Documentation Management Plan

020.10.10.10.00-0001-PLA-DOC_MGMT_PLAN-B

Status: RELEASED

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Change Record

Version	Date	Authors	Affected Section(s)	Reason/Remarks
1	2017-08-01	Treacy	All	Initial Draft started from current VLA Doc Mgt Plan draft Version 6
2	2017-08-21	Treacy, Selina	Many	Incorporated comments from P.E., stripped numerous comments, accepted most changes to date
3	2017-09-08	Treacy		Expanded Doc Type table
4	2019-08-15	Leyba-Newton	Many	Edits for clarity, accuracy; expanded Doc Type table
5	2019-08-16	Selina	1.2, 1.3, 1.5, 2, 3.6, 3.8, 7.	Updating to reflect changes in document management tools/platforms. Preparing for release
A	2019-08-26	Lear	All	Incorporated edits by M. McKinnon; prepared PDF for release as v.A.
A.1	2019-12-10	Lear	All	Updated text to reflect usage of EDMS as Document Repository
A.2	2020-01-16	Leff, Lear	All	Resolved minor inconsistencies; added section and AD cross-references.
A.3	2020-02-10	Lenox	3.8	Added a document type
A.4	2020-02-26	Lear	All	Minor copyediting; clarified doc nos. & titles of ADs; revised cover page
B	2020-03-11	Lear	All	Prepared PDF for approvals & release as v.B

Table of Contents

1 Introduction

1.1 Purpose

This document describes the overall approach to managing documentation within the Next Generation Very Large Array (ngVLA) project and presents guidelines for the creation, identification, and classification of project documents.

A "document" in this context constitutes a word processing file, spreadsheet, graphics file, drawing, schematic, model, firmware code, script, or any similar item that can be contained in an electronic file.

Product Structure Numbers (PSNs) are defined within a Product Tree [AD01]. The Product Tree structure and guidelines for use are also presented in this document.

1.2 Scope

The *ngVLA Project Documentation* includes all plans, requirements, specifications, drawings, schematics, diagrams, test procedures, reports, firmware, source code, written information, and any other information necessary to build, maintain, or otherwise perform work on any ngVLA system.

The *ngVLA Document Repository* refers to the central Electronic Document Management System (EDMS) that stores and serves ngVLA-managed documents. A description of the repository and protocols for storage and retrieval is available in Section 4 and [AD04].

1.3 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. In the event of a conflict between the information stated in this document and the information stated in one of the following listed documents, the information in this document supersedes that available in the other documents.

Ref. No.	Document Title	Document Number
AD01	ngVLA Product Tree	020.10.10.05.00-0001-LIS
AD02	ngVLA Documentation Standards *[in preparation]*	020.10.10.10.00-0007-STD
AD03	ngVLA Configuration Management Plan	020.10.10.15.00-0001-PLA
AD04	Adept Web Client Reference Guide	020.10.10.10.00-0008-PRO
AD05	ngVLA Document Approval Matrix	020.10.10.10.00-0002-LIS

1.4 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.

1.5 Definitions

Part Number: This number identifies a configuration item at any level in the hierarchy. A unique number uses the format 111.22.33.44.55-SSSS to indicate the part's location in the Product Tree, levels one through five, and SSSS is a four-digit sequence number starting with 0001 that distinguishes between multiple parts/documents that fall within the same location or product tree number.

Facility: Product Tree Level 1 is the top-level product category, generally reserved for NRAO facilities or arrays. This includes installations such as the VLA, ngVLA, GBT, VLBA, etc.

System: Product Tree Level 2 is reserved for standalone systems within the facility that can generally be defined under their own functional requirements (e.g., the correlator or the antenna). It also includes Work Breakdown Structure (WBS) elements such as Project Management, Science Communications, Software, and Safety to support documentation management of these artifacts.

Subsystem: Product Tree Level 3 is reserved for subsystem elements and is sometimes also used to define an aggregate of assemblies that provide common functionality, such as the Front End electronics and the Data Transmission System (DTS).

Assembly: Product Tree Level 4 represents a hardware or software item, or an aggregate of both. This typically makes up a collection of components or sub-assemblies that are designed as Line Replaceable Units (LRUs). Examples are modules, receivers, etc.

Sub-Assembly: Product Tree Level 5 represents composite items (hardware and/or software) that make up an assembly having defined functionality and interfaces. This is especially applicable if a sub-assembly may be repurposed in another assembly. Examples are PCBs (printed circuit boards), enclosures, and specific Front End receivers (Bands 1–6).

Component: This is a single piece, or two or more pieces joined together, not normally subject to disassembly or identified by a single part number by the vendor (for example, a resistor, a screw, or a machined piece of metal).

Configuration Item (CI): This is an item uniquely defined by its own set of requirements and complete design documentation, all of which are under configuration control. A configuration item may be at any level of the product tree hierarchy and may be comprised of multiple CIs at lower levels of the Product Tree. The PSN entry is appended with "CI" to make the designation explicit. CIs are expected to have CI Definitions (CIDs) and CI Lists (CILs) as defined in [AD03].

Serial Number: The four-digit serial number is a sequentially assigned, unique identifier used to differentiate between two or more interchangeable parts having the same product structure number (i.e. part number). The serial number will be used in inventory and configuration control. This is most applicable to the sub-assembly and assembly level parts, which may have significant variability in their configuration that requires tracking. Serial numbers shall not be duplicated or reused within a CI. In the event an assembly is retired, decommissioned, or destroyed, the inventory shall be revised to reflect the inactive status.

Controlled Document: Controlled documents are subject to the following:

- Numbering according to the Document Numbering Convention described in this document;
- Version control and secure access via an Electronic Document Management System (EDMS);
- Formal approval required before issuance; and
- Changes required to be authorized and controlled.

Configuration Control: Items are identified for configuration control based on the following factors:

- The potential impact of changes to array performance, operations, and maintenance;
- Impacts to design interfaces; and
- Threats to human health and safety.

2 General Approach to Document Management

The general approach taken to document management is highlighted in the following points, which will be discussed in more detail in subsequent sections.

1. A product-centric approach is taken consisting of a product tree in the form of a hierarchical number scheme detailing the location of each product in use in the project [AD01]. All controlled documents must be contained within the structure of the Product Tree.
2. All controlled documents will be submitted in the native source file formats and as PDFs, both of which will be stored in an electronic Document Repository and accessible by a Web-enabled EDMS interface.
3. All employees will (at a minimum) have read access to the Document Repository. Write access to specific libraries in the EDMS will be limited to personnel requiring such access to create, revise, review, or approve and release documents in those libraries.
4. The PDF files are the officially archived record; hence, approvals and signatures will be applied to the PDF documents rather than the source files.
5. All PDF files submitted must have an associated source file available for future revisions. This is of particular importance if outside vendors supply project documents that require revisions be in the native formats. Contracts shall require files delivered in native formats, except in cases where the vendor clearly retains IP rights.
6. Controlled documents may be in the status of draft, approval routing, released, or obsolete. A document must be reviewed and approved by all parties in the approval routing to be released according to [AD05].

Past released versions of documents will be archived in the EDMS for future reference, both in PDF and native/source formats.

3 Document Number Conventions

3.1 Document Number and Part Number

Part numbers and document numbers are mapped one to one, the only difference being that the document number contains the document type suffix and the part number does not. Hence the terms "document number" and "part number" can be used interchangeably. For our purposes, a part number can refer to either a single component or an assembly of components.

3.2 Fully Qualified Part Numbers

For clarity and consistency, part numbers must include all five levels of the product tree hierarchy as well as a unique sequence number (e.g., 111.22.33.44.55-SSSS). When referring to higher-level assemblies, the part number will be that of the CID, which defines the parts and sub-assemblies that make up the higher-level assembly. Any information included after the sequence number shall be informational only.

3.3 Numbering of Documents

All controlled project documentation falls under the document numbering scheme. Capital letters must be used for all alphabetical components of the document number. Document numbers take the form of:

Document Number: 111.22.33.44.55-SSSS-TTT

Where:

- 111= 1st Level of the Product Tree
- 22 = 2nd Level of the Product Tree
- 33 = 3rd Level of the Product Tree
- 44 = 4th Level of the Product Tree
- 55 = 5th Level of the Product Tree
- SSSS = Sequence Number (see Section 3.6)
- TTT = Document Type Code (DWG, BOM, PRO, MAN, etc.; see Section 3.8)

This numbering scheme permits identification of individual documents or parts by listing the full number (e.g., 030.01.02.03.04-0021-DWG).

3.4 Product Structure Number

The PSN defines the structure of the product tree and shall adopt the following levels (Table 1). The product tree hierarchy ends at the fifth level.

Product Tree Level	PSN Representation	Description	Examples
1st	**111**.00.00.00.00	Facility	VLA, ngVLA, VLBA, GBT
2nd	111.**22**.00.00.00	System	Antenna, Correlator, Management, Safety
3rd	111.22.**33**.00.00	Subsystem	Electronics subsystems, Receivers, Cryogenics
4th	111.22.33.**44**.00	Assembly	All Modules, Feeds, Receivers, etc.
5th	111.22.33.44.**55**	Sub-Assembly	PCBs, mechanical assemblies, wiring harnesses

Table 1 – ngVLA Product Tree levels and examples.

The detailed product breakdown of the ngVLA is defined in [AD01]. The breakdown is system function- and product-oriented; e.g., a module should break down into its component parts, such as the enclosure, individual PCBs, wiring harnesses, etc. It should reflect the composition of the instrument whenever possible. However, the limited number of levels in the tree also requires some flexibility to ensure that an appropriate level of decomposition is maintained throughout the system.

The PSN allows the document to be classified into a system function-oriented, hierarchical product tree structure, which will allow for easy identification and retrieval of the documents. It must always be given as a series of five number fields, the first field with three digits, followed by four fields of two digits, using leading zero placeholders as needed. The number must always be given in full such that all document numbers and part numbers will be the same number of characters.

The consequence of this is that all documents reside at the lowest level of the structure, with anything less than the full five fields treated as a roll-up. For example, viewing the PSN as a computer folder structure, all documents would only reside in the lowest folder, never in an upper folder that also contained subfolders.

3.5 00 Designator

The 00 designator in the product tree can be used for several purposes.

This designation can define a General category at any level of the Product Tree to include documents that are applicable across all branches at the same level. However, for products or common parts that are applicable across some or all branches at that level, a separate branch should be created (e.g. if a mechanical part is common to four Front End bands).

This designator also applies to the branch-level identification for a Configuration Item and related documentation defined in lower branches.

Fully qualified part numbers and document assignments require use of all five levels of Product Tree identifiers. For example, documents at the 020.00.00.00.00 branch are applicable project-wide, across the entire ngVLA. It may be appropriate to assign documents here, but unusual for a part to be defined under this branch. By contrast, 020.30.05.00.00 is applicable within the ngVLA Front End Product Group.

3.6 Sequence Number (SSSS)

The sequence number is a sequential number that is assigned to the document within the Product Tree structure. All documents must be assigned a sequence number. This number is always given as a four-digit number beginning with 0001, with leading zero placeholders used as needed. A sequence number 0000 is not allowed. The sequence number is used to distinguish between different documents and part numbers that fall under the same PSN. No other meaning is ascribed to the sequence number. Unique document types that are frequently referenced should use an appropriate Document Type Designator (Section 3.8).

3.7 Fully Qualified Part Numbers

For clarity and consistency, part numbers shall include all five levels of the product tree hierarchy and a unique sequence number (e.g., 111.22.33.44.55-SSSS). When referring to higher-level assemblies, the part number will be that of the CID which defines the parts and sub-assemblies that make up the higher-level assembly.

Any information included after the sequence number shall be informational only.

3.8 Document Type Designator (TTT)

The last component of the document number is the document type designator. This three-digit abbreviation is used to classify the document into one of the recognized types, as outlined in the table below. A description of what is to be included within the classification of the document type is provided for guidance.

This document type classification serves to identify the main contents of the document to help users locate the information they seek. If an author is uncertain of the appropriate document type designation or if multiple document types apply to a single document, ask for clarification from the Documentation Specialist, or simply choose the most applicable type designator. Where generic document types (e.g., DWG) and more specific types are applicable (e.g., SCH), the more specific type is preferable.

Document Type	Acronym	Description
Agenda	AGD	Meeting agenda.
Block Diagram	BLK	Block diagram representation of a system, process, etc.
Bill of Material/Parts List	BOM	List of parts and/or sub-assemblies used in the creation of an assembly or a list that enumerates all parts including unique type codes (e.g., manufacturer's type number), used in a single product or a logical or functional part of a product.
Budget	BUD	Detailed presentation of a projected cost breakdown.
Corrective Action Report	CAR	A specific type of report in response to a documented discrepancy, non-conformance, or other reported condition that is tracked for compliance or correction.

Document Type	Acronym	Description
Configuration Item Definition	CID	The top level document describing an assembly or sub-assembly. Identifies all applicable documents to the design, fabrication and maintenance of the assembly (typically without noting revision level).
Configuration Item List	CIL	Similar to a CID, but specifies revision levels and captures a snapshot of the configuration, as of the date of issue. For mature products, the CIL may be serial number or revision specific and lists applicable documents to an individual assembly or sub-assembly.
Contract	CON	Binding agreement between vendor, customer, or other parties.
Design Description	DSN	Description of a hardware, software, system, or subsystem design which can include theory of operation, justification for design decisions, high level descriptions of interfaces, proposed operational details, etc.
Drawing	DWG	Document presenting a graphical representation of a system assembly or part.
Engineering Change Request	ECR	Document used to communicate a proposed change to the system, assembly, or part.
Engineering Change Order	ECO	Describes a change to the system and associated drawings. Includes an assessment and approval for implementation.
Engineering Change Notice	ECN	
Firmware	FRM	Personalities used in programmable logic devices, memory images, and other programmable instructions typically associated with circuit level hardware devices; descriptions of such files, or instructions for the build and archiving of such files.
General	GEN	Open category for documents not accounted for elsewhere. Only use this document type when all other document type categories do not apply.
Interface Control Document	ICD	Document describing the specification of the interface between two configuration items.
Instructions	INS	General instructions or information for performing work or tasks where no compliance, inspections, or monitor and control processes are involved.
List	LIS	Document giving an enumeration of items.
Manual	MAN	Document describing how to use or repair a product. Can focus on specific groups (e.g., user, maintenance, installation etc.)
Manufacturer Data Sheet	MDS	Data sheet supplied by an outside manufacturer.
Memorandum	MEM	Narrative document that can address any subject.
Minutes of Meeting	MIN	Meeting report, can include action item list.
Printed Circuit Board	PCB	All PCB manufacturing files such as artwork, layers, etc.
Plan	PLA	Document describing an intended scheme or sub-project.
Procedures	PRO	Description of mandatory steps to execute a certain task or process where compliance is implied.

Document Type	Acronym	Description
Register	REG	A specific type of list which is typically used for tracking of management processes such as the Risk Register, Stakeholder Register, and other lists that are traditionally identified as registers.
Report	REP	Technical reports and design documents.
Requirements	REQ	Document describing the high-level requirements for a system. These are an expression of user needs, and are defined without an implied or assumed implementation.
Request for Proposal	RFP	Proposals, quotes, and other budgetary or costing information requested from vendors, contractors, institutions, or other entities invited to bid on project work.
Request for Waiver	RFW	A formal request from the design team, administration, or other entities to deviate from requirements or process protocols where compliance is otherwise mandated or expected.
Review Item Discrepancy	RID	Notice from the review panel to the team under review that an item in the review package is missing, non-compliant, does not meet requirements, needs further elaboration, is out of scope for the review, etc.
Schedule	SCD	A comprehensive compilation of all tasks, durations, and resource loading needed to complete a work package, an integration of multiple packages, or the entire project.
Schematic	SCH	Schematic representation of an electrical circuit, hydraulic system, etc.
Standard Operating Procedure	SOP	A step-by-step procedure for regular recurring activities, including safety analyses and hazard mitigations. The procedure should be used for training and as a reference when work is performed.
Statement of Work	SOW	Document describing what tasks should be carried out by a defined entity (person, company, institute).
Specification	SPE	Document describing the required specifications of a product.
Source File	SRC	A source file in its native format. Used when a number of drawings or documents are created from a single source file.
Standards	STA	Document describing or listing standards criteria for a system, product, or process.
Test Data Report	TDR	A specific type of report that is the output from a procedure, where the report supports compliance and the procedure may be needed to interpret the results.
Top Level Assembly Drawing	TOP	Used to denote the top-level assembly drawing for a particular subsystem/assembly. Only one document of this type shall exist for each subsystem/assembly.
Template	TPT	
Wire List	WIR	Wiring diagrams and cabling schemes for a system, assembly, or sub-assembly.

3.9 Version Identifier (V)

All released documents must have a version identifier (A, B, C, and so on for each Released Version) indicated within the document. The scheme used to note the current version of a document or file is documented in [AD03].

4 ngVLA Document Repository and Archive

All ngVLA documentation shall be stored and managed in an Electronic Document Management System. This EDMS shall provide secure access, controlled read/write/approve access, version control and recovery, and tracking of all document actions.

4.1 Archival Policies

All documentation and drawings shall be created and stored, in electronic version only, in the Document Repository. For the archival version of documents, the goal is to store documents in formats which are highly portable and stable over time. Therefore, all released documents will be stored in their PDF versions as well as in their native file types. All attempts will be made to maintain access to the PDF files to ensure that the files remain readable through the lifecycle of the project. Software required to access the native file types will also be maintained and archived when feasible.

4.2 Digitizing Documents

A paper copy archive will not be maintained. The Documentation Specialist(s) are responsible for digitizing any documents that are required to be maintained and only available in hardcopy. These shall be scanned and saved to PDF format, then stored in the Document Repository for archival purposes. This may include but is not limited to certificates of compliance, vendor shipping documentation and receipts, faxes, and other legacy documents.

4.3 Superseded Documents

All superseded documents become obsolete documents. An obsolete document is one that no longer reflects the current design, configuration, policy, or procedure within the ngVLA project. Obsolete documents shall be maintained in the EDMS archive; however, they must be clearly marked as "obsolete" in the document properties.

For most documents, the document status is also identified on the title page and in the header of each page. All changes to documents must follow the procedures outlined herein.

5 Document Approval and Change Procedure

The document approval and change procedure is outlined in [AD03] and must be followed for all controlled documents.

6 Electronic File Naming Conventions

Electronic file names are separated into two categories: (1) the PDF document that has been approved, and (2) the source file(s) used to generate the PDF file.

6.1 PDF File Naming

PDF file names will use the same convention as the document numbering scheme, with the document type, revision level, a brief descriptive title, and the file extension added.

111.22.33.44.55-SSSS-TTT-V-TITLE.EXT

For example, a simple drawing of a bracket might have the part number 020.01.02.03.04-0021, which would translate to a file name of "020.01.02.03.04-0021-DWG-A-Bracket.pdf".

When titling a file, the following rules will be observed:

- The description added to the file name should be kept as short and simple as possible, while still giving a brief summary of what the file represents. Given the 256 character limit imposed by certain operating systems for a path + file name, the descriptive title shall be limited to 40 characters.
- No spaces shall be used in the file name; rather, underscores will be used.

6.2 Source File Naming

Whenever possible, source files will be named similarly to PDF files, with the exception that revision numbers are not part of the file name. The source file name will have the part number followed by the document type and a brief description. For the example above, the Autodesk Inventor file name would be "020.01.01.01.01-0021-DWG-Bracket.idw".

6.3 CAD File Naming Issues

Should the above scheme interfere with the operation of computer-aided design (CAD) software packages, alternative source file naming schemes may be used.

CAD software packages often produce a set of interrelated files that ultimately produce one or many printable or viewable drawings. Since these files are not easily separated, and do not map 1:1 to individual drawings, they should be submitted as a single package. All source files for drawings must always be submitted with a PDF of the composite drawing.

In such cases, a ZIP file or equivalent (.rar, .tar, .tgz, etc.) shall be submitted with the full source file set and the aggregated file shall be marked with its own unique sequence number. The document type shall be noted as SRC (Source).

7 Document Accessibility

7.1 Document Storage

All controlled project documents will be maintained in the ngVLA Document Repository (described in Section 4) and will be accessible to all members of the ngVLA project via a Web-based interface to the EDMS. The EDMS will provide functionality for searching the repository, downloading documents, versioning, tracking user access and actions, and routing documents through approval/signature workflows.

7.2 Access to the ngVLA Document Repository

The ngVLA Document Repository will be accessible only to individuals within the NRAO organization and internal to the NRAO network. All information or documentation that needs to be accessed by non-NRAO personnel will be copied to externally accessible websites or via other means with authorization by the Project Director.

7.3 File Format Standards

To maximize document accessibility, the standard format for the dissemination of project documentation is PDF. Therefore, all released and deliverable documents will be maintained in PDF form. The source files (for example, Word, Excel, Autodesk Inventor, Altium, etc.) will be maintained as well.

8 Appendix

8.1 Abbreviations and Acronyms

Abbreviation	Non-Abbreviated Reference
ACU	Antenna Control Unit
AD	Associated Document
BOM	Bill of Materials
CAD	Computer-Aided Design
CASA	Common Astronomy Software Applications
CI	Configuration Item
CID	Configuration Item Definition
CIL	Configuration Item List
CPU	Central Processing Unit
DTS	Data Transmission System
ECO	Engineering Change Order
EDMS	Electronic Document Management System
FE	Front End
GBT	Green Bank Telescope/Observatory
ID	Identification
IF	Intermediate Frequency
LO	Local Oscillator
LRU	Line Replaceable Unit
M&C	Monitor and Control
MIB	Module Interface Board
ngVLA	Next-Generation Very Large Array
NRAO	National Radio Astronomy Observatory
PBS	Product Breakdown Structure (Product Tree)
PCB	Printed Circuit Board
PDF	Portable Document Format
PSU	Power Supply Unit
PSN	Product Structure Number
VLA	Jansky Very Large Array
VLBA	Very Long Baseline Array
WBS	Work Breakdown Structure