Array Configuration: Technical Requirements

020.23.00.00.00-0001 REQ

Status: **RELEASED**

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Change Record

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
D	2025-09-18	Mason		Updates ECR-0004: AAC0104 area corrected. Table 2 last line area increased. AAC0401 removed core antenna count. Removed AAC0501, AAC0502, AAC0601, AAC0701, AAC0703, AAC0704, AAC0706, and AAC0707 (site criteria now in [RD49]). Add references to site dev. work and TP system concept + requirements.

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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], the configuration 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 spread sheet [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
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

Ref. No.	Document Title	Rev/Doc. No.
RD26	Configuration: Reference Design Rev D Description	ngVLA Memo #92
RD27	Preliminary ngVLA Observing Band Availability Estimate	ngVLA Memo #73
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
RD32	System Level Evaluation of Aperture Size	ngVLA Antenna Memo #2
RD33	Array Configuration: Design Description	020.23.00.00.00-0002 DSN
RD34	Configuration: Rev E Staggered Spiral Tests	ngVLA Memo #100
RD35	Enhanced Central Condensation Options for the Configuration of ngVLA MID	ngVLA Memo #102
RD36	Rev E MID Tests: Sensitivity at 7mas Resolution	ngVLA Memo #104
RD37	Suggested Changes to ngVLA LONG	ngVLA Memo #105
RD38	First characterization of MID locations in Northern Mexico	ngVLA Memo #111
RD39	High Dynamic Range Imaging at 8 GHz at 1mas Resolution	ngVLA Memo #112
RD40	ngVLA Dynamic Range Requirements	ngVLA Memo #113
RD41	High Dynamic Range Imaging at 8 GHz with Spiral and Core, Including Phase Errors	ngVLA Memo #114
RD42	Subarray Study for the Envelope Observing Program	ngVLA Memo #121
RD43	Characterization of the synthesized beam with and without MID antennas in Mexico	ngVLA Memo #122
RD44	Candidate Phase Calibrators at 93GHz in the ngVLA Sky: Developments Since 2022	ngVLA Memo #123
RD45	A Comparison of the Imaging Capabilities of RevF and RevE ngVLA Configurations for Protoplanetary Disk Studies	ngVLA Memo #127
RD46	Transitioning to Rev F: Site Development Considerations	ngVLA Memo #129
RD47	The Total Power Array Concept of Operations & System-Level Requirements	020.27.00.00.00-0001 REQ
RD48	Analysis of ngVLA Rev E Mid Sites Using GIS	ngVLA Memo 124
RD49	ngVLA Antenna Site Selection Criteria	020.23.00.00.00-0005 MEM

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.

Sections 3.2 and 3.3 provide background on the project, and a high-level description of the array configuration. 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. Section 3.5 summarizes the scientific performance requirements.

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.

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 memos 102, 104, 111, 122, and 124. Some of the technical investigations that evaluating the design options are documented in [RD20, RD29, RD30, RD34, RD35, RD36, RD37, RD38, RD39, RD40, RD41, RD42, RD43, RD44, RD45, RD46]; detailed, GIS site analysis of specific sites is presented in [RD46, RD48, RD49].

We briefly review the design here for completeness and context:

The ngVLA array design includes three components: 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 ~700 mas resolution at 1cm.
- A multi-arm spiral capable of high-fidelity snapshot imaging down to ~80 mas at 1cm.

- A multi-arm spiral on longer baselines for imaging down to ~3 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). In addition, at least 4 antennas in the core sub-component will be usable to measure total power in order to fill in the center of the (u,v) plane (the Total Power Array or TPA [RD47]). It is possible that other antennas will also be capable of scientifically useful total power observations, at least for some use cases. A long baseline array (LONG) — consisting of ten outlying stations with 3 antennas each — will provide intercontinental-scale baselines for achieving resolutions of ~0.1 mas.

Current and previous revision configuration files are kept for internal use at https://gitlab.nrao.edu/ngvlascisupport/ngvla-configurations with a public-facing description of the currently planned configuration maintained at https://ngvla.nrao.edu/page/array-config.

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.

Table 1: Key performance parameters for monitoring during design.

Key Performance Parameter	**Req. No.**
Highest angular resolution, Main Array @ 30 GHz	SYS1301, SCI0103, SCI0108
Highest angular resolution, LONG @ 30 GHz	SCI0118
rms/rms_{NA} versus angular resolution	SCI0100, SCI0102, SCI0107
Largest Recoverable Scale with the SBA	SCI0104

3.5 Summary of Array Configuration Performance Requirements

Following is a summary of the major requirements 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, as well as the subarray used for the observation. As a guiding principle, we have adopted the goal of achieving angular resolutions ranging from ~0.3 mas to 1000 mas at 30 GHz with a loss of roughly a factor of two or less in sensitivity, relative to natural weighting. 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 LONG, 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 snapshot 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 ~0.07micro-Jy/bm at 30 GHz and 0.5 micro-Jy/bm at 100 GHz is required for studying protoplanetary disks.

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 requirements for the SBA and total power system are derived to perform very low surface brightness observations of extended objects [RD12, RD18, RD25, RD47]. They 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.

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	42,300 m^2	SYS1306, SCI0106, SCI0109, SCI0108
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. The aperture sizes selected are informed by a series of trade studies [RD32] and practical considerations identified by the antenna designers.

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)
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 equal or exceed the values given 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
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].

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

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	8,500 m^2

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 are described in [RD47].

Parameter	Req. #	Value	Traceability
TP antennas	AAC0401	Total power antennas and subsystems will be identical to antennas of the main interferometric array to the extent possible. The TP antennas shall be included as antennas in the core sub-component.	SCI0104 SYS2802

4.5 Site Selection Performance Requirements: atmospheric attenuation and stability

There are no firm requirements that every site must meet regarding atmospheric attenuation and stability. The criteria and guidelines for antenna site choice, in this regard, are discussed in [RD33, RD47, RD48, RD49].

4.6 Site Selection Regulatory Requirements

Parameter	Req. #	Value	Traceability
Environmental impact	AAC0602	Sites shall be screened for environmental impact, such as overlap with identified endangered species habitat.	CON001, SYS2802

Other antenna site location criteria related to regulatory criteria are discussed in [RD33, RD47, RD48, RD49].

4.7 Site Selection Logistics and Interface Requirements

Parameter	Req. #	Value	Traceability
Maintenance access	AAC0702	Sites shall have clear access for maintenance at all times. i.e. no predicted access restrictions or seasonal roads.	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

More detailed discussion of the guidelines used to optimize the selection of individual sites is given in [RD33, RD46, RD48, RD49].

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, with geographic latitude and longitude in decimal degrees.
- 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 Configuration Files

Files describing the array configuration will be delivered in a format compatible with RADPS once the relevant functionality is available and adopted by the Project. CASA-compatible configuration files will be provided while CASA remains supported by NRAO for ngVLA simulations and analysis; thereafter, they are optional. Delivered files will include:

- Configuration files for the components of the main array: core, spiral, and MID.
- Configuration file for the SBA (19 6m antennas).
- Configuration file for LONG (30 18m antennas).

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
RSS	Root of Sum of Squares
RTP	Round Trip Phase
SAC	Science Advisory Council

Acronym	**Description**
AD	Applicable Document
BLM	Bureau of Land Management
CDR	Conceptual Design Review
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