categorization of "Major" refers to the scope of the change as follows: notionally, if there are material changes to the L1 & L2 requirements or system level architecture or 5 or more baselined documents are affected by the change, the change should be classified as major and should be managed via the ECR process. Category 3 changes are approved by the Project Engineer with recommendation from the project CCB.

5.2.4 Category 4: Minor System Changes

This category is defined to reduce the workload for minor changes at the system level. The categorization of "Minor" refers to changes that are not material on the L1 & L2 requirements or architecture, and that require changes to less than 5 baselined documents. Such changes can be made via the Engineering Change Notice process and are approved by the Project Engineer.

5.2.5 Category 5: Major Subsystem Changes

This category is defined for major changes to subsystems. This includes changes to the scope, schedule and budget of the subsystem, that do not affect the scientific capability, schedule or budget of the overall project. It includes technical changes to the subsystem design or lower level specifications or any other baselined subsystem documentation. The "Major" category refers to material changes to the subsystem architecture or lower level component specifications or to changes that require more than 5 baselined documents to change. Such changes should be managed via the ECR process and approved by the Project Manager, with recommendation by the project CCB.

5.2.6 Category 6: Minor Subsystem Changes

This category is defined to reduce the workload for minor changes that are confined to a single IPT. The categorization of "Minor" refers to changes that are not material to the scope of the subsystem, and that require changes to less than 5 baselined subsystem documents. Such changes can be made via the Engineering Change Notice process and are approved by the IPT leader.

5.3 Engineering Change Request (ECR) Process

The ECR process is a structured process to facilitate requesting a change, obtaining approval, and implementing the change. The ECR phases, process steps, and states are shown in Figure 1 below. The roles, responsibilities, and detailed actions for these steps are shown in Figure 2.

During the initiation and assessment phase, the Responsible Engineer is identified who will be best suited to drive the assessment and implementation of the ECR. The Responsible Engineer works with the configuration manager, identified change authority, and all affected parties to ensure an accurate and complete ECR assessment.

The ECR form [RD02] is a comprehensive definition of the change including

1. Identification of the ECR and responsible engineer.
2. Categorization of the level of change.
3. Description of the scope of the change.
4. Comprehensive impact assessment including impact on existing baselines, schedule, budget and risk. This shall include a complete list of affected baseline documents with version numbers.
5. Comprehensive list of actions to complete the change.

The completed and verified form is submitted to the CCB, which makes a recommendation to the Authority, who may approve or reject the proposal or ask for a refinement or adjustment for re-assessment. Once approved, the Responsible Engineer drives the implementation of all the identified actions. When all actions are completed, the Configuration Manager circulates the ECR for completion sign-off.

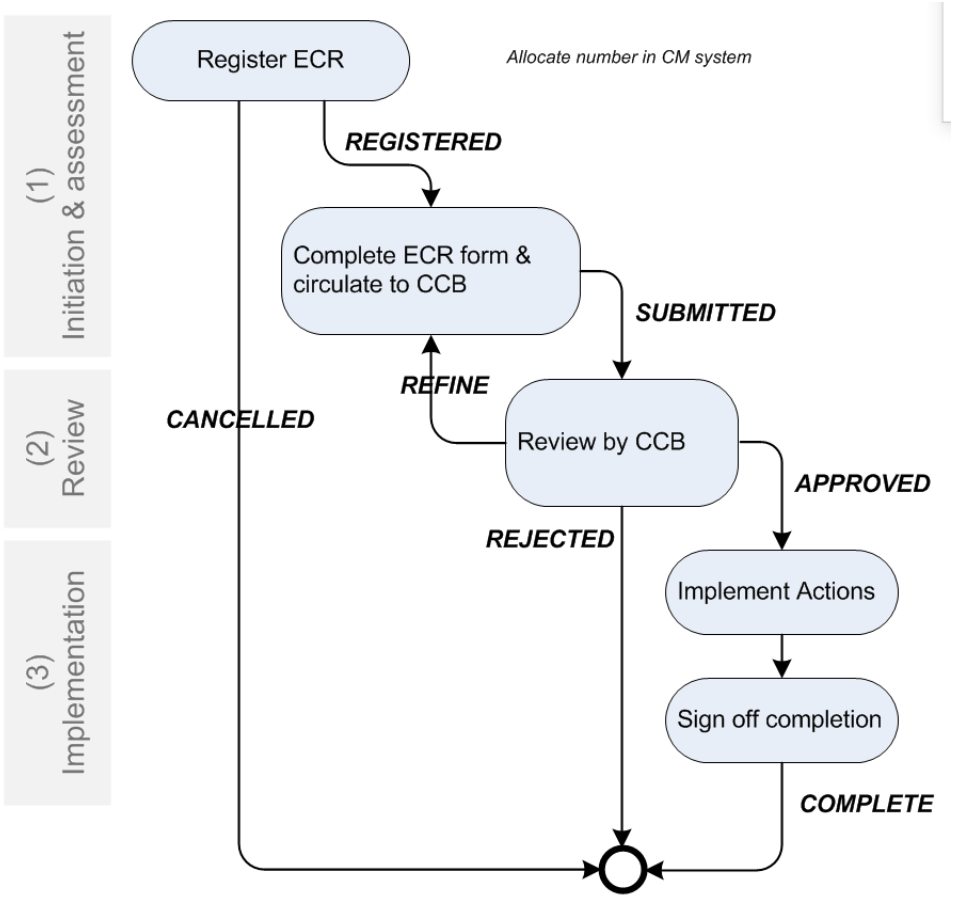

Figure 1: ECR process.

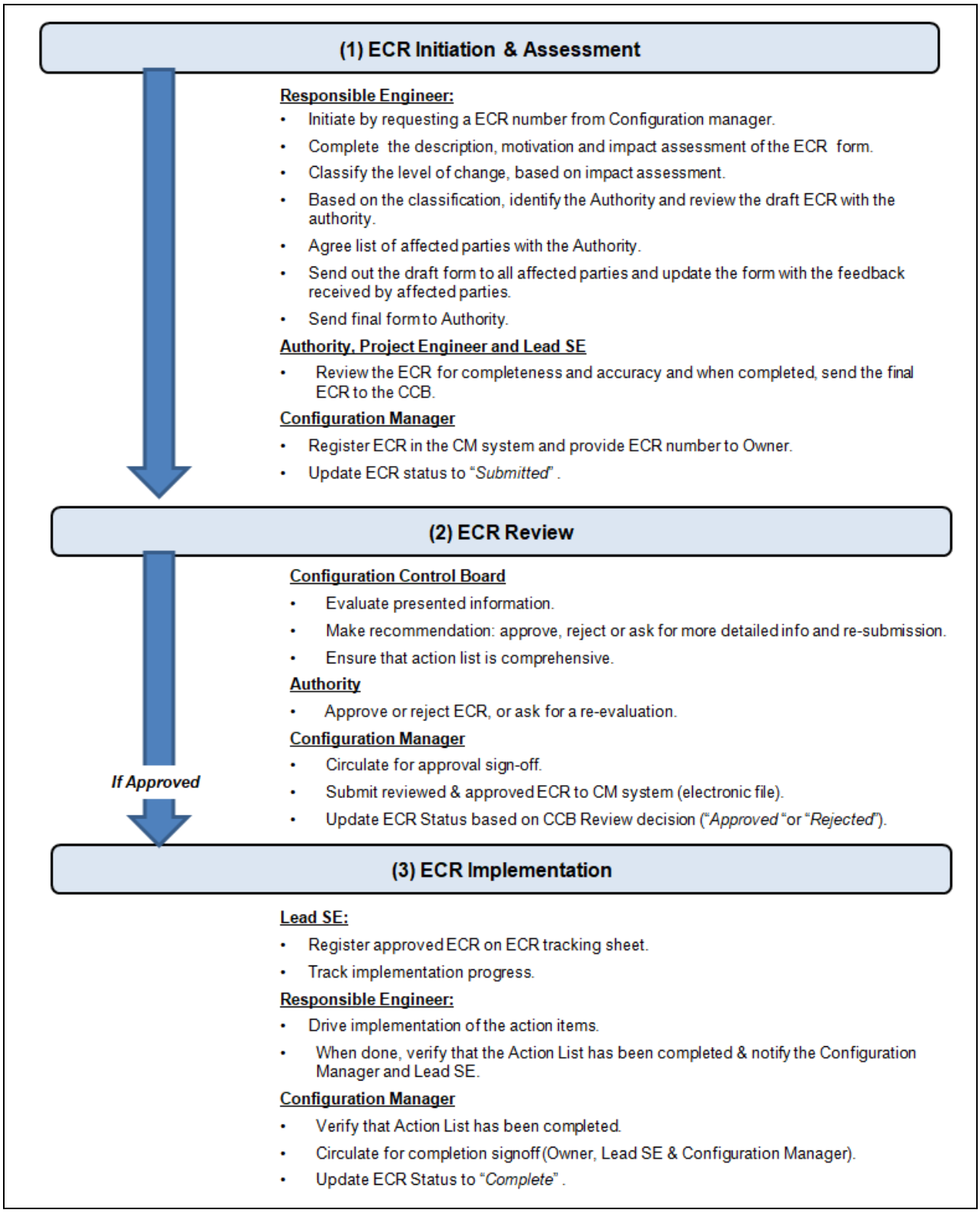

Figure 2: ECR activities, roles, and responsibilities.

5.4 Engineering Change Notice (ECN) Process

The ECN process is similar to the ECR process, but requires no board approval. During initiation, the Responsible Engineer is identified who will be best suited to drive the assessment and implementation of the ECN. An ECN form [RD03] is used for the notification process. The ECN phases, process steps and states are shown in Figure 3 below. The roles, responsibilities and detailed actions for these steps are shown in Figure 4 (next page).

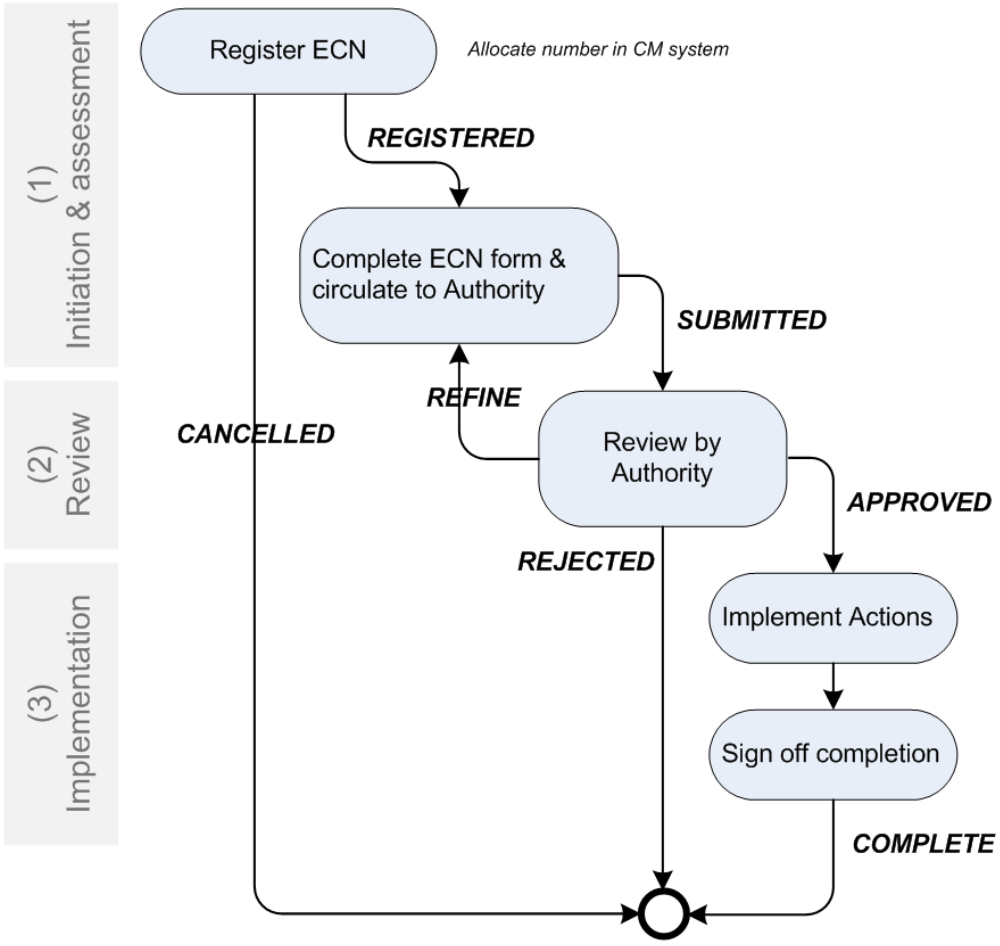

Figure 3: Engineering Change Notice process.

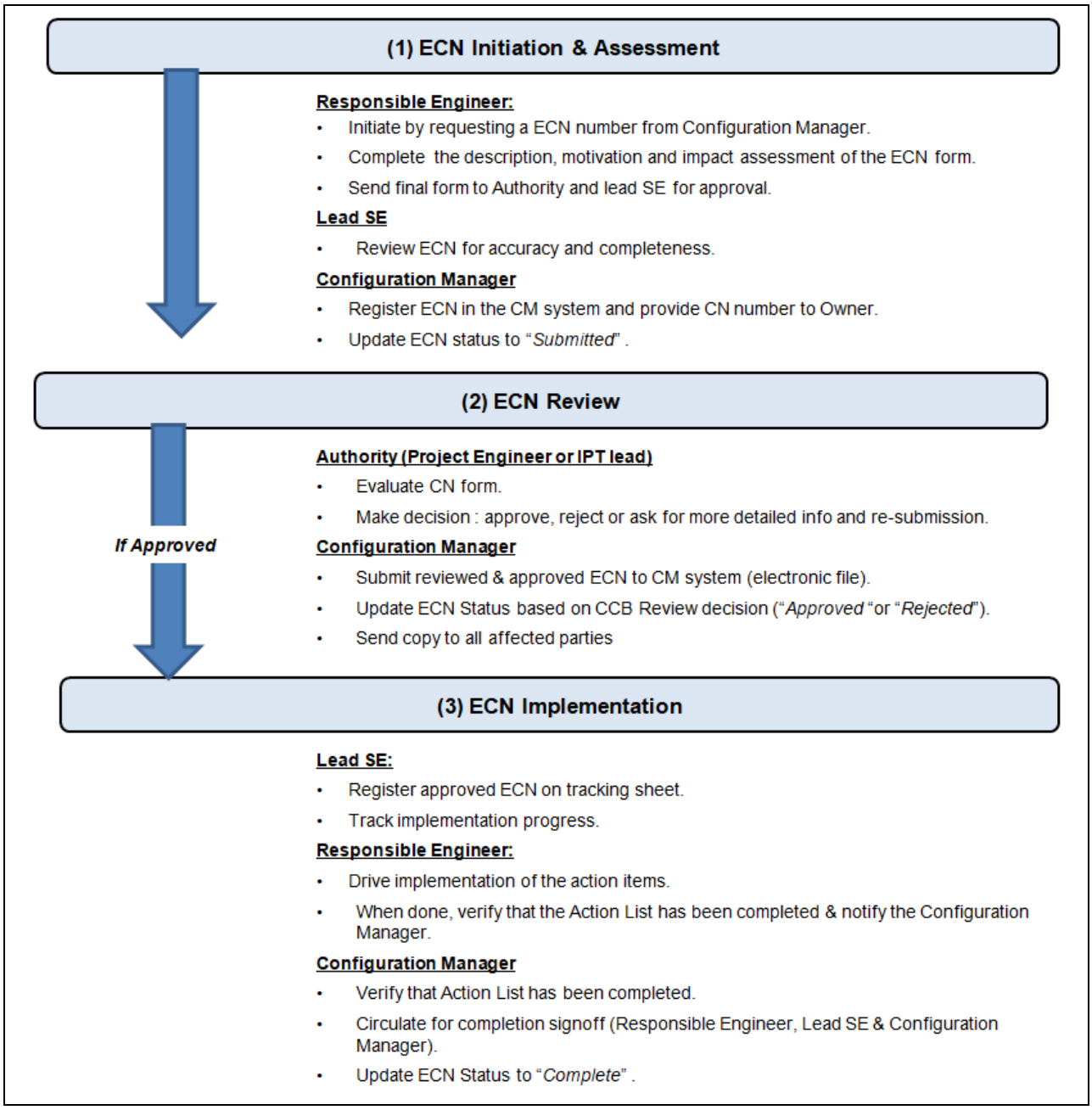

Figure 4: Engineering Change Notice activities, roles, and responsibilities.

6 Configuration Data and Structure

This section defines how the Configuration Items will be structured in the CM system and how the data items associated with Configuration Items will be defined.

6.1 Configuration Item Structure

Configuration Data includes the following two categories of data:

1. ***Product Configuration Data***: Configuration Data related to the end user product or "created system" and its subsystems, components or parts.
2. ***Project Programmatic Data***: That is not specific to the product, but to the organizational process that creates the product, i.e. the "creating system." This includes project planning and management information.

These two types of data will be organized in different sections of the configuration management system as defined in the following two sections.

6.1.1 Product Configuration Data

Product Configuration Data is all the documentation and technical data that is associated with the items in the ngVLA Observatory as defined in the Product Breakdown Structure (PBS) [AD02]. The PBS forms the structure of the product configuration and items in the PBS are called Configuration Items (CIs). The Configuration Data of CIs includes all documentation and data required for development, manufacture, serial production, procurement, verification and operation:

1. Development data, including
   - Specifications.
   - Design documentation and design drawings.
   - Interface drawings and documents.
   - CAD and other models.
2. For manufactured items: Manufacturing data, including: manufacturing drawings, assembly drawings, assembly procedures, parts lists, Bill of Materials (BOM), electrical diagrams and PCB manufacturing data.
3. For procured items: Procurement specifications and/or data sheets.
4. For items containing software/firmware: software/firmware build instructions and links to software source code (see Section 6.5).
5. Verification documentation as applicable including: test procedures, test reports or certificates of conformance.
6. For production items: Production data including build history, test procedures, and test reports.
7. User instructions and maintenance instructions.

Product Configuration Data includes serialization information, product versions, and modification status of CIs.

Product Configuration Data includes Concessions for all CIs as defined in [AD05]. The CM tool shall store the Concessions and associate concessions with specific CI serial numbers.

The PBS requires the ability to hold the same configuration item in multiple places in the PBS (e.g. parts that are reused in multiple places in the design. The CM tool should be able to handle different versions of a CI to make provision for cases where multiple versions of a component are used in the system.

Physical location information should be stored by the CM tool if such information is not managed in the Support System.

For documents and drawings, both the source file and approved PDF files should be stored. Older versions should be kept on record when the version is updated.

6.1.2 Project Programmatic Data

The configuration system may also contain programmatic information required for the management of the project to support the Systems Engineering and Project Management functions (this data may also be managed in a separate repository). This includes management plans, management reports, schedules and budgets. In cases where programmatic information is of general nature and applicable to the entire project, programmatic information is typically managed in a structure that is separate from the product structure in the CM system. In cases where management information is specific to a CI, such data should be located in the product data hierarchy.

6.2 Configuration Item Definition (CID)

The Configuration Item Definition (CID) is a document that identifies the complete set of data that defines a Configuration Item in the PBS.

During the development phase, the CID is a living document and is prepared by the Responsible Engineer. Version information is not recorded in the CID because it is not attempting to capture a configuration at a specific point in time (this is done via the CIL – see below). Rather, it attempts to catalog all relevant information necessary to build, maintain, or otherwise perform work on the item.

The CID may be in the form of a table, with the rows representing the complete Product Breakdown Structure (PBS) of the configuration item down to leaf level and columns representing the different types of documentation and data to be delivered. The matrix cells shall indicate which documentation is required for each item in the PBS. The document types (columns) should make provision for all the different data types as defined in Section 6.1.1. The columns shall be grouped to indicate the stages at which the documentation is to be delivered at the major milestones of the product's development: PDR, CDR, Production Readiness Review and Acceptance Review.

6.3 Configuration Item Data List (CIL)

The Configuration Item List (CIL) is a serial number or revision specific list that catalogs the relevant Configuration Data of the Configuration Item at a point in time. The list should include all available data elements that are identified in the CID. For each document or data element, the CIL shall indicate the name, number and revision and change status. Where applicable, the CIL shall also indicate concession status and modification status. Note that the CIL is a snapshot in time: it captures the configuration of the item at a specific time only. The CIL is typically generated at major reviews or when the item needs to be baselined (e.g. after a formal review).

6.4 Configuration Baselines

A Configuration Baseline is an approved set of Configuration Data that establishes the characteristics of a Configuration Item at major reviews as defined in the SEMP (Concept Baseline, Preliminary Design Baseline, Final Design Baseline, etc.). A Configuration Baseline consists of a list of documents and Configuration Data elements of a Configuration Item – typically a ***subset of documents listed in the CIL***. The baseline serves as a point of reference for future activities relating to the Configuration Item and changes to the baseline require formal change management.

6.5 Software Configurations

The management of software source code, build environment and version control will be done separately from the CM system. Software tools and development environments are better suited to manage the configuration of software. However, the CM tool shall be able to store all the relevant software version and build environment information for a Configuration Item in order to reference a product to a specific software version, with reference information to the software configuration tool.

7 Configuration Management Tool

An appropriate tool shall be chosen to facilitate the Configuration Management function for the ngVLA project. The required capabilities of the tool are defined in Section 10, with references to relevant sections in this document.

8 Configuration Identification

This section defines how items in the CM system shall be identified to ensure a consistent naming and numbering methodology.

8.1 Parts Identification

Unique product identification is required to associate a Configuration Item with all its Configuration Data. This section defines how items are identified for ngVLA.

8.1.1 Part Number

Configuration Items (also referred to as "Parts") are numbered using the following format:

020.xx.xx.xx.xx

The CI numbering is structured in two sections as follows:

1. ***020*** identifies the item as a project-specific ngVLA product. All CIs developed or procured for the ngVLA will have the same prefix.
2. ***xx.xx.xx.xx*** identifies the product uniquely. The structure in the numbering system may be used to indicate product hierarchy. However, the authoritative product hierarchy is defined in the PBS.

8.1.2 Serialization

All CIs that are produced in large numbers (nominally more than 5) shall be serialized.

8.1.3 Part Marking

Part Marking is required for at least the following items:

1. Maintenance significant CIs as identified in FMECA analysis: Physical items that need to be identifiable during the operational phase for corrective or preventive maintenance.
2. All Line Replaceable Units (LRUs).
3. Shop Replaceable Units (SRUs) where applicable.

Part Markings shall include the following, unless physical space is not available:

1. Part Number
2. Part Name/Description
3. Part Version
4. Part Serial Number (for serialized items)
5. Supplier Name
6. Electronic identification (Bar Code or equivalent electronically identifiable marking)
7. Modification status (if applicable)

8.2 Management Item Identification

Management Items are categories of management work that requires its documents and information to be managed formally. The data related to Management Items are the Project Programmatic Data defined in Section 6.1.2. Management Items shall be organized in a folder structure that is separate from the PBS structure in the configuration management system. However, programmatic information that relates to a specific CI may be stored in the PBS structure (e.g. project plan for a specific CI).

Management Items are numbered using the following format:

020.xx.xx.xx.xx

The numbering is structured in two parts as follows:

1. ***020*** identifies the item as a project-specific ngVLA item. All management information relating to the ngVLA will have the same prefix.
2. ***xx.xx.xx.xx*** identifies the category of management information – this relates to a "folder" structure for organizing the project programmatic data (e.g. Systems Engineering or Project Management). The numbering allows for some hierarchy in the folder structure. The numbering range for Management Items shall not overlap with the numbering range used for CIs.

8.3 Document Identification

Document identification is defined in the ngVLA Document Management Plan [AD01].

8.4 Identification of ECRs and ECNs

ECR and ECN forms are documents and should be allocated a document number in line with [AD01].
In addition to the document numbers, ECRs and ECNs shall be given identification numbers as shown below for the purpose of change management tracking and reporting.

ECRs shall be identified as follows:

020.ECR.xxxx

where ***xxxx*** is a serially allocated number from the ECR register.

ECNs shall be identified as follows:

020.ECN.xxxx

where ***xxxx*** is a serially allocated number from the ECN register.

8.5 Identification of Concessions

Concessions shall be identified as follows:

020.CCS.xxxx

where ***xxxx*** is a serially allocated number from the Concessions register.

9 Appendix A: Acronyms and Defined Terms

9.1 Acronyms

Acronym	Non-Abbreviated Reference
BOM	Bill of Materials
CAD	Computer Aided Design
CCB	Change Control Board
CI	Configuration Item
CID	Configuration Item Definition
CIL	Configuration Item List
CM	Configuration Management
CMS	Configuration Management System
COTS	Commercial Off The Shelf
ECN	Engineering Change Notice
ECR	Engineering Change Request
FMECA	Failure Modes, Effects and Criticality Analysis
IPT	Integrated Product Team
LRU	Line Replaceable Unit
ngVLA	Next Generation Very Large Array
NRAO	National Radio Astronomy Observatory
NSF	National Science Foundation
PBS	Product Breakdown Structure (Product Tree)
PCA	Physical Configuration Audit
PCB	Printed Circuit Board
RD	Reference Document
SE	Systems Engineering / Systems Engineer
SEMP	Systems Engineering Management Plan
VLA	Very Large Array

9.2 Defined Terms

Baseline	A baseline is an approved set of versioned documents that is associated with a reference point in a product's development life cycle. The objective of a baseline is to reduce a project's vulnerability to uncontrolled change by fixing and formally change controlling the set of documents after a major review.
Configuration Item	A component of the system that requires the management of its Configuration Data.
Concession	A specific written authorization by the client to accept an item from a manufacturer which, during verification, is found to depart from its specified requirements, but nevertheless is considered suitable for use, either permanently or for a specified time period.
Configuration Data	The Configuration Data of a CI includes all documents and other information that is required for the development, manufacture, serial production, procurement, verification and operation of the CI.
Management Item	A category of management work that requires its documents and information to be managed formally.
Product Breakdown Structure	A list defining the hierarchical decomposition of the Configuration Items of a product.

10 Appendix B: Configuration Management Tool Requirements

The following set of requirements are defined for the ngVLA Configuration Management Tool, with reference to relevant sections in this document.

Category	Priority(1)	Capability	Ref. Section
Access Control			
	M	Control access to modify the Configuration structure according to a configuration structure management list.	5
	M	Control read access to all Configuration Data according to a read access list.	5
	M	Control write access to all Configuration Data according to a write access list.	5
	P	Provide access to templates.	-
Configuration Structure			
	M	Use the PBS as a structure for recording all the Configuration Item data.	6.1.1
	M	Hold identical Configuration Items in different parts of the PBS.	6.1.1
	M	Manage the configurations of multiple versions of a Configuration Item.	6.1.1
	M	Manage the configurations of multiple serial items of the same CI version.	6.1.1
	M	Associate modification status with specific serialized CIs.	6.1.1
	M	Ability to define a separate structure for the project programmatic information, categorized as Management Items.	6.1.2
Configuration Data			
	M	Store multiple types of documentation and data, including development, manufacturing, production, procurement, verification and end user data as defined in the CID.	6.2 6.1.1
	P(2)	Store location information for CIs.	6.1.1
	M	For documents and drawings, store both the source file and approved PDF. Retain older versions.	6.1.1
	M	For software CIs, store software version and build environment information.	6.5
Configuration Item Listing			
	M	Generate a CIL for a selected Configuration Item.	6.3
	M	Generate parts list and BOM for a manufactured item.	6.1.1
Configuration Baselining			
	M	Define a Configuration Baseline, consisting of a subset of documents/data elements listed in the CIL.	6.4
	M	Approve a Baseline.	6.4
	M	Manage access control to baselined documents to ensure that future changes are controlled through the appropriate change management processes.	6.4 5
	M	Report on Baseline status (status of all documents in the baseline).	6.4

	M	Maintain a history of all versions of baselined Configuration Data	5
Change Control			
	M	Identify ECR numbers and ECN numbers. Prohibit duplication.	5
	M	Store ECRs and ECNs and track their current status.	5
	P	Identify all actions associated with ECRs and ECNs.	5
	P	Manage ECR and ECN workflows.	5
	M	Link ECRs and ECNs with all affected documents.	5
	M	Manage write access for documents that are under change control.	5
	P	Report on all approved, incomplete changes, with list of outstanding actions.	5
Concessions			
	M	Identify Concessions with unique numbering. Prohibit duplication.	6.1.1
	M	Associate CIs with Concessions.	6.1.1
	P	Report the status of Concessions with outstanding actions.	6.1.1
Configuration Identification			
	M	Allocate unique CI numbers. Prohibit duplication.	8.1
	M	Allocate unique serial numbers, version numbers and modification status to relevant CIs. Prohibit duplication.	8.1
	M	Allocate unique document numbers based in the CI number. Prohibit duplication. Associated documents with CIs.	8.3
	M	Manage the versioning and approval status of documents.	8.3
	P	Manage document approval workflows.	8.3

(1) M = Mandatory; P=Preferred
(2) Location information is mandatory if the Support System does not manage this information.

Table 2: CM Tool requirements.