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Array Configuration: Technical Requirements

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PREPARED BY	**ORGANIZATION**	**DATE**
B. Mason, C. Carilli, V. Rosero, B. Butler	ngVLA/NRAO	2022-08-31
E. Murphy	ngVLA/NM-Operations	

APPROVALS	**ORGANIZATION**	**SIGNATURES**
E. Murphy, Project Scientist	ngVLA,NRAO	E. J. Murphy E. J. Murphy (Sep 1, 2022 16:30 EDT)
Thomas Kusel Systems Engineer	ngVLA,NRAO	Thomas Kusel (Sep 5, 2022 21:15 GMT+2)
R. Selina, Project Engineer	ngVLA,NRAO	R. Selina R. Selina (Sep 6, 2022 17:53 MDT)
W. Esterhuyse, Antenna Project Manager	ngVLA,NRAO	

RELEASED BY	**ORGANIZATION**	**SIGNATURE**
W. Esterhuyse, Project Manager	ngVLA, NRAO	

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Version	Date	Author	Affected Section(s)	Reason
A	2019-07-09	Lear	All	Initial Release
A.01	2021-10-15	Mason, Carilli	All	Update & reorganize for CDR; renumber requirements.
A.02	2022-01-12	Lear	All	Formatting, minor copy edits.
A.03	2022-01-12	Mason, Carilli, Lear	Header, 3.5, 4.1, 4.3	Fix typos & formatting, clarify AAC0108
A.04	2022-01-26	Selina	1,2	Correcting template text and references to reference design.
B	2022-01-26	Lear	All	Prepared PDF for signatures and release.
C	2022-08-31	Mason	All	Updated per T-CDR RIDS

Table of Contents

1 Introduction

1.1 Purpose

This document presents a set of technical requirements for the ngVLA Array Configuration. Many requirements flow down from the preliminary ngVLA System Requirements [AD02], which in turn flow down from the preliminary ngVLA Science Requirements [AD01].

The Science goals have been elaborated by the Science Advisory Council (SAC) and Science Working Groups (SWGs), and are captured in a series of use cases. An analysis of these use cases, and the flow down recursively to the science, system, and subsystem requirements, is reflected in this draft.

1.2 Scope

The scope of this document is the ngVLA array configuration. Described in the Array Configuration Conceptual Design Description Document [RD33], it is designed to meet the science requirements determined in the detailed community analysis of the broad ngVLA science case, as captured in the science use case spreadsheet [RD01] and summarized in ngVLA memos 17, 18, and 19, and in [AD01] and [AD02].

The requirements establish the performance and functional requirements applicable to the ngVLA array configuration based on the science program analysis. These requirements then lead to the conceptual design description, described in [RD33].

2 Related Documents and Drawings

2.1 Applicable Documents

The following documents are applicable to this Technical Specification to the extent specified. In the event of a conflict between the documents referenced herein and the content of this Requirements Specification, the content of the *highest*-level specification (in the requirements flow-down) shall be considered the superseding requirement for design elaboration and verification.

Ref. No.	Document Title	Rev/Doc. No.
AD01	ngVLA Science Requirements	020.10.15.05.00-0001-REQ
AD02	System Requirements	020.10.15.10.00-0003-REQ
AD03	Operations Concept	020.10.05.00.00-0002-PLA
AD04	Antenna Technical Requirements	020.25.00.00.00-0001-SPE
AD05	Short Baseline Array Antenna Preliminary Technical Requirements	020.47.05.00.00-0001-SPE

2.2 Reference Documents

The configuration requirements draw extensively from work presented in the ngVLA memo series, available online at https://ngvla.nrao.edu/page/memos. The following references provide additional supporting analysis or context that informed the design of the array configuration.

Ref. No.	Document Title	Rev/Doc. No.
RD01	ngVLA Science Use Case Parameterization Spread Sheet	2017-06-20 V24
RD02	ngVLA Reference Design Development & Performance Estimates	ngVLA Memo #17
RD03	Summary of the Science Use Case Analysis	ngVLA Memo #18
RD04	Key Science Goals for the Next Generation Very Large Array (ngVLA): Report from the ngVLA Science Advisory Council	ngVLA Memo #19
RD05	Image Capabilities: High Redshift CO	ngVLA Memo #13
RD06	Investigating the Early Evolution of Planetary Systems with ALMA and the Next Generation Very Large Array	ngVLA Memo #33
RD07	More on Synthesized Beams and Sensitivity	ngVLA Memo #16
RD08	ngVLA Dynamic Range	ngVLA Memo #30
RD09	Deep Fields at 8GHz	ngVLA Memo #35
RD10	Initial Imaging Tests of the Spiral Configuration	ngVLA Memo #41
RD11	Resolution and Sensitivity of ngVLA-revB	ngVLA Memo #47
RD12	The ngVLA Short Baseline Array	ngVLA Memo #43
RD13	Fast Switching Phase Calibration at 3mm at the VLA Site	ngVLA Memo #1
RD14	Possible Configurations for the ngVLA	ngVLA Memo #3
RD15	Snapshot coverage of the ngVLA: an alternate configuration	ngVLA Memo #49
RD16	Taperability study for the ngVLA and performance estimates	ngVLA Memo #55
RD17	High Dynamic Range Imaging	ngVLA Memo #64
RD18	Demonstrations and Analysis of ngVLA core + Short Baseline Array for Extended Structure Imaging	ngVLA Memo #67

Ref. No.	Document Title	Rev/Doc. No.
RD19	A Study of ngVLA Subarray Efficiency: Plains and Fractions of the Core	ngVLA Memo #72
RD20	Sub-Array Selection for the Reference Observing Program	ngVLA Memo #76
RD21	Configuration: Reference Design Description Rev C.01	ngVLA Memo #82
RD22	The ngVLA Long Baseline Array: Configuration Suggestions	ngVLA Memo #84
RD23	Comparison of Alternative Configurations for the ngVLA Plains Subarray	ngVLA Memo #85
RD24	Imaging Evaluation of Two Mid Configurations	ngVLA Memo #86
RD25	Image Fidelity Study of KSG3	ngVLA Memo #89
RD26	Configuration: Reference Design Rev D Description	ngVLA Memo #92
RD27	Preliminary ngVLA Observing Band Availability Estimate	ngVLA Memo #73
RD28	Seismic Study and Risk Assessment for ngVLA sites	ngVLA Memo #93
RD29	A Notional Reference Observing Program	020.10.15.05.10-0001-REP
RD30	A Notional Envelope Observing Program	020.10.15.05.10-0002-REP
RD31	Surface Weather and Atmospheric Measurements at the VLA Site, VLBA Sites, and Relevant Locations in the Southwest US	ngVLA Memo #94
RD32	System Level Evaluation of Aperture Size	ngVLA Antenna Memo #2
RD33	Array Configuration: Design Description	020.23.00.00.00-0002-DSN

We refer the reader to these memos for more details on science simulations that relate to the configuration design and characterization of the design, as well as to the ngVLA Science Book: *Science with a Next Generation Very Large Array* (2018, ASP).

3 Overview of the Array Configuration Technical Requirements

3.1 Document Outline

This document presents the technical requirements of the ngVLA array configuration. These parameters determine the overall form and performance of the array configuration.

The functional and performance specifications, along with detailed explanatory notes, are found in Section 4. The notes elaborate on the meaning, intent, and scope of the requirements. These notes form an important part of the requirements definition and should guide the verification procedures. In many cases the notes explain or analyze how the numeric values of requirements were derived. Where numbers are not well substantiated, this is also documented in the notes. In this way, the required analysis and trade-space available is apparent to scientists and engineers who will guide evolution of the ngVLA array configuration concept.

Section 3.4 identifies Key Performance Parameters (KPP) that should be estimated and monitored throughout the design phase. These metrics facilitate trade-off analysis of various concepts and help identify and resolve tensions between requirements as the design progresses.

3.2 Project Background

The Next Generation Very Large Array (ngVLA) is a project of the National Radio Astronomy Observatory (NRAO) to design and build an astronomical observatory that will operate at centimeter wavelengths (25 cm to 0.26 cm, corresponding to a frequency range extending from 1.2 GHz to 116 GHz). The observatory will be a non-reconfigurable synthesis radio telescope operating in a phased or interferometric mode.

The signal-processing center and the majority of antennas will be located at the Very Large Array site on the Plains of San Agustin, New Mexico. Operations will be conducted from both the VLA Site and the Array Operations and Repair Centers in Socorro, NM.

3.3 General Array Configuration Description

The description of the array that satisfies the following requirements can be found in the Array Configuration Design Description document [RD33] (further details can be found in ngVLA memo 92 on the Rev D configuration used for this design review). We briefly review it here for completeness.

The ngVLA array design includes three subarrays: the main interferometric array, the short baseline array, and the long baseline array. Antennas within the main array are distributed over a range of physical scales and with different geometries in order to fulfill different science use cases:

- A semi-random, condensed core providing high surface brightness sensitivity at ~500 mas resolution at 1cm.
- A multi-arm spiral capable of high-fidelity snapshot imaging down to ~60 mas at 1cm.
- A multi-arm spiral on longer baselines for imaging down to ~2 mas at 1cm.

The main array will be augmented by a compact array of smaller antennas that will provide sensitivity on larger angular scales (the Short Baseline Array or SBA), and approximately 4 antennas of the main array will be equipped to measure total power in order to fill in the center of the (u,v) plane (the Total Power Array or TPA). Additionally, a long baseline array (LBA) consisting of ten outlying stations will provide intercontinental-scale baselines for achieving resolutions of ~0.1 mas.

The configuration working group plans to have, by PDR, an optimized set of configurations that meet the requirements for the Key science and fulfill the envelope science program. The deliverables from the Configuration working group will be a set of antenna locations in ICRF Earth-centered XYZ coordinates, and longitude, latitude, elevation, in a format that can be incorporated into SIMOBSESVE in CASA. These configurations and simulation tools are located at: https://ngvla.nrao.edu/page/tools

3.4 Key Performance Parameters

This section provides Key Performance Parameters (KPPs) that the designer should estimate and NRAO should monitor throughout the project design phase. The KPPs strongly influence the eventual effectiveness of the facility and are useful high-level metrics for trade-off decisions. These parameters are of higher importance to NRAO, so improved performance above the requirement is desirable. Section 4 discusses the KPPs' impact on system-level performance.

The technical requirements are generally specified as *minimum* values to give the designer latitude in optimization for a balanced design. Understanding the anticipated performance of the array configuration (not just its specified minimum) based on these parameters assists in system-level analysis and performance estimation. These parameters may also be useful for determining the relative priority of the requirements documented in Section 4 and can assist in the required analysis should tensions be identified between requirements, or reductions in capability be required to fit within cost constraints.

Table 1 shows the KPPs identified for monitoring. For the configuration imaging performance, the primary points of reference are the simulations of sensitivity vs. resolution, with weighting appropriate to obtain a synthesized beam adequate to perform the Key Science Programs. This analysis will be presented in an Imaging Performance Report. Figure 1 (on the next page) shows the current analysis on sensitivity versus resolution.

Key Performance Parameter	**Req. No.**
Highest angular resolution, Main Array @ 30 GHz	SYS1301, SCI0103, SCI0108
Highest angular resolution, LBA @ 30 GHz	SCI0118
rms/rms_{NA} versus angular resolution	SCI0100, SCI0102, SCI0107
Largest Recoverable Scale with the SBA	SCI0104
Fiber Utility Length	CON001, SYS2802
Percentage of Sites off Private or BLM land	CON001, SYS2802

Table 1: Key performance parameters for monitoring during design.

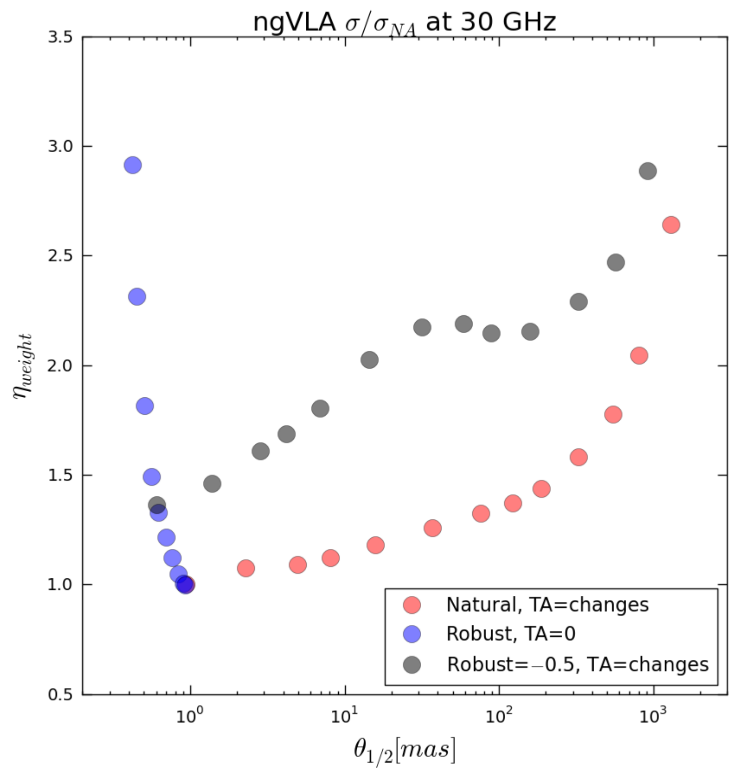

Figure SEQ Figure * ARABIC 1: Image noise (rms) at different angular resolutions (FWHM) achieved by varying the imaging weights, simulated at 30 GHz. The noise has been scaled relative to that of the naturally weighted image (rms_{NA}). The red symbols correspond to use of a uv-taper and natural weights, and the blue symbols to Briggs robust weighting without a taper. The gray symbols are for Briggs robust = –0.5 and a varying uv-taper, which considerably improves beam quality (see ngVLA memo 55).

3.5 Summary of Array Configuration Performance Requirements

Following is a summary of the major requirements in order to provide the reader with a high-level view of the desired system. Should there be a conflict between the requirements listed here and the descriptions in Section 4, the latter shall take precedence.

The array configuration is designed to perform a broad range of science programs, ranging from:

1. High resolution (10 mas at 30 GHz), sensitive observations of exoplanets forming on AU-scales (T_B ~3 K in one hour at 10mas resolution at 30GHz in continuum), to
2. Good surface brightness sensitivity observations at 100 mas of molecular gas in distant galaxies (T_B ~8K at 100mas resolution at 30GHz and 10 km s^{-1} spectral resolution), to
3. Imaging of large-scale structures in nearby galaxies at ultra-low surface brightness at 1000 mas resolution (T_B ~1mK in one hour in the continuum at 30GHz).

The configuration design reflects the multi-scale requirements from the array science case. The ultimate sensitivity as a function of resolution will depend critically on the specific synthesized beam for the science application in question, but as a guiding principle, we have adopted the goal of roughly a factor two loss in sensitivity from spatial resolutions ranging from ~0.3 mas to 1000 mas at 30 GHz. For the PSF metric, we have adopted the goal of a <10% skirt at a radius from the beam center = FWHM. Current simulations suggest this is adequate for many of the key science goals. Further testing is in progress in this area.

The primary parameter defining the configuration is total collecting area, which dictates the maximum sensitivity of the array. Related to this is the distribution of antennas across the array, which dictates the relative sensitivity at a desired spatial resolution. This total collecting area requirement derives ultimately from spectral line sensitivity requirements (SCI0102), which states: *A line sensitivity of 30 Jy/bm/km/s for frequencies between 10 and 50 GHz is required to support both astrochemistry studies and deep/blind spectral line surveys. A line sensitivity of 1–750 mK at 5"–0.1" angular resolution and 1–5 km/s spectral resolution between 70 and 116 GHz is required to simultaneously support detailed studies of CO and variations in gas density across the local universe.*

The maximum baseline in the Main array requirement flows from the angular resolution requirement, SCI0103: *A synthesized beam having a FWHM better than 5 mas with uniform weights is required at both 30 and 100 GHz.* For the LBA, the maximum baseline requirement is set by SCI0118: *A 0.7 mas synthesized beam at 10 GHz is required to support measurement of proper motions for GW events at a distance of 200 Mpc.*

The number of antennas on the Plains is dictated by image fidelity requirements and sensitivity on scales of 100 mas at 30 GHz, SCI0108: *The ngVLA should produce high fidelity imaging (>0.9) over a wide range of scales, spanning from a few arcmin to a few mas*. The snap shot fidelity requirement, SCI0109, states: *The ngVLA snapshot performance should yield high fidelity imaging on angular scales >100 mas at 20 GHz for strong sources.*

The distribution and number of antennas in the Main array is set by dynamic range requirements for deep fields SCI0113: The system brightness dynamic range shall be >45 dB to support deep field studies at 8 GHz and >35 dB to support deep continuum imaging of nearby galaxies at 27 GHz, as well as by imaging requirements of proto-planetary disks SCI0100: An rms noise of ~0.07 Jy/bm @30 GHz and 0.5 Jy/bm @100 GHz is required for studying protoplanetary disks. We note that a higher dynamic range (i.e., > 45 dB) is likely required to detect the same population of sources at lower frequencies, but this is not a high scientific priority.

The diameter and number of antennas in the core is set by the surface brightness sensitivity requirements on the larger scales of SCI0102: *A line rms noise of 1–750 mK at 5"–0.1" angular resolution and 1– 5 km/s spectral resolution between 70 and 116 GHz is required to simultaneously support detailed studies of CO and variations in gas density across the local universe.*

The parameters for the SBA and total power system are derived to perform very low surface brightness observations of extended objects. The details relating to the science and the requirements are given in ngVLA memo 43. The requirements flow from the Largest Recoverable Scale (SCI0104), and the need to have matched surface brightness sensitivity on the longer baselines of the SBA and the main array core. For reference, SCI0104 states: *Angular scales of >20" x (116 GHz/ν) must be recovered at frequencies ν <116 GHz. A more stringent desire is accurate flux density recovery on arcminute scales at all frequencies*.

4 Array Configuration Functional and Descriptive Requirements

These requirements apply to a properly functioning system, under the normal operating environmental conditions unless otherwise stated.

As elaborated in [RD33], the combination of spatial scales of interest, operational cost considerations, and practicalities of the antenna design leads to a multi-component configuration:

1. A main interferometric array of 214 x 18m apertures, with three distinct sub-components:
   a. Core Sub-Component: 114 18m antennas with minimum spacings of 39m (set by antenna design), distributed to a maximum radius of 2.2 km from the center of the Main Array;
   b. Spiral Sub-Component: 54 18m antennas distributed from a 2.3km radius from the Main Array center to a maximum radius of 20 km;
   c. Mid Sub-Component: 46 18m antennas distributed from a minimum radius of 26 km from the Main Array center to a maximum radius of 700 km;
2. A long baseline array of 30 x 18m apertures;
3. A short baseline array of 19 x 6m apertures; and
4. A total power array of approximately[1] 4 x 18m apertures (that are part of the 214 main array).

This fundamental array architecture is assumed in the derivation of these array configuration requirements. The aperture sizes selected are informed by a series of trade studies [RD32] and practical considerations identified by the antenna designers.

4.1 Total Collecting Area and Antenna Requirements

Parameter	Req. #	Value	Traceability
Main interferometric antenna aperture	AAC0101	18m diameter	SCI0104, SCI0106, SCI0100, SCI0102
Geometric collecting area, main array	AAC0102	54,456 m^2	SYS1021, SYS1306, SCI0100, SCI0102, SCI0106
Core sub-component collecting area	AAC0103	A minimum of 45% of the array collecting area shall be located within 2.5 km of the array vertex.	SYS1306, SCI0104, SCI0102, SCI0106
Spiral plus Core sub-components collecting area	AAC0104	46,300 m^2	SYS1306, SCI0106, SCI0109, SCI0108

[1] The detailed TP system specification (including the optimum number of TP antennas) is actively under development and will be determined in CY2022 according to the current project plan.

Parameter	Req. #	Value	Traceability
Long baseline array collecting area	AAC0105	7,634 m^2	SCI0117
Long baseline antenna aperture	AAC0106	18 m diameter	SYS1101, SYS2802
Short baseline antenna aperture	AAC0107	6 m diameter	SYS1302, SYS2802
Short baseline array: Number of elements	AAC0108	19	SYS2802
Total power sensitivity	AAC0109	Total power antenna(s) shall have sufficient sensitivity in aggregate to match the surface brightness sensitivity of SBA in observing times that are equal within a factor of four, with a goal of equal times.	SCI0104, SYS1304

Note that the total number of elements within the main interferometric array and short baseline array can be adjusted so long as the total system construction and operations cost requirements (CON001, CON002) are not violated. Aperture diameters are provided here as requirements based on the selected system architecture with traceability back to the antenna requirements. Both aperture sizes can be revisited within small ranges but have practical constraints that are accounted for in AAC0101 and AAC0207. Note that the number of antennas in the SBA also has a strong impact on *u,v* coverage, with fewer antennas being disfavored for this reason.

4.2 *Spatial Scales*

Parameter	Req. #	Value	Traceability
Main interferometric array: Longest baseline	AAC0201	The longest baseline between antennas shall be greater than 650 km, preferably ~ 1000 km.	SYS1301, SCI0103; KSG1-001, KSG1-003, KSG2-001
Main interferometric array: Shortest baseline	AAC0202	The main interferometric array shall have baselines shorter than 50m but no shorter than 38m, with a goal of complete snapshot uv-coverage within this range..	SCI0104
Core sub-component, maximum baseline	AAC0203	5 km	KSG3 (HIZ1, NGA8)

Parameter	Req. #	Value	Traceability
Spiral sub-component maximum baseline	AAC0204	39 km	KSG2, KSG5
Long baseline array: Longest Baseline	AAC0205	8794 km	SCI0118 [KSG5-001, KSG5-002]
Short baseline array: Shortest Baseline	AAC0206	The SBA shall provide baselines as close as practical to 11m, but not less than 11m.	SYS1302, SCI0104; KSG3-005 KSG2-004
SBA: longest baseline	AAC0207	> 1.5x minimum 18m antenna baseline in core	SCI0108, SCI0104
Zero spacing/single dish total power	AAC0208	It is a goal that the system measures total power, with apertures larger than 1.5x the shortest interferometric baseline when observing zenith.	SYS1303, SCI0104, KSG3-005, KSG2-004

4.3 Distribution of Collecting Area

Parameter	Req. #	Value	Traceability
Compact core	AAC0301	The system shall include a compact core. At minimum, 45% of the array collecting area shall be located within 2.5 km of the array vertex.	SYS1306 SCI 0104 SCI 0102; KSG3
Radial distribution of baselines	AAC0302	The distribution of baselines in a single integration snapshot at zenith with the ngVLA main array shall meet the requirements in Table 2 (below), where A1 is the geometric collecting area of a single antenna in the array and N(b; b1 < b < b2) is the number of baselines between lengths b1 and b2.	SYS1306; SCI0107, SCI0108, SCI0109; KSGs 1–5
SBA compactness	AAC0303	The SBA antennas will be as compactly arranged as feasible to image a field equivalent to the primary beam of the Main array antennas with similar brightness sensitivity on the overlapping angular scales.	SCI0104, SCI0108

Parameter	Req. #	Value	Traceability
Integration time ratios	AAC0304	The main interferometric array, short baseline array, and total power array shall sample overlapping spatial scales. The ratio of integration time on one array to the other on these scales shall not exceed a factor of four with a goal of matched integration times.	SYS1304, SCI0104

The array collecting area is distributed to provide high surface brightness sensitivity on a range of angular scales spanning from approximately 10 mas to 1000 mas. A large fraction of the collecting area is in a randomly distributed core to provide high snapshot imaging fidelity and there are arms extending asymmetrically out to ~1000 km baselines to fill the (u,v)-plane via Earth rotation and frequency synthesis. The specific distribution of sensitivity as a function of baseline length was developed and refined by considering the aggregate demands of driving and identified science use cases [RD29, RD30].

Baseline Span: b1, b2	Collecting Area: A1 * Sqrt(N(b; b1< b<b2))
38 m, 100 m	1,600 m^2
100 m, 1 km	11,750 m^2
1 km, 4 km	17,900 m^2
4 km, 20 km	18,380 m^2
20 km, 500 km	21,250 m^2
> 500 km	9,000 m^2

Table 2: Sensitivity as a function of baseline length. This metric is defined in terms of *baselines*, not number of antennas within a nominal radius.

4.4 Total Power Recovery

Total power antennas will accommodate the specific requirements of total power observing such as rapid, accurate slewing (for OTF) and relatively higher signal stability. TP-specific requirements that are implied are a deliverable of the Total Power Working Group (TPWG) to be provided by the PDR, as described in Section 5.5 of [RD33].

Parameter	Req. #	Value	Traceability
TP antennas	AAC0401	Total power antennas and subsystems will be identical to antennas of main interferometric array to extent possible. The four TP antennas are included as part of the 118 Core antennas.	SCI0104 SYS2802

TP-specific needs	AAC0402	There is no requirement AAC0402	SCI0104

4.5 Site Selection Performance Requirements

Parameter	Req. #	Value	Traceability
Performance up to 3 mm: Opacity	AAC0501	It is desired that all main array sites have Opacity <10% at 90 GHz for >30% of the year.	SCI0001, SCI0100, SCI0102
Performance up to 3 mm: Phase stability	AAC0502	It is desired that all sites have phase stability that allows for residual rms phase <30 deg using fast switching phase calibration with a 30 sec cycle time at 90 GHz, for >30% of the year.	SCI0001, SCI0100, SCI0102

4.6 Site Selection Regulatory Requirements

Parameter	Req. #	Value	Traceability
Land ownership	AAC0601	It is desired that sites on private and BLM land be prioritized. USFS and Tribal properties shall be avoided when possible.	CON001, SYS2802
Environmental impact	AAC0602	Sites shall be screened for environmental impact, such as overlap with identified endangered species habitat.	CON001, SYS2802

4.7 Site Selection Logistics and Interface Requirements

Parameter	Req. #	Value	Traceability
Station access roads	AAC0701	It is desired that all sites be within 2 km of an existing road or access point.	CON001, SYS2802, STK2401
Maintenance access	AAC0702	Sites shall have clear access for maintenance at all times. I.e. no predicted access restrictions or seasonal roads.	CON001, SYS2802
Station proximity to power lines	AAC0703	It is desired that all sites be within 2 km of an existing three-phase power line.	CON001, SYS2802

Parameter	Req. #	Value	Traceability
Station proximity to high bandwidth optical fiber	AAC0704	It is desired that all sites be within 2 km of an existing fiber optic network.	CON001, SYS2802
Fiber optic transmission lengths	AAC0705	Sites shall be selected assuming "home run" fibers are required from the site to the correlator. Total fiber transmission distances shall be minimized through shared right-of-way and trenches.	CON001, SYS2802
RFI mitigation	AAC0706	It is desirable that sites limit line of sight to public roads, transmitters, and other known sources of RFI.	SYS1203, SYS1204
Site safety and security	AAC0707	It is desirable that sites have rural neighbors who may provide indirect site security checks.	CON002, SYS2802

Antenna positions should be such that access is readily available for regular and emergency maintenance visits. Antennas should be located as best as possible away, or terrain-shielded, from significant sources of terrestrial interference, such as cell phone towers, radio transmitters, airport or other radars, and related.

5 Documentation Requirements

5.1 Technical Documentation

All documentation and electronic files related to array configuration shall meet the following requirements:

- The language used for written documentation shall be English.
- Drawings shall be generated according to ISO standards and use metric units or decimal lat/lon.
- The electronic document formats are Microsoft Word and Adobe PDF.

Any deviation from the above shall be agreed to by the ngVLA project office.

5.2 Software and Software Documentation

The primary configuration analysis software will be supported within the CASA package. Deliverables will include

- Configuration file for the ngVLA interferometric array (244 18m antennas).
- Configuration files for the components of the main array, i.e. core only (114 18m antennas), core + spiral (168 18m antennas).
- Configuration file for the SBA (19 6m antennas).
- Configuration file for the LBA (30 18m antennas).

- Support of the SIMOBSERVE tool, and related tools, to generate simulated observations of relevant astronomical sources.
- Support of the imaging tools in CASA that optimize the array performance (image sensitivity and dynamic range as a function spatial resolution).

6 Appendix

6.1 Abbreviations and Acronyms

Acronym	Description
AD	Applicable Document
BLM	Bureau of Land Management
CDR	Conceptual Design Review
EIRP	Equivalent Isotropic Radiated Power
EM	Electro-Magnetic
FDR	Final Design Review
FOV	Field of View
FWHM	Full Width Half Max (of Primary Beam Power)
ICD	Interface Control Document
IF	Intermediate Frequency
KPP	Key Performance Parameters
KSG	Key Science Goal
MTTR	Mean Time To Repair
ngVLA	Next Generation VLA
PDR	Preliminary Design Review
PSF	Point Spread Function
RD	Reference Document
RFI	Radio Frequency Interference
RMS	Root Mean Square

Acronym	Description
AD	Applicable Document
BLM	Bureau of Land Management
CDR	Conceptual Design Review
RSS	Root of Sum of Squares
RTP	Round Trip Phase
SAC	Science Advisory Council
SBA	Short Baseline Array
SNR	Signal to Noise Ratio
SRSS	Square Root Sum of the Square
SWG	Science Working Group
TAC	Technical Advisory Council
TBD	To Be Determined
TP	Total Power
USFS	United States Forest Service
VLA	Jansky Very Large Array

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