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# SANSA NASA Matjiesfontein Site Requirements Specifications



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|---|---|---|
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# Abbreviations

| | |
|---|---|
| AIT | Assembly, Integration, and Testing |
| DCN | Document Change Note |
| DGS | Data Ground Segment |
| EMC | Electro-Magnetic Compatibility |
| EMI | Electro-Magnetic Interference |
| EO | Earth Observation |
| ICASA | Independent Communications Authority of South Africa |
| ICD | Interface Control Document |
| IRS | Interface Requirement Specification |
| ITU | International Telecommunications Union |
| MCS | Mission Control System |
| MOC | Mission Operations Centre |
| NA | Not Applicable |
| PMP | Programme Management Plan |
| QA | Quality Assurance |
| SA | South Africa |
| SACSA | South African Council for Space Affairs |
| SADC | Southern African Development Countries |
| SAEOS | South African Earth Observation Strategy |
| SANSA | South African National Space Agency |
| SAWS | South African Weather Services |
| SEMP | System Engineering Management Plan |
| SO | Space Operations, SANSA |
| SS | Space Segment |
| TBC | To Be Confirmed |
| TBD | To Be Defined |
| TRS | Technical Requirement Specification |
| TT&C | Telemetry, Tracking & Command |
| UHF | Ultra-High Frequency |
| UPS | Uninterruptable Power Supply |
| VHF | Very High Frequency |

## Table 1: General Definitions

# 1 SCOPE

## 1.1 PURPOSE

The purpose of this specification document is to have a high-level overview of the NASA site requirements specification to allow SANSA to have a holistic understanding of the high-level requirements.

## 1.2 MISSION OBJECTIVES

The National Aeronautics and Space Administration (NASA) is considering entering a partnership with the South Africa National Space Agency (SANSA) to implement a multi-purpose, multi-agency space exploration site near Matjiesfontein (MTJ), South Africa (SA). The site will house both NASA-sponsored and SANSA-sponsored capabilities and will be extendable to house additional capabilities consistent with the missions of NASA and SANSA.

The proposed site is located near the town of Matjiesfontein, a small tourist town situated in the Western Cape Province, an arid region of the Republic of South Africa (RSA), between Cape Town and the South African Large Telescope (SALT). Cape Town is approximately 150 miles southwest of MTJ and SALT is approximately 80 miles northeast of MTJ. The land on which the town is situated has been willed in a trust for the use of education and technology, and already hosts some geodesy infrastructure.

## 1.3 CONTENT

This document provides a high-level description of the entire LEGS 2 programme at Matjiesfontein site in South Africa. The format of this document is based on ECSS-E-ST-10-06C, Space Engineering Technical Requirements Specification.

## 1.4 APPLICABILITY

This document provides a broad overview of the programme to enable engineers to develop concepts and implementing designs to meet the high-level user requirements.

## 1.5 CLASSIFICATION

This document is classified as “Confidential”. It may be accessed by all personnel within SANSA and NASA working on this programme and contractors and other stakeholders as decided by the SANSA project team.

# 2 RELATED DOCUMENTS

## 2.1 APPLICABLE DOCUMENTS

The following are applicable documents and are related to this document. The (latest revisions of the) documents listed below form part of this document and are applicable to the extent specified herein.
Applicable documents MUST therefore be read in conjunction with this document.

**ORDER OF PRECEDENCE**

In the event of a conflict between the text of this document and the applicable documents cited here, the text of this document shall take precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

| Document Name | Document Revision | Document Number |
|---|---|---|
| [1] Project SANSA NASA Agreement<br>[2] Project SANSA NASA Contract | | |

## 2.2 REFERENCE DOCUMENTS

The following are reference documents which provide background or supplementary information that might assist the reader in understanding this document.

| Document Name | Document Revision | Document Number |
|---|---|---|
| [3] Project Management Plan | | TBD |
| [4] Space Engineering - Ground systems and operations -Part 1: Principles and requirements | | ECSS-E-70 Part 1A |
| [5] SENSE-LEGS-SPEC-001_DRAFT | | SENSE-LEGS-SPEC-001_DRAFT |
| [6] Lunar Exploration Ground Site (LEGS) 2 Facilities Requirements Document (FRD) | | LEGS 2 FRD 459-FRD-LEGS_Rev5 |
| [7] NASA SANSA Study Agreement | | |

# 3 REQUIREMENTS

## 3.1 REQUIREMENT OVERVIEW

This document captures the requirements for the SANSA deep space network site which will be located at Matjiesfontein town.

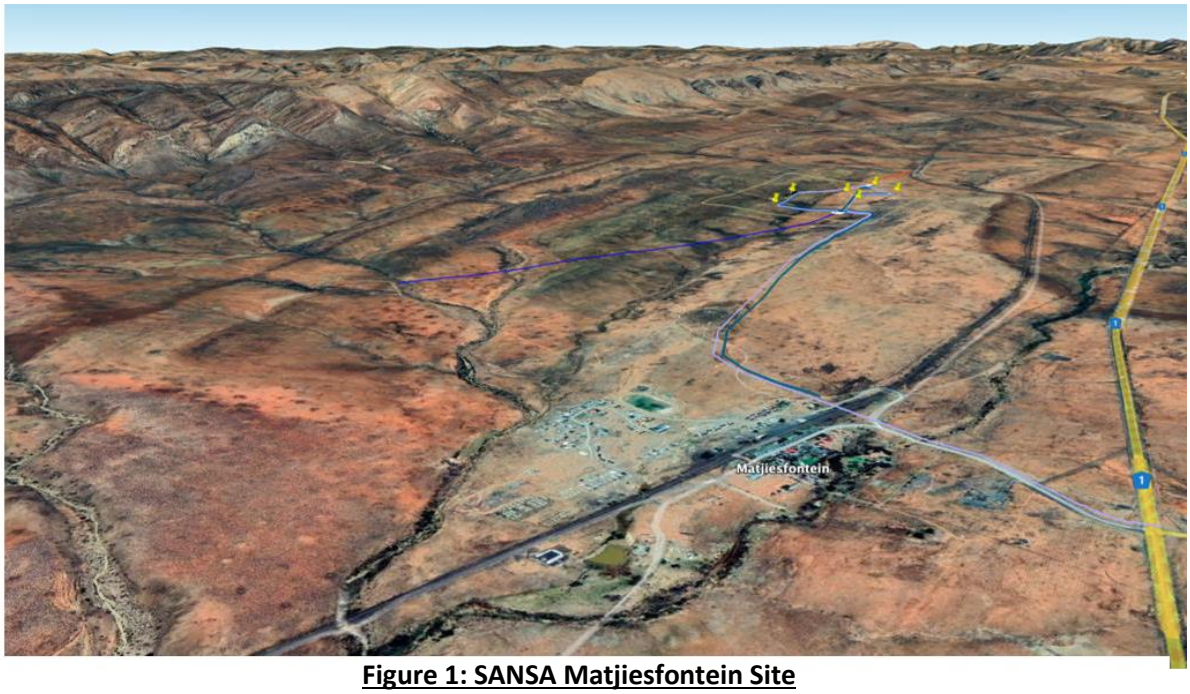


**Figure 1: SANSA Matjiesfontein Site**

Figure 2 is a Google Earth image indicating the location of SANSA NASA deep space network site in relation to Matjiesfontein town.

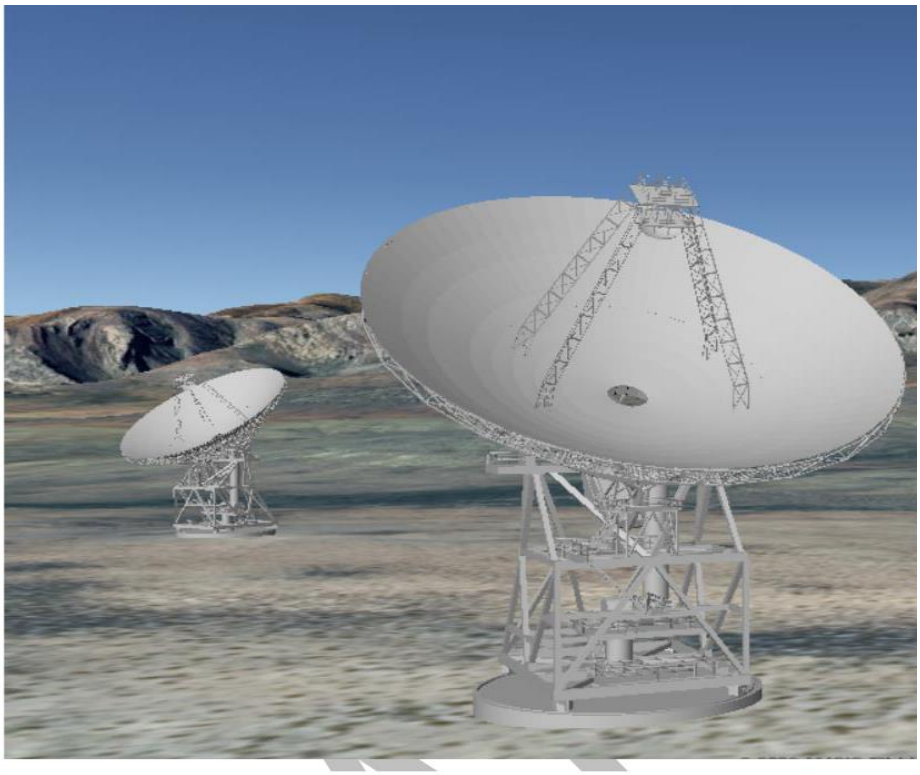

**Figure 2:Deep Space Network at Matjiesfontein**

Figure 3 is a model image indicating the location of SANSA 18-24-meter-deep space network antennas to be located at Matjiesfontein site.

**GENERAL REQUIREMENT**

REQ_1 Inherent availability

The SANSA Matjiesfontein ground station shall have the 99,95% availability.

REQ_2 Relevant legislations

The SANSA Matjiesfontein ground station site shall comply to the following legislations:

- Facilities Regulations GNR .924 OF 2004.
- National Buildings Regulations R1081 of 1988.
- Environmental Regulations for Workplaces GNR.2281 of

1998. REQ_3 Operation availability

The SANSA Matjiesfontein ground station site shall enable the operation of the site 24/7 during LEGS critical events.

REQ_4 RF safety standard

The SANSA Matjiesfontein site shall comply with NASA RF Safety requirements and the NPR 2570.1C NASA Radio Frequency (RF) Spectrum Management Manual.

REQ_5 RF analysis

SANSA shall conduct an RF analysis for building /antenna blockages from the LEGS 2

antenna asset. NASA shall conduct a concurrent analysis.

REQ_6 Manlift/Craneduct

The SANSA Matjiesfontein facilities shall have manlift or crane to be for use by LEGS 2 personnel. Lift shall be able to fit through a redone entrance door.

REQ_7 Generator

SANSA shall provide information on Diesel generator fuel supply, including, capacity, and delivery time. Diesel shelf life is six months as per SIRD draft document.

REQ_8 Construction documents

SANSA shall provide Matjiesfontein ground station construction documents to NASA for QA/QC review prior to final issue for construction.

REQ_9 Design schedules

SANSA shall provide design schedule with design milestones and description of deliverables at each milestone.

- Provide at least 10 business days for NASA review at each milestone. (Review at TIM).
- Provide a specification table of contents.
- Provide submittal matrix – NASA to identify material submittals they wish to review.

REQ_10 Build history

SANSA shall provide as-built record documents of the Matjiesfontein ground station site.

**STANDARDS REQUIREMENT**

REQ_11 Infrastructure code analysis

SANSA shall provide an infrastructure code analysis that references the latest editions of the following codes and/or standards, including but not limited to:

- International Building Code (IBC).
- International Existing Building Code (IEBC).
- International Energy Conservation Code (IECC).
- International Fire Code (IFC).
- International Fuel Gas Code (IFGC).
- International Mechanical Code (IMC).
- International Plumbing Code (IPC).
- International Private Sewage Disposal Code (IPSDC).
- International Code Council A117.1 Accessible and Usable Buildings and Facilities.
- National Fire Protection Association (NFPA), in particular,
  - NFPA 101 Life Safety Code.
  - NFPA 13 – Standard for the Installation of Sprinkler Systems.
  - NFPA 30 Flammable and Combustible Liquids code.
  - NFPA70 – National Electrical Code (NEC).
  - NFPA70E – Standard for Electrical Safety in the Workplace.
  - NFPA72 – National Fire Alarm and Signaling Code.

- NFPA75 – Standard for the Protection of Information Technology Equipment.
- NFPA90A – Standard for the Installation of Air conditioning and Ventilating Systems.
- NFPA110 – Standard for Emergency and Standby Power systems.
- NFPA780 – Lightning Protection.
- NFPA2001 – Standard for Clean Agent Fire Extinguishing Systems.
- NFPA 285 Standard.

- American Society of Civil Engineers (ASCE).
- American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE).
- Americans with Disabilities Act (ADA).
- Architectural Barriers Act (ABA).
- American National Standards (ANSI).
- UL Solutions (Underwriters Laboratory).
- Prevailing municipal and/or country building codes.
- GSFC Codes and standard:
  - NASA-STD-8719.7 – Facility Systems Safety Guidebook.
  - NASA-STD-8719.11B – Standard for Fire Protection and Life Safety.
  - 452-STD-SN-001, Equipment Rack Standard for Space Network Ground Stations.
  - 452-STD-SN-002, Electrical Power System Standard for Space Network Ground Stations.
  - 452-STD-SN-003, Grounding System Standard for Space Network Ground Stations.
  - NPR 1620.3B NASA Physical Security Requirements.

*The most stringent code/standard will dictate design*

**DESIGN/CONSTRUCTION REQUIREMENT**

REQ_12 As-build records

As-built records that include design chances after project construction is completed shall be provided.

REQ_13 Design schedule

A design schedule which includes design milestones and deliverable descriptions for each milestone shall be provided.

REQ_14 Design milestone

Design milestones shall include a Programming Review, 30% Design, 60% Design,90% Design, and Final Design.

REQ_15 Documentation

Documentation and deliverables shall be provided to NASA a minimum of 10 business days prior to each milestone for a joint team review at a Technical Interchange Meeting (TIM).

REQ_16 Programmatic review

The following shall be provided at the Programming Review in addition to the design documents:

- Specifications table of contents
- Submittal matrix.
- NASA to identify material submittals they wish to review REQ_17 Operations and maintenance

Operations and maintenance manuals, of equipment installed shall be provided in AutoCAD, PDF, Word-doc format.

**SITE REQUIREMENT**

REQ_18 Site analysis

Analysis shall be conducted to determine impacts to the watercourse traversing the facility access roads as a result of the LEGS antenna construction.

REQ_19 Landscape plan

SANSA shall provide a landscape plan integrated with the site plan shall be provided.

REQ_20 Site Plan

A site plan that includes all structure locations and future site development shall be provided.

REQ_21 Site Utility Plan

A site utility plan indicating power, domestic/potable water, fire water, and wastewater treatment shall be provided.

REQ_22 Antenna Visibility

A LEGS 2 antenna location study for technical viability of the proposed antenna site shall be conducted.

REQ_23 Antenna location

The LEGS 2 antenna shall be installed at the SANSA ground station site in a mutually agreed upon location.

REQ_24 Site Access

Access to the site shall be 24hr x 7days x 365 days and include access to the LEGS 2 antenna and LEGS 2 related facilities to NASA approved personnel.

REQ_25 Weather Station

The SANSA facility shall include a weather station that provides weather data required for antenna operations.

REQ_26 Site Survey

SANSA shall provide a site survey by a licensed firm with control points for design and construction. The survey shall delineate the location of NASA facilities.

REQ_27 Topographic survey

A topographic survey in AutoCAD Civil 3D of 1m Digital Elevation Map (DEM) or better shall be conducted.

- The ground survey shall locate existing utilities, geometry (edge of road, runway, buildings, drainage features etc.).

- If a LIDAR survey can be performed, a 0.5m (1.64ft) accuracy is desired (1m (3.28ft) is satisfactory).

REQ_28 Ground clearance

The SANSA Matjiesfontein ground station site shall provide a cleared and levelled antenna field and installation area for the LEGS 2 antenna.

REQ_29 Inclination profile

The Matjiesfontein ground station antenna shall be <10 for lunar/deep space profile and <5 around for near earth.

REQ_30 Storm water

The SANSA Matjiesfontein ground station site shall provide positive storm water runoff away from antenna sites and handholes. Foundation must be, as a minimum height, to the equivalent elevation of the adjacent buildings.

REQ_31 Water ways

Naturally occurring waterways shall be diverted or channelled away from the LEGS 2 antenna sites.

REQ_32 Antenna site

The LEGS 2 antenna site and antenna install area shall be cleared and grubbed of all existing vegetation.

REQ_33 Staging area

The SANSA Matjiesfontein ground station site shall provide an equipment and antenna assembly staging area approximate size 324m² (approx. 60ft x 60ft). Equipment pad shall have grounding connection to be used during antenna assembly.

REQ_34 Construction

The SANSA Matjiesfontein ground station site shall provide construction access to the antenna field.

REQ_35 Access roads

SANSA Matjiesfontein ground station access roads shall be as follows:

- Access roads at each site shall be made to address water flow impacts due to the LEGS antenna construction/installation.
- A paved access road to the LEGS 2 antenna area.
- SANSA shall ensure that the antenna pad area shall be 60m x 60m (approx. 200ftx200ft) to allow room for antenna and crane access.
- SANSA shall ensure that the roads can accommodate the antenna vendor width and loading requirements for cranes.
- SANSA shall provide site access roads to NASA's antenna (5m wide).

REQ_36 Safety practices

SANSA shall implement RF safety practices to avoid radiating over buildings and other structures.

REQ_37 Visitors parking

SANSA shall provide a minimum of 5 (TBR) parking spaces for LEGS 2 personnel and visitors.

REQ_38 Site development

SANSA Matjiesfontein ground station Site development plans shall be as follows:

- SANSA shall provide planned structures locations and future site development plans.
- The SANSA ground station site shall provide a minimum setback from existing structures, roadways, fence lines NPR 1620.3a Section 3.9.1.h, Fence lines 30ft and perimeter lighting.

REQ_39 Frequency spectrum

The SANSA Matjiesfontein ground station site shall have clear radio frequency spectrum in the following bands:

- S: 2025- 2120MHz, 2200 – 2300MHz.
- X: 7145 – 7250MHz 8400 – 8500 MHz.
- Ka: 25500-27000MHz 34200-24700MHz.

REQ_40 Environmental conditions

The SANSA Matjiesfontein ground station site shall have the following environmental condition throughout the year:

- Rainfall < 200mm/y.
- Rain rate: 10cm/h.
- Wind: Operational < 75km/h.
- Survivable < 130 km/h.
- Cloudy days < 5days/month.
- -25 < Temp < 50C.
- Solar radiation: < 300BTU/ft^2.
- Hail < 1” in 48km/h wind.
- Snow 30psf.
- Ice 19mm in winds of 64km/h.

REQ_41 Location

The distance form nearest town shall not be more than 50km and the distance from nearest port shall be less than 300km.

REQ_42 Seismic activity

SANSA Matjiesfontein ground station site shall have IBC 2009 seismic design category C requirement.

REQ_43 Soil condition

The soil resistivity in SANSA Matjiesfontein ground station site shall be less than 10

ohms.

REQ_44 EIA

Environmental impact assessments shall be completed with no block elements prior before starting construction.

REQ_45 Medical equipment

Provision for medical equipment shall be made at SANSA Matjiesfontein ground station site as per OSHAS and first aid kits.

REQ_46 Ownership duration

SANSA shall have access to the Matjiesfontein ground station site for at least 40 years.

REQ_47 Lightning protection/grounding/EMC

All SANSA Matjiesfontein ground station facilities shall be designed such that it ensures adequate lightning protection based on international best practices with limited electrical interconnection between facilities (FO preferred). Interconnection between facilities to ensure acceptable isolation for lightning ingress.

REQ_48 Encapsulated area

SANSA Matjiesfontein ground station site shall have Encapsulated area to ensure the elevation mask during the duration of the installation considering future expansion of the site.

REQ_49 Garden services

Natural environment around the facilities at SANSA Matjiesfontein ground station site shall be maintained to agreed standard.

**LANDSCAPE REQUIREMENT**

REQ_50 Civil plan

SANSA team shall provide a landscape plan integrated with the site/civil plan.

REQ_51 Preservation

SANSA shall preserve natural landscape as much as possible.

REQ_52 Vegetations

There shall be no combustibles built or vegetation within 10 (TBR) meters from the LEGS antenna.

REQ_53 Perimeter fence (National Key Point Compliant)

SANSA Matjiesfontein site shall have a clear view 3m high fence as per the EIA.

**STRUCTURAL**

REQ_54 Foundation

The SANSA Facility shall provide the foundation to support the LEGS 2 antenna. The antenna specifications are the following:

- NASA to provide antenna structural foundation requirements to SANSA.
- NASA to provide radome structural foundation requirement to SANSA as needed.

- Antenna diameter.
- Dead Load.
- Live Load.
- Fence line setback.
- Required radial distance from fence.
- Maximum dish height off ground.
- Pedestal and physical dimensions.
- Vibration from antenna movement that affects the foundation.

REQ_55 Geotechnical study

The SANSA Facility will conduct a geotechnical study with borings and soils report by professional engineer and copy of report shall be provided to NASA.

REQ_56 Seismic loads

The seismic loads for the LEGS 2 facility structural design shall be determined in accordance with IBC 2021, based on the maximum considered ground motion accelerations for the location.

REQ_57 Wind loads

The wind loads for structural design shall be determined in accordance with SEI/ASCE 7-22 Risk Category IV. Basic wind speed shall be upgraded to 120 mph (approx. 194km/hr) at antenna stow position.

REQ_58 Drainage system

SANSA shall ensure that the foundation surface is to have positive drainage.

**ARCHITECTURAL REQUIREMENT**

REQ_59 ADA compliance

SANSA shall provide ADA compliant bathrooms available to Ops, maintenance personnel and visitors.

REQ_60 Distance

SANSA shall ensure that the LEGS 2 antenna is at a maximum distance of 500m from the LEGS 2 operations and equipment rooms. (TBR).

REQ_61 Logistics area

SANSA Matjiesfontein ground station site shall make the following provisions for the logistics area:

- If applicable, the SANSA site shall allow for an equipment/spare's storage areas in the SANSA logistics area.
- SANSA shall ensure that any LEGS 2 personnel or visitors have access and use of use of common shipping, receiving, and logistics areas.

REQ_62 NASA required access.

NASA shall have access to the following:

- Conference Room for twenty occupants minimum. Provide electrical circuits suitable for US electronic devices.
- Sleeping Quarters for four people (in shifts).
- Restrooms with showers.
- Staff Amenities such as kitchen, breakroom, laundry facilities.
- Workshop.

REQ_63 Enclosed office

NASA shall have access to one enclosed office and one touchdown space outside of the NASA secure area. These spaces will have access to local Wi-Fi.

REQ_64 ADA standards

SANSA shall ensure that the facility design adheres to the latest ADA standards.

REQ_65 Buildings compliance

The minimum distance required between buildings shall comply with the latest edition of the IBC. All buildings shall adjoin or have access to a public way or yard on not less than one side as defined by the latest edition of the IBC (IBC 2021).

REQ_66 Occupational health and safety

SANSA facility design shall implement the OSHA 29 Part 1910 Occupational Health and Safety standards.

**FIRE DETECTION/ SUPPRESSION REQUIREMENT**

REQ_67 Interface

The SANSA facilities shall have the following interface requirement:

- Interface the LEGS 2 antenna smoke detectors with the main SANSA facility smoke detection system.
- Interface the LEGS 2 antenna fire alarms.

REQ_68 IT

SANSA shall ensure Information Technology Equipment Rooms shall be protected with clean agent system, in accordance with NFPA 75, NFPA 76.

REQ_69 Facilities compliance

All SANSA facilities shall comply with requirements of NFPA 101 Life Safety Code and NASA- STD-8719.11B.

REQ_70 Fire sprinkler

All SANSA facilities shall be protected with fire sprinkler systems where required by NFPA standards.

REQ_71 Fire compliance

Fire protection water supply and firewater pumping shall be provided in accordance with and NFPA 20.

REQ_72 VESDA

The SANSA facilities shall ensure that the LEGS 2 equipment, operations and antenna smoke detection iss provided by a VESDA (Very Early Smoke Detection Apparatus) system.

REQ_73 Redundancy

The SANSA site shall implement redundancy into their smoke and fire alarm system. (Class A signalling line and notification circuits.).

REQ_74 Firewall

SANSA shall provide fire wall of rating as required by NFPA101 and NASA-STD8719.11B at Matjiesfontein ground station site.

**PLUMBING REQUIREMENT**

REQ_75 Antenna radome

If applicable SANSA shall ensure that LEGS 2 antenna Radome has positive slope for drainage or floor drain to storm sewer system or daylight.

**HEATING, VENTILATION, AIR CONDITIONING REQUIREMENT**

REQ_76 Redundant cooling

A site HVAC plan that details redundant cooling and coverage of the LEGS equipment, operations, and antenna areas shall be provided to NASA.

REQ_77 Tier 3 redundancy

The SANSA HVAC design shall provide Tier 3 redundancy (as defined by the Uptime Institute's Data Center Site Infrastructure Tier Standard) for HVAC equipment feeding the LEGS equipment, operations, and antenna areas.

REQ_78 Humidity and temperature

Humidity and temperature requirements shall be provided in the NASA provided room data sheets.

REQ_79 HVAC failure

The HVAC system shall be sized to support the full load of the facility with no single points of failure.

REQ_80 Antenna HVAC

The LEGS 2 antenna HVAC shall be powered by the LEGS facility's utility power bus (TBR) The LEGS antenna high power amplifiers (HPAs) and drive system shall be powered by the LEGS facility technical power bus.

REQ_81 HVAC (N+1) configuration

The minimum level of the HVAC system redundancy shall be an (N+1) configuration.

REQ_82 HVAC cooling

The HVAC systems shall be configured to automatically restore cooling to their spaces upon failure of the primary unit(s).

REQ_83 Facility Infrastructure

The SANSA facilities infrastructure shall provide HVAC with sufficient capacity to maintain room temperature of the LEGS 2 ground equipment area with a heat dissipation of 171 kBTU/hr (TBR).

REQ_84 LEGS 2 humidity

The SANSA facility shall ensure that the LEGS 2 equipment room has a humidity of 40 - 60% (TBR).

REQ_85 Operational rooms HVAC

SANSA facility shall ensure that the LEGS 2 equipment and operational rooms HVAC maintain a room temperature set point of 65 – 70 degrees F (TBR) approx. 18 – 23 degrees C.

REQ_86 Equipment rack standard

SANSA Matjiesfontein ground station equipment racks shall be as follows:

- The LEGS 2 rack equipment hot aisle shall be at the rear of the equipment racks. (In accordance with 452-STD-SN-001 Equipment Rack Standard) .
- If applicable, The LEGS 2 cold aisle shall be in front of the equipment racks. (In accordance with 452-STD-SN-001).

REQ_87 HVAC design

The SANSA HVAC design shall provide N+1 redundancy for HVAC equipment feeding the LEGS equipment and antenna areas.

REQ_88 BMS

- All LEGS building spaces (Ops room, Equipment Spaces, etc) shall be monitored and controlled by SANSA facility BMS. BMS shall report to centralized BMS monitoring systems located at WSC including trouble alarms for both facilities and security systems.
- The LEGS 2 antenna HVAC shall be incorporated into the SANSA facility building management system.

**ELECTRICAL REQUIREMENT**

REQ_89 Site Electrical utility plan

A Site Electrical Utility Plan shall be provided to NASA. A plan will include the following:

- Site drawings that show the physical locations of all transformers, switchgear, panels, power distribution units, uninterruptible power supplies, power conditioning units, isolation switches, generators and temporary facility connections.
- An electrical one line/single line per IEEE 315-1975/ANSI Y32.9 showing power distribution from, and including, the site incoming transformers to the main facility bus.

  Included on the one line/single line should be all distribution within the facility including generators, photovoltaic grid, uninterruptible power supplies, power distribution units, power conditioning units, isolation switches, and temporary facility connections.
- Fuel tank locations and capacities. Fuel delivery locations and any installed polishing systems.

REQ_90 Distribution model

A site power distribution model with power conditioning and backup generation at the appropriate voltages and capacity for LEGS equipment shall be provided.

REQ_91 Tier-3 reliability requirement

The SANSA facility electrical requirements shall meet Tier-3 reliability requirements for 24/7/365 LEGS 2 operations as defined by the UPTIME Institute.

REQ_92 Separate utility

A separate utility power and technical power distribution shall be provided.

REQ_93 Diesel Generators

Data on diesel generator fuel supply, including source, capacity, and delivery time shall be provided to NASA. (Diesel shelf life is six (6) months per SIRD draft document)

REQ_94 Diesel fuel quality

Maintenance of the diesel fuel quality for the diesel generators shall be provided.

REQ_95 Distribution system

SANSA Matjiesfontein ground station electrical distribution system shall comply with the following standards:

- 452-STD-SN-002, Electrical Power Standard for Space Network Ground Stations and.
- 452-STD-SN-001 Equipment Rack Standard for Space Network Ground

Stations. REQ_96 Ground impedance

A ground impedance test in conjunction with the design of the antenna grounding system shall be conducted.

REQ_97 Grounding system

Grounding systems at SANSA Matjiesfontein ground station site shall be as follows:

- The SANSA facility grounding system shall comply with 452-STD-SN-003, Grounding System Standard for Space Network Ground Stations.
- The SANSA facility electrical distribution system shall provide technical power to technical loads at 120/208V, 60Hz.
- The SANSA facility shall provide a technical UPS backed power source and a utility commercial power source.

REQ_98 Final design

A short circuit and relay coordination study on the final electrical system design shall be conducted.

REQ_99 Electrical Compliance

All electrical work and installs shall be in compliance with NFPA 70E.

REQ_100 Power design configuration

SANSA Matjiesfontein ground station design shall include the NASA provided specification/ requirements for the UPS and ensure that NASA concurs with the power design configuration prior to installation.

REQ_101 Power restoration

The electrical power distribution scheme shall be designed to automatically restore power to the LEGS-2 systems within 10 seconds of a loss of commercial/normal power to the load.

REQ_102 Power redundancy

The SANSA Matjiesfontein ground station technical power source and the utility power source shall provide N+1 power redundancy.

REQ_103 Outages prevention

The SANSA ground station site shall provide power backup generators with sufficient fuel storage to eliminate effects of commercial power outages for up to 2 weeks. (TBR).

REQ_104 South African Standard voltage

The electrical power (technical and utility ) shall be delivered at the South Africa standard voltages of 400/230V, 50Hz and will utilize South African standard receptacles (Type M or N).

REQ_105 Facilities power source

The SANSA Matjiesfontein ground station technical power source shall provide power to the LEGS antenna, antenna HVAC, antenna security, LEGS indoor HVAC, lighting, and LEGS equipment.

REQ_106 TVSS

The SANSA Matjiesfontein ground station electrical power infrastructure shall provide transient voltage surge suppression (TVSS) on the LEGS 2 antenna/equipment technical power feed.

REQ_107 Voltage drops

The maximum voltage drop of the antenna technical power feeder shall be less than 3% of the nominal rated voltage.

REQ_108 Automated Switching

Electrical switching operations shall be continuous and automated.

REQ_109 UPS specifications

The SANSA facility design shall include NASA provided UPS specification/requirements.

REQ_110 arc-flash

SANSA ground station facility shall provide appropriate arc-flash calculations and labelling of incident energy levels for the technical power and utility power distribution equipment.

REQ_111 Single point of failures

The SANSA Matjiesfontein ground station power and electrical design shall eliminate technical power distribution single point of failures to the greatest extent possible.

REQ_112 Dual power feeds

SANSA ground station technical power design shall accommodate dual power feeds (a side and b side power) to the antenna and the LEGS 2 equipment racks.

REQ_113 Technical power feeds

The technical power shall have redundant technical power feeds provided for the SANSA

main building.

REQ_114 Back-up generator

Technical and utility power shall be backed by the back-up generators.

REQ_115 Perimeter lighting encompassing

SANSA ground station shall provide perimeter lighting encompassing the LEGS antenna field in accordance with NPR 1620.3B.

REQ_116 UPS feeder power fails.

SANSA Matjiesfontein ground station UPS feeder power fails shall be as follows:

- The SANSA facility technical power design shall consider method to provide power to LEGS critical equipment in the case that the UPS feeder power fails.
- The SANSA electrical design shall consider N+1 redundancy in the equipment used to power the critical load in the event of a UPS feeder power failure.
- The SANSA electrical design shall provide UPS system(s) sized to provide backup power to technical loads in the event of a UPS input feeder power failure for at least 30minutes. The UPS systems shall contain VRLA battery strings.

REQ_117 Power and telecommunication cable

SANSA shall provide the Matjiesfontein ground station will the following:

- SANSA to provide power and telecommunication cable trays as required per design.
- SANSA shall provide cable and signal tray design that separates power and signal cables.

REQ_118 Power load

- SANSA technical power load shall provide at least 70kVA technical power to the LEGS 2 equipment/antenna.
- SANSA utility power load shall provide at least 120kVA utility power for the LEGS 2 equipment/rooms/antenna areas.

REQ_119 Emergency shut off

SANSA shall provide a means to turn off power to all LEGS 2 equipment and antenna areas. (i.e. emergency shut off).

REQ_120 Floodlighting

The SANSA facility shall provide floodlighting around the LEGS 2 antenna.

REQ_121 Power distinction

SANSA shall ensure that there will be a distinction between utility power and technical power. *NASA will provide information of items assigned to each type.*

REQ_122 NASA Power config

It shall be ensured that NASA concurs with the site power design configuration prior to installation.

REQ_123 UPS batteries

The UPS batteries shall be sized for 30-minute backup at UPS full load capacity.

REQ_124 Power transition

Commercial power to run on UPS power for up to 15 minutes (TBR) before transition to diesel generator power. Require two weeks of diesel run time.

*NASA will provide information on time required.*

REQ_125 Work lights

SANSA shall ensure that NASA has the ability to connect work lights within antenna enclosure.

REQ_126 Lightning protection

SANSA shall ensure to implement lightning protection in their facility design. NASA may provide lightning detection – TBD.

REQ_127 Technical power loads

The SANSA technical power load shall provide at least 200 kVA technical power to the LEGS 2 equipment/antenna. (Rough power estimate additional margin of 25% was included to get 102kVA and then an additional 98kVA in the estimates for multiple unknowns,).

| **400/230V, 50Hz technical power bus 3PH-4W** | | | |
|---|---|---|---|
| **Item** | **Contains** | **Power Estimation** | **Notes**<br>**(Known equipment power estimates)** |
| LEGS antenna | Antenna drive, servomotors, HPAs, LNAs, frequency converters | 20 kVA (estimated final TBD) | Estimate used for LEGS 1 based on a similar antenna |
| LEGS equipment racks | PDUs in the racks, modems, gateways, servers, Ethernet switches, IF switches | 50 kVA (estimated final TBD) | Estimate used for LEGS 1 based on a similar antenna's equipment design. Scaled for LEGS Design |
| LEGS timing equipment racks | NTP servers, timing receivers, GPS receivers | 1 kVA | Servers = 100 W * 2 servers = 200 W, timing receivers = 52 W * 2 receivers = 104 W, GPS receivers = 100 W * 2 receivers = 200 W (total = 200 + 104 + 200 = 504 W round up to 1kVA) |
| LEGS GPS antennas | LEGS GPS antenna A and B | 0.1kVA | 50 W per antenna * 2 = 100 W |
| LEGS Op room consoles | LEGS Ops consoles | 6.4 kVA | Estimate is based on other workstations assuming 4 monitors per workstation. 1600 Watt = 1.6 kVA. Estimating 4 workstations |
| LEGS security items | Badge readers, sensors, cameras | 2.072 kVA | Sensor processor = 6 W + (100mW *2 relays) = 6.2W<br>Badge readers = 660mW * assume 15 = 9900mW = 9.9W<br>Cameras = 2.8W *assume 20 = 56W, control/network box = 1kVA |

| | | | |
|---|---|---|---|
| LEGS Move System | Mission Voice loops (MOVE) keysets (initial assumption - 1 in Ops room, 1 in equipment room, 1 in antenna pedestal) | 2.0 kVA | 120V * 2.5 amps = 300 watts per keyset.<br>300 W = 0.3 kVa (assume 2 sets = 2 * .3) = .9 kVa<br>Control box = 1kVA |

REQ_128 Utility power loads

The SANSA utility power load shall provide at least 250 kVA utility power for the LEGS 2 equipment/rooms/antenna areas (Includes 25 percent margin for growth and 41Kva for unknowns).

| **400/230V, 50Hz utility power bus** | | | |
|---|---|---|---|
| **Item** | **Contains** | **Power Estimation** | **Notes**<br>**(Known equipment power estimates)** |
| LEGS antenna | Pedestal/hub lighting, HVAC, auxiliary outlets, hub lighting | 106 kVa | Estimate used for LEGS 1 based on a similar antenna |
| Perimeter lighting | Lights around the LEGS fenced perimeter | 11 kVa | Each fixture consumes 400 W; Assuming x1 fixture every 60' -> 26 fixtures for perimeter |
| LEGS cooling | HVAC for LEGS Ops and Equipment rooms | 50 kVA | estimated TBD on final design. Assumed chilled water DX type HVAC solution. |

**REQUIRED CIRCUIT REQUIRMENT**

REQ_129 Required circuit.

SANSA Matjiesfontein antenna shall have the following power configuration.

**Table 2:Required circuit requirement.**

| Subsystem | Circuit | Qty. | Viasat interface | CFE mating interface |
|---|---|---|---|---|
| Antenna Subsystem - Utility Power | 480/277, Three-Phase,Wye(Five Wire) 60Hz 150 | 1 | Exterior 480/400V 3PH transformer | Flying Lead Maximum Breaker Rating 150A |
| Antenna Subsystem - Technical Power | 120VAC, Singl-Phase,Wye(Three Wire) 60Hz 175A | 1 | Antenna Disconnect Panel (DC1) | Flying Lead Maximum Breaker Rating 175A |
| Indoor Equipment (Viasat Equipment inCFE rack in Ops) | 120VAC, Singl-Phase, 60Hz 8.0A | 1 | IEC – 320 Power Cord with C14 Male connector | Indoor rack Power distribution unit Connector type at customer discretion. |

REQ_130 Antenna power and heating requirement

SANSA Matjiesfontein antenna shall have the following power and heating requirement:

**Table 3:Heating requirement**

| Subsystem | Power | Power (+2% margin)a | Heat generated into redome |
|---|---|---|---|
| Antenna Subsystem -Utility Power ,radome not installed | 88KVA | 106KVA | N/A |
| Antenna Subsystem -Utilitty Power ,radome installed | 59KVA | 71KVA | 42.000 BTU/hr |
| Antena subsystem Technical Power | 16KVA | 20KVA | 42.000 BTU/hr |
| Indoor Equipment | 500 VA | 600VA | N/A |

**UTILITY REQUIREMENT**

REQ_131 Concrete duct bank

- The SANSA facility shall provide a 6-way reinforced concrete duct bank to provide power and communications to the LEGS 2 antenna.
- The LEGS 2 antenna duct bank(s) shall be installed in accordance with 452-STD-SN-002.
- Communications and power runs in the LEGS 2 duct bank shall be placed in independent conduits.
- The duct bank for the LEGS 2 antenna shall contain a minimum of two spare power conduits.
- The duct bank for LEGS 2 shall contain a minimum of one spare communication conduit.

REQ_132 US power plugs

SANSA shall provide US plugs power type for use by LEGS 2 personnel in at least one conference room.

REQ_133 Conveyances

- The SANSA facility shall provide independent conveyances for technical and utility power.
- A minimum of one communication conveyance shall be provided to interconnect the SANSA LEGS 2 rooms/building(s) and LEGS 2 antenna.

**TELECOMMUNICATIONS REQUIREMENT**

REQ_134 Telephone

The SANSA facility shall provide the means/the ability to connect a telephone to the inside of the LEGS antenna pedestal.

REQ_135 Mission voice key set

The SANSA facility shall provide the means to install a mission voice keyset in the LEGS antenna pedestal and Ops rooms.

REQ_136 Bandwidth

- The SANSA facility shall provide Short/Medium Term: 10Gbps (international bandwidth usage approximately 2.6 Gbps), with dual (2 x links) for full redundancy. Additional 100Mbps line for additional redundancy.

- The SANSA facility shall provide Ethernet Category 6aCat6a cable can handle up to 500 MHz frequency with bandwidth support of up to 10 Gbps efficiently for 100 meters.

**WATER MANAGEMENT REQUIREMENT**

REQ_137 Stormwater Management Master Plan

A Stormwater Management Master Plan shall be provided to NASA. And Analysis in the storm water management master plan shall include 2,10, and 100-year storm events or intervals as recommended.

REQ_138 Watercourse Analysis

Watercourse analysis shall be conducted to determine LEGS 2 construction impacts throughout the site (including roads, buildings, fencing, antenna, etc.).

REQ_139 Water Ways

The SANSA site/facility shall be graded so waterways and storm/water runoff will not impact the LEGS2 antenna and related buildings.

**RADIO FREQUENCY REQUIREMENT**

REQ_140 Communication frequency

The SANSA facility shall support LEGS 2 antenna X-band and Ka-band RF communication.

REQ_141 NASA RF safety

SANSA shall comply with NASA RF Safety requirements and the NPR 2570.1C NASA Radio Frequency (RF) Spectrum Management Manual.

REQ_142 RF analysis

An RF analysis for building/antenna blockages from the LEGS 2 antenna asset shall be conducted while NASA conduct a concurrent RF analysis.

REQ_143 RFI interferences

Existing or planned buildings in the SANSA facility shall not interfere with the LEGS 2 antenna RF communication.

REQ_144 Antenna security fence

The antenna security fence shall not interfere with the LEGS 2 antenna RF communication.

REQ_145 Planned futture Antennas

Planned or future antennas in the SANSA facility shall not interfere with the LEGS 2 antenna RF communication

REQ_146 X and Ka band collimonation

The facilities and infrastructure to perform X-band and Ka-band collimation shall be provided for LEGS 2.

REQ_147 Antenna RF mask

It shall be ensured that trees and vegetation outside the antenna security fence and perimeter security fence not interfere with the LEGS 2 antenna RF mask.

**NETWORK REQUIREMENT**

REQ_148 Connectivity

The LEGS 2 operations and equipment rooms shall have telephone/VOIP connectivity to the LEGS antenna.

REQ_149 LEGS 2 antenna and Equipment room

Network routing cable trays and fiber duct bank shall be provided between the LEGS 2 antenna and equipment room.

REQ_150 Network standard

SANSA and NASA networks shall be secured/hardened in accordance with NASA standards and requirements NIST 800-53 Rev 5.

REQ_151 Network routing paths

NASA shall install network cabling from the LEGS 2 antenna and equipment room utilizing the providing network routing paths.

REQ_152 NASA Mission Voice system

Conduits and cable routing between the telecom, operations, equipment, and antenna pedestal shall be provided for the NASA mission voice system.

REQ_153 NASA Mission Voice system cabling

NASA to provide cabling and NASA mission voice system installation/configuration in these areas.

REQ_154 Rooms network

The connection between the rooms shall be separate from SANSA networks.

REQ_155 Facility ethernet and fiber cabling

Facility ethernet and fiber cabling shall be plenum rated (CMP) in plenum and air duct areas.

REQ_156 BMS netowk

The SANSA facility network infrastructure shall be separate from NASA networks except for the BMS which shall provide notifications to a WSC monitoring system by dry contact designed to isolate the two systems.

REQ_157 Dual redudant

The SANSA facility shall provide dual redundant 10 Gbps network connections between the LEGS equipment room and operations room.

REQ_158 Dual redudant global network

The SANSA facility shall provide a high availability, dual redundant 10 Gbps connection (international bandwidth usage is expected to be approximately 2.6 Gbps) from the LEGS equipment room to a global network.

REQ_159 Cable routing

All cable routing in rooms shall be by cable tray and cable routing between rooms shall be via conduit.

REQ_160 Physical/geographical diversity

This connection from the LEGS equipment room to a global network shall be separate from SANSA networks.

- Physical/geographical diversity should be considered if available for the dual connections.

**INTERIORS REQUIREMENT**

REQ_161 Static electricity

SANSA shall ensure that control of static electricity in equipment room may be controlled by electro-static dissipative flooring, humidity levels, grounding etc.

REQ_162 Lighting

SANSA shall apply OSHA standard 29 Part 1910 when considering lighting for areas where personnel will be staffed. Considerations such as task lighting and ability to dim lights shall be considered.

**BUILDING REQUIREMENT**

REQ_163 Operations room

The Dedicated Operations Room for NASA inside NASA security boundary shall have the following specifications:

- Size Floor area LEGS: at least 40m² (TBR).
- Floor: No special requirements noted.
- Ceiling height: +/- 5m (ventilated ceiling and raised floor included).
- Cable ingress: TBD (Is there a standard that would ensure good thermal and secure entry).
- Windows /doors: Not required.
- Environmental: Climate controlled (HVAC), split systems.
- Temp: 19-25°C.
- Humidity: 40- 60%.
- Noise: < 60dBA (Check OSHA: 60 for long-term working exposure: no fatigue 83 for non-permanent damage).
- Lighting: OSHA 29 ANSI A11.1-1965.
- Entrance security: Limited based on clearance, biometric/PIN code/card access.
- Display, furniture: Large displays for status and real-time information. Workstation for each operator/function? Workstation Includes PC with 3-4 screens + ergonomic chair.
- Warnings visual/audible: Audible and visible warnings based on output from MCS and Building management systems to alert operators to required actions.
- Fire detection and protection: Redundant fire/smoke detection system. Use of clean agent suppression system to be discussed verses wet pipe sprinkler in Ops Room.

*NASA to verify requirements.*

REQ_164 Equipment room(s)

**Signal processing :**

The Dedicated Signal processing room for NASA inside NASA security boundary shall have the following specifications:

- Size: Floor area: LEGS at least 100m²
- Installation Requirements
- Floor: Raised floor - No raised floor is required for LEGS equipment room (NASA to ensure rack design can accommodate raised floor configuration at WSC and non-raised floor at LEGS 2 and 3 sites if applicable).
- Ceiling height +/- 5m (ventilated ceiling and raised floor included).
- Room requirements: Grounding, VESDA system monitor system, NASA standards for equipment rooms.
- Fire suppression system clean agent system.
- UPS systems: Yes, sized for technical loads.
- Cable ingress: TBD.
- Structured Cable Management System: Separate signals dividers, RF/IT cables separated.
- Windows /doors: No Windows
- Environmental Climate controlled (HVAC) Split systems (TBR by design)
- Temp 19-21°C
- Humidity 40 - 60% locked room, locked rack, room lighting-dimmable lights ops
- Noise < 65dBA.
- Lighting OSHA 29 ANSI A11.1-1965 / IES Standard.
- Common telecommunications, common equipment will need common conditions, locked cabinet in a shared server room. Need to verify with White Sands staff.

• Entrance security Limited based on clearance, biometric/PIN code/card access. • Display, furniture No displays or furniture required (low backless wheeled chairs for work low in server racks) Warnings visual/audible as required from building code.

- Fire detection and protection VESDA / Clean Agent system
- Automatic extinguishing systems preferred or manual fire extinguisher (carbon dioxide, argon, nitrogen, FM 200 etc.).
- Frequency and timing equipment Resides in equipment room. 5 or 6 pieces of computer sized equipment.
- Storage: Store spares in same conditioned space.
- Verify: ESD requirements, humidity requirements (ro/di water?), flooring.
- BAS will be on SANSA network - NASA will want to monitor building access.

REQ_165 Offices:

The Dedicated Office Room for NASA inside NASA security boundary shall have the following specifications: **See the full room datasheet.**

REQ_166 Auditorium:

The Dedicated Auditorium Room for NASA inside NASA security boundary shall have the following specifications: See the full room datasheet.

REQ_167 Bathrooms:

The Dedicated Bathrooms Room for NASA inside NASA security boundary shall have the following specifications: See the full room datasheet.

REQ_168 Sleeping Quarters: Number of rooms: 5

The Dedicated sleeping quarters Room for NASA inside NASA security boundary shall have the following specifications: See the full room datasheet.

REQ_169 Kitchen:

The Dedicated Kitchen Room for NASA inside NASA security boundary shall have the following specifications: See the full room datasheet.

REQ_170 Breakout area:

Indoor:

Indoor break area TBD m^2 with suitable furniture to support food consumption and general relaxation.

Outdoor:

Covered outdoor break area TBD m^2 with suitable furniture to support food consumption and general relaxation.

REQ_171 Power generation building:

SANSA propose that all gensets collocated in an open plan hanger type facility designed with noise reduction and in the style as per EIA.

REQ_172 Lifting capability Overhead crane:

The SANSA Matjiesfontein site shall have a crane with lifting capacity of 15-20T reaching whole area. Motorized both axes.

REQ_173 Rooms:

Provision for the following rooms shall be made with size and floors to match the power station: See the full room datasheet.

REQ_174 Garage:

The Matjiesfontein site shall have parking space that conforms to South African standards.

REQ_175 Storage both at Mechanical and electronic workshops:

The workshops shall have the height of Height +/- 6m with Heavy concert flooring Spares warehouse, equipment storage and maintenance building (such as man-lifts, fork-lifts, etc.).

REQ_176 Lockable Shelving:

SANSA Matjiesfontein site shall have Shelving Lockable with key/biometric access for the following storage:

- Equipment.
- Spares.
- Inventory.

REQ_177 Flammable/Hazardous store:

SANSA Matjiesfontein site shall have a separate building for flammables.

REQ_178 Possible effluent plant

Provision for Effluent plant shall be made depending on the regulations.

REQ_179 Reception:

The Dedicated reception Room for NASA inside NASA security boundary shall have the following specifications: See the full room datasheet.

REQ_180 Renewable power:

The Dedicated renewable power Room for NASA inside NASA security boundary shall have the following specifications: See the full room datasheet.

REQ_181 Security Room:

The Dedicated security Room for NASA inside NASA security boundary shall have the following specifications: See the full room datasheet.

REQ_182 Renewable power:

The Dedicated renewable power Room for NASA inside NASA security boundary shall have the following specifications: See the full room datasheet.

REQ_183 Security Room:

The Dedicated security Room for NASA inside NASA security boundary shall have the following specifications: See the full room datasheet.

REQ_184 Waiting Area:

The Dedicated waiting area Room for NASA inside NASA security boundary shall have the following specifications: See the full room datasheet.

REQ_185 Workshop(s) (Co-located with power generation):

The SANSA Matjiesfontein site shall have the following workshops which are co-located with the power generation:

• Mechanical/Electrical: size of 100 m² Location: Co-located with power gen/stores?

• Electronic: Size of 100 m² Location: Co-located with equipment rooms?

• Tools: TBD (lathe, drill, sander, milling machine.

• Special requirements based on tools: I.e., special requirement for ventilation/ power noise etc.

REQ_186 Fuel Storage:

SANSA Matjiesfontein site shall have appropriate facility to store the following fuel:

• Diesel: 300,000L on site Stored above ground (*as per EIA) near Greenhouse as per fuel storage regulations.

• Coolant TBD.

REQ_187 Parking:

Provision for parking as the “South African Parking Standards T.C. MACKEY, O.A.W. VANZYL, AND J. C. VORSTER” shall be made as follows:

REQ_188 Water:

SANSA Matjiesfontein site shall have water for the following use:

• General use: Access to sustainable water with flow rate of at least xl/min.

• Potable: Access to potable water with flow rate of at least xl/min.

• Storage: Fire protection: 750,000L.

• Distribution Boreholes ????: General use water to be distributed continuously to pre-determined points across site. Potable water to be distributed continuously to all the inhabited buildings.

REQ_189 Sanitation:

SANSA Matjiesfontein facilities shall have Ablutions available at all the inhabited buildings: Number of persons to be served: x.

•Access for all genders and all levels of ability as per OSHAS.

•Each main building to include at least

REQ_190 Wastewater management:

SANSA Matjiesfontein site shall have No access to municipal sewer.

REQ_191 Fire protection:

SANSA MTJ site shall have water-based fire protection system with Objective: 3 hours of water supply at 250,000L/hour automatic-start diesel backup water pumps that can deliver 250,000L/hr delivery 750,000L water storage tanks.

REQ_192 Power:

Power availability shall be 99.99%.

REQ_193 Renewable energy:

Provision for renewal energy shall be made that augment national grid with at least TBD kVA local generated renewable energy. (Integrated power generation design required to address interaction between power sources).

REQ_194 Back-up:

The SANSA Matjiesfontein site shall provide backup power capabilities using the following systems:

• Generators: Full synchronized generator backup for complex (N+1) 2x 1MW (expandable to 4) dependent on outcome of availability analysis.

• UPS: Full UPS to maintain the complex (N+1) for 2min UPS for antenna installation to be located at the antenna

REQ_195 Distribution:

The distribution systems for SANSA Matjiesfontein site shall use the 11kV 3phase ring feed, step down transformers at each cluster of antennas, main buildings. Size of transformers: TBD based on power budget for each installation.

REQ_196 Communications:

The following communication systems shall be use as the means to provide internet access:

REQ_197 Waste disposal:

The Site shall have waste disposal TBD Separated with an agreement to dispose in an environmentally responsible way (re-cycle + hazardous waste policy).

REQ_198 General safety program:

The SANSA facility design shall comply with NPR 8715.3D NASA General Safety Program Requirements.

REQ_199 SANSA Fire detection system:

A site fire detection and suppression plan detailing coverage of LEGS equipment, operation, and antenna areas shall be provided.

REQ_200 SANSA NASA fire detection system:

The SANSA facility fire detection system (smoke and fire alarms) shall provide LEGS 2 equipment and operations room status to WSC.

REQ_201 Fire alarm system redundancy:

Redundancy shall be incorporated into the smoke and fire alarm system.

REQ_202 Fire break:

Fire breaks shall be maintained within the LEGS antenna security fence and perimeter security fence.

REQ_203 Smoke/fire dampers:

All air duct openings in the fire resistance rated barrier shall be protected with U.L. Listed, combination, smoke/fire dampers

REQ_204 LEGS 2 lighting protection:

The LEGS 2 antenna shall be protected with a lightning protection system in accordance with 452-STD-SN-003.

REQ_205 Self closing doors:

All doors in the fire resistance rated barrier shall be self-closing, positive latching, U.L. Listed fire door assemblies.Self closing doors:

REQ_206 ISO standard:

All safety signage shall follow ISO standard 3864-1 2019, and 7010:2019.

REQ_207 Facility NASA protection system:

The facility shall adhere to the primary NASA fire protection & life safety requirements documents: NASA Standard 8719.11B, SAFETY STANDARD FOR FIRE PROTECTION:

• Other referenced requirements documents include, but are not limited to, NFPA 13, NFPA 72, NFPA 75, NFPA 76, NFPA 101, and NFPA 2001.

REQ_208 NASA Authority Having Jurisdiction:

Wherever requirements conflict or there is an interpretation question, the final decision shall be made by the NASA Authority Having Jurisdiction (AHJ).

REQ_209 Fire resistance:

Penetrations in the fire-resistance-rated barrier shall be kept to a minimum in number.

REQ_210 Resistance rated barrier:

All penetrations in the fire resistance rated barrier shall be protected with a U.L Listed, through penetration, fire stop system appropriate for the penetrating object and barrier construction.

REQ_211 NASA separated structure:

NASA areas to include the operations, telecommunications, and equipment rooms, (Mission Critical Equipment and Mission Critical Infrastructure) shall be separated from the rest of the structure by U.L. listed design, fire resistance rated barriers of not less than 1 hour rating.

REQ_212 Smoke detections system:

The clean agent system shall be released by the air sampling smoke detections system.

REQ_213 Clean agent system:

The clean agent system, agent selection shall be approved by the NASA AHJ.The clean agent system,

REQ_214 Discharge audible:

Pre-discharge and post discharge audible and visual notification appliances, and associated signage, shall be approved by the NASA AHJ.

REQ_215 Air sampling system:

The air sampling system shall be connected to the building fire alarm system according to local requirements.

REQ_216 Pre-action sprinkler system:

Should local requirement direct the installation of a building-wide sprinkler systems, NASA shall require separately valved pre-action sprinkler system with double interlock, and separate water flow indication.

REQ_217 Multiple supervisory signals:

All NASA fire protection systems trouble, alarm, water flow, and multiple supervisory signals shall be transmitted to a constantly attended location reporting to a designated NASA authority.

REQ_218 NASA areas:

All NASA areas shall be provided with audible and visual building fire alarm notification appliances according to local requirements.

REQ_219 SANSA BMS:

The SANSA facility shall have a building mass notification system that interfaces with the LEGS 2 antenna, equipment, and operation rooms. (i.e., a PA system or loud-speaker system that broadcasts safety alerts to the site).

REQ_220 Perimeter security fence:

The SANSA site shall provide a perimeter security fence around the facility according to NPR 1620.3B NASA Physical Security Requirements for NASA facilities and properties.

REQ_221 Perimeter LEGS security fence:

A LEGS 2 antenna security fence shall be installed a minimum of 30m (98.4ft) from the

antenna.

REQ_222 Vegetation:

All vegetation in a 9.14m (30ft) clear zone inside/outside the perimeter security fence.

REQ_223 Antenna vegetation:

All vegetation between the antenna security fence and the perimeter security fence shall be removed.

REQ_224 LEGS 2 antenna fence:

The SANSA site shall provide an antenna security fence around the LEGS 2 antenna according to NPR 1620.3B.

REQ_225 LEGS 2 antenna fence:

The SANSA site shall provide an antenna security fence around the LEGS 2 antenna according to NPR 1620.3B

REQ_226 LEGS 2 Minimum Elevation:

The LEGS 2 antenna shall not impact the antenna security fence when the antenna is at minimum elevation.

REQ_227 Antenna security fence lighting:

Perimeter security fence and antenna security fence lighting in accordance with NPR 1620.3B shall be provided.

REQ_228 Antenna security fence width :

The perimeter security fence and antenna security fence shall include an entrance/exit gate with a minimum width of 5m (16.4ft) (sufficient for cranes, semi trucks, etc.).

REQ_229 Access to LEGS 2 facility:

Access to the LEGS 2 antenna and LEGS 2 related facilities shall be limited to NASA approved personnel.

REQ_230 Separate security system:

SANSA and NASA shall provide separate security systems (cameras and sensors) for the antenna security fence and perimeter security fence.

REQ_231 Separate security network:

Verify that the SANSA and NASA security systems has been on separate networks.

REQ_232 NASA cleared list :

All security systems shall be on the NASA approved and cleared list.

REQ_233 Certified SANSA contractors:

Certified SANSA contractors shall install the security systems & shall be validated/tested by NASA.

REQ_234 Interior/exterior LEGS 2 security:

NASA shall provide a security system to monitor the interior/exterior of the LEGS 2 antenna, equipment room, and operations room.

REQ_235 WSC security systems:

The NASA security system shall be connected to the WSC security system.

REQ_236 NASA SANSA security system:

The NASA security system shall not be connected to the SANSA security system.

REQ_237 Monitoring security cameras:

SANSA shall provide a security system (security cameras) to monitor the LEGS 2 antenna, equipment room, and operations room exteriors.

REQ_238 SANSA security system Elements:

No SANSA security system elements shall be in the LEGS 2 antenna, equipment room, and operations room.

REQ_239 NASA security systems:

A NASA security system shall monitor the interior of the LEGS 2 antenna, equipment room, and operations rooms.

REQ_240 SANSA physical security:

SANSA site security shall physically monitor the SANSA security systems and respond to physical security issues.

REQ_241 Security incidents:

SANSA shall notify NASA of any security incidents in near real-time.

REQ_242 Security:

The SANSA MTJ site shall have the following security measures: See the full requirement.

REQ_243 Cyber security requirement:

SANSA's MTJ site shall have network that must meet or exceed NIST 800-53 standards or provide evidence of compensating controls to which NASA has the obligation to accept or provide additional measures. From antenna spec: NPR 2810.1A, NASA Procedural Requirements Security of Information Technology, and all applicable NASA IT Security Handbooks and NASA Interim Technical Directives.

REQ_244 LEGS 2 access road:

The SANSA facility shall include an improved road to the LEGS 2 antenna area.

REQ_245 Minimum Setbacks:

The SANSA site shall provide a minimum setback from existing structures, roadways, fence lines per NPR 1620.3a Section 3.9.1.h - Fence lines, 9.14m (30ft) and perimeter lighting.

REQ_246 Vendors road requirements:

It shall be ensured that the roads can accommodate the antenna vendor width, loading, turn-around, and unloading requirements for cranes.

REQ_247 Access Roads specification:

SANSA MTJ site shall have the following road access requirements: See the full requirement.

REQ_248 Shipping:

SANSA Matjiesfontein facilities shall have the Ability to send and receive equipment and documents internationally with maximum delay of TBD hours.

REQ_249 Vehicles:

Provision for the following vehicles shall be made to be used during and after construction: See the full requirement.

REQ_250 Security:

Refer to security requirements.

REQ_251 Lightning detection:

SANSA Matjiesfontein facility shall be able to Detect lightning strikes in 100km radius.

REQ_252 Weather station:

Provision for Weather station shall be made on SANSA Matjiesfontein site in order to record and monitor the following parameters:

REQ_253 Building monitor system

SANSA Matjiesfontein facilities shall have BMS with the ability to monitor and control the following: See the full requirement.

REQ_254 Antenna Physical Specifications:

NASA shall provide the LEGS 2 antenna physical specifications to

SANSA REQ_255 Antenna Vendors Foundation:

NASA shall provide SANSA with the LEGS 2 antenna vendor's foundation requirements/conceptual design.

REQ_256 LEGS 2 Antenna Foundation:

A LEGS 2 antenna foundation shall be provided by SANSA.

REQ_257 Antenna foundation height:

The LEGS 2 antenna foundation height above grade shall be a minimum of 10.2cm (4 in) and maximum of 17.8cm (7 in).

REQ_258 Antenna foundation slope:

The LEGS 2 antenna foundation shall be sloped away from the antenna pedestal to ensure water does not pool next to the antenna.

REQ_259 Foundation construction:

On-site NASA or NASA delegate presence during the antenna foundation construction shall be accommodated.

REQ_260 Antenna spicification document:

The proposed foundation design, specifications and materials documents/artifacts shall be provided to NASA.

REQ_261 Specification review:

NASA shall review and provide approval of the proposed foundation design,

specifications and materials documents/artifacts prior to the foundation implementation.

REQ_262 Water detection system:

A water detection system that detects water in the antenna area where electrical equipment is located shall be provided.

REQ_263 Distance to the antenna:

SANSA Matjiesfontein site shall be the following distance from the following facilities: See the full requirement.

REQ_264 Antenna Interfaces:

Antenna shall have the following interfaces: See the full requirement.

REQ_265 Antenna separation:

SANSA antenna shall maintain 5-degree horizontal mask separation for antenna.

REQ_266 Antenna foundation:

SANSA antenna shall have foundation TBD.

REQ_267 Test and measurement equipment & calibration requirement:

SANSA Matjiesfontein site shall have but not limited to the following test and calibration equipment:

- Spectrum analyser (Site analyser).
- Signal generators
- Oscilloscope.
- FO testing, splicing.
- Phase noise measurement equipment

REQ_268 Site preparation areas :

SANSA Matjiesfontein site shall have Xm2 flat area for construction of sub-assemblies.

REQ_269 Collimation tower:

SANSA Matjiesfontein site shall have colimitation tower. TBD (MTJ site Selection Assessment: Revision 3: 2.1.7.5).

REQ_270 Antenna Pad:

A clear and levelled area around the antenna foundation pad area, approximately 40m x 40m (131.2ft x 131.2ft) shall be provided.

REQ_271 Antenna UPS:

The antenna room shall have UPS room and renewable Co located with the Antenna. Size will be specified according to battery capacity.

REQ_272 Antenna Foundation:

Two staging areas contiguous to the antenna foundation to provide room for antenna assembly, reflector assembly, parking for shipping containers, and crane access shall be Clear and levelled.

The staging areas shall be approximately:

- One 15m x 25m (49.2ft x 82ft) for approximately 5 shipping containers and antenna assembly.
- The second 25m x 25 m (82ft x 82ft) for antenna reflector assembly.

REQ_273 Antenna Staging Area:

The staging areas shall be capable of supporting 31.8 - 36.3 metric ton (70,000-80,000 lb.) for shipping containers and supporting heavy machinery (cranes, man-lifts, etc.).

REQ_274 Electrical Reticulation for (Generation, storage and distribution):

- Generation

•2 MVA, 132kV step down to 11kv Main substation and 2km overhead/underground lines to a 2MVA step-down 400v substation

•Renewables (1 MVA) to tie in

•2 x 500kVA Generators parallel configuration (Upgradable to 4) Standards to be provided.

•Fuel storage bunded tanks 60000lt

- Battery Storage

•Capacity to sustain load for 24 hours.

-Reticulation HT ring feed 3km with 7x

350kva minisubs placed as per plan

-All systems to be monitored and controlled remotely.

-Solar panels per requirement (1 MVA) battery room as per



## 4 SSUPPLEMENTARY REQUIREMENTS – ROOM DATA SHEETS

**The NASA SANSA site-specific room:**

Details are provided in this section. There are six specific building areas/rooms required by LEGS 2. These areas are:

1. A dedicated LEGS 2 equipment room
2. A dedicated LEGS 2 operations room
3. A dedicated LEGS 2 storage room
4. Shared telecommunications room space
5. Shared storage space in the logistics area
6. Shared office space in the administrative areas

**SANSA Rooms from main operations building:**

The building project for a new Main Operations Building is estimated at approximately 2000 m2, which include the internal layout as per design specifications. The building is restricted to a single story with a height restriction of 6m.

7. SANSA Operations Room
8. SANSA 2 x Open plan Office space
9. 4 x Individual Offices
10. 20-Seater Boardroom (sub-dividable)
11. SANSA Equipment Room (Tier 3 Reliability Structure)
12. Auditorium theatre (60 pax)
13. Kitchen with seating area/chatroom
14. Female sleeping quarters (2 Beds)
15. Male sleeping quarter (2 Beds)
16. Staff Toilets with shower facilities (F)
17. Staff Toilets with shower facilities (M)
18. Staff Toilets for people with disabilities
19. Electronic workshop.
20. Electronic workshop
21. Equipment store
22. Materials store
23. Power distribution room
24. Borehole and water storage (portable)
25. Water storage (Fire protection)
26. Inside recreational area
27. Outside recreational area
28. Gen House
29. Security room

**Generator House and Office Space**

This building is estimated to be 500m2. The building must be designed to purpose with a height restriction of 6m:

30. Generator room to house 4 generators.
31. Power control room
32. Overhead gantries
33. Mechanical workshop
34. Equipment store
35. Material store
36. Kitchen
37. 2 x individual offices
38. Restrooms with shower facilities
39. 1 x Open plan offices seating 6 pax
40. Parking area
41. Flammable Materials store (freestanding as per regulation).
42. Fuel store (freestanding as per regulation).
43. Used oil area.

44. Transformers
45. Garage (freestanding)
46. Wastewater disposal (per EIA)
47. Grey water disposal
48. Noise suppression as per acoustics standard

**Entrance Gate, Guardhouse and Logistics Building with Loading bay**

The building is estimated to be 200 m2 including furniture and fittings. The building is restricted to a single story with a height restriction of 12m

49. Goods receiving and clearance area with loading bay.
50. Guardhouse to have concrete roof.
51. Lockable goods receiving store.
52. Logistics room
53. Security Reception area
54. Security Control Room
55. Safe
56. 2 x individual office
57. Restrooms
58. Boom gates



### 4.1 The Equipment room

The equipment room data sheet is provided below.

| Equipment Room | | | | |
|---|---|---|---|---|
| A | | **Space Requirements** | **Response** | **Notes** |
| | 1 | Room Type Designation | Essential Information Technology Equipment Mission Critical Equipment | Refer to NASA-STD-8719.11B STANDARD FOR FIRE PROTECTION AND LIFE SAFETY Designation of MCE or MSI influences final interpretation of STD 8719.11B |
| | 2 | Occupants | Intermittent occupancy by existing staff | |
| | 3 | Equipment and furniture | The NASA dedicated Equipment Room shall be able to accommodate:<br>-11 equipment racks measuring 609.6 cm, (2ft) wide by up to 1.219 meters (4ft) deep<br>-Assume tall racks – 228.6 cm (90 in)<br>-1 workbench area 3.048m x 1.524m (10ftx5ft).<br>-2-4 PDU's<br><br>**Frequency and timing equipment:** Resides in equipment room. 5 or 6 pieces of computer sized equipment. Requires roof area to install corresponding GPS antenna and connectivity to equipment room. | Refer to 452-STD-SN-001 EQUIPMENT RACK STANDARD<br>If applicable, The LEGS 2 hot aisle shall be at the rear of the equipment racks.<br>If applicable, The LEGS 2 cold aisle shall be in front of the equipment racks. |
| | 4 | Functional adjacencies | Adjacent to NASA Operations Room, which is also within NASA secure boundary. Adjacent to NASA Storage Room. | |
| | 5 | Minimum floor area | 111m² (1200sqft) | TBR with final equipment layout. |
| | 6 | Min. plan dimension(s) (ft-in) | 9.8mx11.5m (32ftx38ft) | TBR with final equipment layout. |
| | 7 | Floors | Provide Raised Floor access system, .091m (3ft) above concrete slab. | Provide moisture control in slab on grade to prevent excess moisture release. |

| | | | | |
|---|---|---|---|---|
| | 8 | Walls and Partitions | Wall framing, gypsum board, sound attenuation insulation extend fully from slab to underside of deck. Minimum 1hr rated walls and openings. | Refer to NASA-STD-8719.11B STANDARD FOR FIRE PROTECTION AND LIFE SAFETY.<br>-Penetrations in the fire resistance rated barrier shall be kept to a minimum in number<br>-All penetrations in the fire resistance rated barrier shall be protected with a U.L Listed, through penetration, fire stop system appropriate for the penetrating object and barrier construction<br>-All air duct openings in the fire resistance rated barrier shall be protected with U.L. Listed, combination, smoke/fire dampers<br>-Provide non-combustible blocking in walls where required for wall mounted equipment and furniture.<br>-Seal all penetrations with minimum acoustical sealant / fire rated sealant if required.<br>-Provide textured and painted finish.<br>-Provide Sound Transmission Class Rating walls of STC 50 or better. |
| | 9 | Ceilings | Height - Min 2.74m (9ft) finished floor to ceiling. | Minimum dimensions are 0.91m (3ft) slab to top/raised floor, 2.74m (9ft) top/raised floor to finish ceiling. Provide equivalent of a 0.61m x 0.61m (2ft x 2ft) suspended square pattern acoustical tile finish ceiling system at 3.65m (12ft). Ensure adequate space in building design for the MEP and FP systems above suspended ceiling. |
| | 10 | Windows | Window to Operations Room is allowed | |

| | | | | |
|---|---|---|---|---|
| | 11 | Doors | Door into Equipment Room<br>- Minimum equivalent of 2.43m (8ft) tall x 1.82m (6ft) wide double door rated for one-hour wall, no viewing glass. Welded metal frame, painted.<br>Door between Operations Room and Equipment Room<br>-Minimum equivalent of 2.13m (7ft) tall x 0.91m (3ft) wide single door rated for one-hour wall, no viewing glass. Welded metal frame, painted. | All doors in the fire resistance rated barrier shall be self-closing, positive latching, U.L. Listed fire door assemblies |
| B | | **Physical Security** | **Response** | **Notes** |
| | 1 | Physical secure boundary | Dedicated Equipment Room for NASA within NASA secure boundary | General building conduit, ductwork, fiber etc. shall not be routed through NASA secure boundary. |
| | 2 | Access/Access Devices | Limited access based on NASA/SANSA approved access requirements. Rough in electrical and low-voltage connection for key card/PIV access control | |
| C | | **Fire Protection** | | **Notes** |
| | 1 | Extinguishers | | Refer to NASA-STD-8719.11B STANDARD FOR FIRE PROTECTION AND LIFE SAFETY |

| | | | | |
|---|---|---|---|---|
| | 2 | System | NASA specific areas Equipment, Operations, Storage Rooms, and SANSA/NASA shared Telecommunications Rooms shall be protected with a NFPA 75, NFPA 76, NFPA 2001, compliant, primary, clean agent fire suppression system zoned appropriately for the protected spaces. The system shall be released by the air sampling smoke detections system. Agent selection shall be approved by the NASA AHJ. Pre-discharge and post discharge audible and visual notification appliances, and associated signage, shall be approved by the NASA AHJ. | Primary NASA fire protection & life safety requirements document is NASA Standard 8719.11B, SAFETY STANDARD FOR FIRE PROTECTION<br>Other referenced requirements documents include, but are not limited to, NFPA 13, NFPA 72, NFPA 75, NFPA 76, NFPA 101, and NFPA 2001<br>Wherever requirements conflict or there is an interpretation question, the final decision rests with the NASA AHJ<br>Should local requirement direct the installation of a building-wide sprinkler systems, NASA requires a separately valved pre-action sprinkler system with double interlock, and separate water flow indication |
| | 3 | Detection and alarm | NASA specific areas Equipment, Operations, Storage Rooms, and SANSA/NASA shared Telecommunications Rooms areas shall be protected with an air sampling type, very early warning smoke detections systems (VESDA preferred) with not less than three alert/action levels and signal outputs<br>This system shall be connected to the building fire alarm system according to local requirements | All NASA fire protection systems trouble, alarm, water flow, and multiple supervisory signals shall be transmitted to a constantly attended location reporting to a designated NASA authority. (WSC) Building monitoring system shall provide notifications to a WSC monitoring system by dry contact designed to isolate the two systems.<br>All NASA areas shall be provided with audible and visual building fire alarm notification appliances according to local requirements |
| E | | **Thermal Environment** | **Response** | **Notes** |
| | 1 | ASHRAE 2021 Equipment Thermal Guidelines for Data Processing Environments | These requirements assume electronic equipment operates in a Class A1 environment defined as follows: "*Typically a data center with tightly controlled environmental parameters (dew point, temperature, and relative humidity) and mission critical operations.*" | Plan for a contingency of a 25% expansion capability for future NASA needs. Increase in capability to span across all mechanical and electrical systems. |

| | | | | |
|---|---|---|---|---|
| | 2 | Temp set points & tolerances | 18-23°C (65-70°F) | |
| | 3 | Humidity control (%Range) | 45-55% | |
| | 4 | HVAC System(s) | The SANSA HVAC design shall provide Tier 3 redundancy for HVAC equipment feeding the LEGS equipment room | The SANSA facility infrastructure shall provide HVAC with sufficient capacity to maintain room temperature of the LEGS 2 ground equipment area with a heat dissipation of 171 kBTU/hr (TBR). |
| F | | **Electrical** | **Response** | **Notes** |
| | 1 | 400/230V, 3 phase | From UPS to PDU's within the space | See Distribution of Loads diagram |
| | 2 | 400/230V, 3 phase | From PDU's to space | See Distribution of Loads diagram |
| | 3 | Power Requirements | See 452-STD-SN-002, Electrical Power System Standard for Space Network Ground Stations, 3.2,.4.5 Computer Room Power for design guidance | See line A3 this document for estimated rack/equipment list. Final equipment room layout, equipment specifications and cut sheets to be provided for use in design |
| | 4 | Grounding | The SANSA facility infrastructure shall provide LEGS equipment grounding in the LEGS 2 equipment rooms in adherence to 452-STD-SN-003 Grounding System Standard for Space Network Ground Stations | |
| | 5 | Electrostatic Control | Provide electro-static dissipative (ESD) floor tiles on raised floor | Provide grounding system under the raised floor for racks and floor. |
| G | | **Lighting** | **Response** | **Notes** |
| | 1 | Area Illumination level (FC) | SANSA shall apply OSHA and NASA Procedural Requirements when considering lighting for areas where personnel will be staffed. Considerations such as task lighting and ability to dim lights shall be considered. | OSHA 29 CFR 1926.26, NPR 1620.3B, Illuminating Engineers Society Handbook |

| | | | | |
|---|---|---|---|---|
| | 2 | Area lamp/fixture type(s) | LED's | |
| | 3 | Switching/Dimming | Dimming required | |
| H | | **Communications** | **Response** | **Notes** |
| | 1 | NASA MOVE System | Design by NASA, Conduit infrastructure by SANSA | Secure system, Telecom Room to Operations, Equipment Rooms and Antenna |
| | 2 | Telephone | VOIP | To Antenna |
| | 3 | Dedicated conduit to Communications Room | | |
| I | | **Electronic Safety and Security** | **Response** | **Notes** |
| | 1 | Video surveillance | Design by NASA, Conduit infrastructure by SANSA | Separate NASA/SANSA systems. Camera systems to have adjustable framerates if adjacent to LED's. |
| | 2 | Detection/alarms | Design by NASA, Conduit infrastructure by SANSA | Separate NASA/SANSA systems |
| | 3 | Mass Notification System Audible/ visual warning system: | The SANSA facility shall have a building mass notification system that interfaces with the LEGS 2 antenna, equipment and operation rooms. (i.e., a PA system or loud-speaker system that broadcasts safety alerts to the site) | BMS shall provide notifications to a WSC monitoring system by dry contact designed to isolate the two systems. |

### 4.2 Operations room

The equipment room data sheet is provided below.

| Operations Room | | | | |
|---|---|---|---|---|
| A | | **Space Requirements** | **Response** | **Notes** |
| | 1 | Room Type Designation | Essential Information Technology Equipment<br>Mission Critical Equipment | Refer to NASA-STD-8719.11B STANDARD FOR FIRE PROTECTION AND LIFE SAFETY<br>Designation of MCE or MSI influences final interpretation of STD 8719.11B |
| | 2 | Occupants | Four (4) occupants | |
| | 3 | Equipment and furniture | Four workstations with four monitors per station.<br>1 CPU per station, network printer, tv monitor | NASA Provided |
| | 4 | Functional adjacencies | Adjacent to NASA Equipment Room also within NASA secure boundary | |
| | 5 | Minimum floor area | 40m² (430sqft) | TBR with final equipment layout |
| | 6 | Min. plan dimension(s) (ft-in) | 6mx6.5m (20ftx21.5ft) | TBR with final equipment layout |
| | 7 | Floors | Provide Raised Floor access system, 0.91m (3ft) above concrete slab. | Provide moisture control in slab on grade to prevent excess moisture release. |

| | | | | |
|---|---|---|---|---|
| | 8 | Walls and Partitions | Wall framing, gypsum board, sound attenuation insulation extend fully from slab to underside of deck. Minimum 1hr rated walls and openings. | Refer to NASA-STD-8719.11B STANDARD FOR FIRE PROTECTION AND LIFE SAFETY.<br>-Penetrations in the fire resistance rated barrier shall be kept to a minimum in number<br>-All penetrations in the fire resistance rated barrier shall be protected with a U.L Listed, through penetration, fire stop system appropriate for the penetrating object and barrier construction<br>-All air duct openings in the fire resistance rated barrier shall be protected with U.L. Listed, combination, smoke/fire dampers<br>-Provide non-combustible blocking in walls where required for wall mounted equipment and furniture.<br>-Seal all penetrations with minimum acoustical sealant / fire rated sealant if required.<br>-Provide textured and painted finish.<br>-Provide Sound Transmission Class Rating walls of STC 50 or better. |
| | 9 | Ceilings | Height - Min 2.74m (9ft) Finished floor to ceiling. | Minimum dimensions are 0.91m (3ft) slab to top/raised floor, 2.74m (9ft) top/raised floor to finish ceiling. Provide equivalent of a 0.61m x 0.61m (2ft x 2ft) suspended square pattern acoustical tile finish ceiling system at 3.65m (12ft). Ensure adequate space in building design for the MEP and FP systems above suspended ceiling. |
| | 10 | Windows | Window to Equipment Room is allowed | |
| | 11 | Doors | Door into Operations Room - Minimum equivalent of 2.13m (7ft) tall x 0.91m (3ft) wide door rated for one-hour wall, no viewing glass. Welded metal frame, painted. | All doors in the fire resistance rated barrier shall be self-closing, positive latching, U.L. Listed fire door assemblies |
| B | | **Physical Security** | **Response** | **Notes** |

| | | | | |
|---|---|---|---|---|
| | 1 | Physical secure boundary | Dedicated Ops Room for NASA within NASA secure boundary | General building conduit, ductwork, fiber etc. shall not be routed through NASA secure boundary. |
| | 2 | Access/Access Devices | Limited access based on NASA/SANSA approved access requirements. Rough in electrical and low-voltage connection for key card/PIV access control | |
| C | | **Fire Protection** | **Response** | **Notes** |
| | 1 | Extinguishers | | Refer to NASA-STD-8719.11B STANDARD FOR FIRE PROTECTION AND LIFE SAFETY |
| | 2 | System | NASA specific areas Equipment, Operations, Storage Rooms, and SANSA/NASA shared Telecommunications Rooms shall be protected with a NFPA 75, NFPA 76, NFPA 2001, compliant, primary, clean agent fire suppression system zoned appropriately for the protected spaces. The system shall be released by the air sampling smoke detections system. Agent selection shall be approved by the NASA AHJ. Pre-discharge and post discharge audible and visual notification appliances, and associated signage, shall be approved by the NASA AHJ. | Primary NASA fire protection & life safety requirements document is NASA Standard 8719.11B, SAFETY STANDARD FOR FIRE PROTECTION Other referenced requirements documents include, but are not limited to, NFPA 13, NFPA 72, NFPA 75, NFPA 76, NFPA 101, and NFPA 2001 Wherever requirements conflict or there is an interpretation question, the final decision rests with the NASA AHJ Should local requirement direct the installation of a building-wide sprinkler systems, NASA requires a separately valved pre-action sprinkler system with double interlock, and separate water flow indication |

| | | | | |
|---|---|---|---|---|
| | 3 | Detection and alarm | NASA specific areas Equipment, Operations, Storage Rooms, and SANSA/NASA shared Telecommunications Rooms areas shall be protected with an air sampling type, very early warning smoke detections systems (VESDA preferred) with not less than three alert/action levels and signal outputs This system shall be connected to the building fire alarm system according to local requirements | All NASA fire protection systems trouble, alarm, water flow, and multiple supervisory signals shall be transmitted to a constantly attended location reporting to a designated NASA authority. (WSC) Building monitoring system shall provide notifications to a WSC monitoring system by dry contact designed to isolate the two systems. All NASA areas shall be provided with audible and visual building fire alarm notification appliances according to local requirements |
| E | | **Thermal Environment** | **Response** | **Notes** |
| | 1 | Temp set points & tolerances | 18-25°C (65-77°F) | Plan for a contingency of a 25% expansion capability for future NASA needs. Increase in capability to span across all mechanical and electrical systems. Separate Temperature Control from Equipment Space |
| | 2 | Humidity control (%Range) | 40-60% | |
| | 3 | HVAC System(s) | The SANSA HVAC design shall provide Tier 3 redundancy for HVAC equipment feeding the LEGS equipment room | |
| F | | **Electrical** | **Response** | **Notes** |
| | 1 | 400/230V, 3 phase | From PDU's to space | See Distribution of Loads diagram |
| | 2 | Power Requirements | See 452-STD-SN-002, Electrical Power System Standard for Space Network Ground Stations, Computer Room Power for design guidance | See line A2 for estimated equipment list. Final operations room layout, equipment specifications and cut sheets to be provided for use in design. Plan for a contingency of a 25% expansion capability for future NASA needs. Increase in capability to span across all mechanical and electrical systems. |

| | | | | |
|---|---|---|---|---|
| | 3 | Grounding | The SANSA facility infrastructure shall provide LEGS equipment grounding in the LEGS 2 equipment rooms in adherence to 452-STD-SN-003 Grounding System Standard for Space Network Ground Stations | |
| | 4 | Electrostatic Control | Provide static dissipative (ESD) floor tiles on raised floor | Provide grounding system under the raised floor for racks and floor. |
| G | | **Lighting** | **Response** | **Notes** |
| | 1 | Area Illumination level (FC) | SANSA shall apply OSHA and NASA Procedural Requirements when considering lighting for areas where personnel will be staffed. Considerations such as task lighting and ability to dim lights shall be considered. | OSHA 29 CFR 1926.26, NPR 1620.3B, Illuminating Engineers Society Handbook |
| | 2 | Area lamp/fixture type(s) | LED's | |
| | 3 | Switching/Dimming | Dimming required | |
| H | | **Communications** | **Response** | **Notes** |
| | 1 | NASA MOVE System | Design by NASA, Conduit infrastructure by SANSA | Secure system, Operations, Equipment Rooms and Antenna |
| | 2 | Telephone | VOIP | To Antenna |
| | 3 | Dedicated conduit to Communications Room | | |
| I | | **Electronic Safety and Security** | **Response** | **Notes** |
| | 1 | Video surveillance | | Separate NASA/SANSA systems |
| | 2 | Intrusion detection/alarms | | Separate NASA/SANSA systems |

| | | | | |
|---|---|---|---|---|
| | 3 | Mass Notification System Audible/ visual warning system: | The SANSA facility shall have a building mass notification system that interfaces with the LEGS 2 antenna, equipment and operation rooms. (i.e., a PA system or loud-speaker system that broadcasts safety alerts to the site) | BMS shall provide notifications to a WSC monitoring system by dry contact designed to isolate the two systems. |



### 4.3 Storage room

The storage room data sheet is provided below.

| Storage Room | | | | |
|---|---|---|---|---|
| A | | **Space Requirements** | **Response** | **Notes** |
| | 1 | Room Type Designation | Essential Information Technology Equipment Mission Critical Equipment | Refer to NASA-STD-8719.11B STANDARD FOR FIRE PROTECTION AND LIFE SAFETY<br>Designation of MCE or MSI influences final interpretation of STD 8719.11B |
| | 2 | Occupants | Intermittent occupancy by existing staff | |
| | 3 | Equipment and furniture | Shelving and cabinets | Furniture to be NASA provided |
| | 5 | Functional adjacencies | Adjacent to NASA Equipment Room, which is also within NASA secure boundary. | Storage Room to be designed for potential expansion of Equipment Room into storage room space. |
| | 6 | Minimum floor area | 18.5m² (200sqft) | TBR with final equipment layout. |
| | 7 | Min. plan dimension(s) (ft-in) | 3m x 6.1m (10ft x 20ft) | TBR with final equipment layout. |
| | 8 | Floors | Slab on grade or raised floor | Provide moisture control in slab on grade to prevent excess moisture release. |

| | | | | |
|---|---|---|---|---|
| | 9 | Walls and Partitions | Wall framing, gypsum board, sound attenuation insulation extend fully from slab to underside of deck. Minimum 1hr rated walls and openings. | Refer to NASA-STD-8719.11B STANDARD FOR FIRE PROTECTION AND LIFE SAFETY.<br>-Penetrations in the fire resistance rated barrier shall be kept to a minimum in number<br>-All penetrations in the fire resistance rated barrier shall be protected with a U.L Listed, through penetration, fire stop system appropriate for the penetrating object and barrier construction<br>-All air duct openings in the fire resistance rated barrier shall be protected with U.L. Listed, combination, smoke/fire dampers<br>-Provide non-combustible blocking in walls where required for wall mounted equipment and furniture.<br>-Seal all penetrations with minimum acoustical sealant / fire rated sealant if required.<br>-Provide textured and painted finish.<br>-Provide Sound Transmission Class Rating walls of STC 50 or better. |
| | 10 | Ceilings | Height - 2.74 m (9ft) CLEAR from finished floor to finished ceiling | Match ceiling height of adjacent NASA equipment room. Provide equivalent of a 0.61m x 0.61m (2ft x 2ft) suspended square pattern acoustical tile finish ceiling system at 3.65m (12ft). Ensure adequate space in building design for the MEP and FP systems above suspended ceiling. |
| | 11 | Windows | None | |
| | 12 | Doors | Door into Storage Room<br>-Minimum equivalent of 2.43m (8ft) tall x 1.82m (6ft) wide double door rated for one-hour wall, no viewing glass. Welded metal frame, painted. | All doors in the fire resistance rated barrier shall be self-closing, positive latching, U.L. Listed fire door assemblies |
| B | | **Physical Security** | **Response** | **Notes** |
| | 1 | Physical secure boundary | Dedicated Equipment Room for NASA within NASA secure boundary | General building conduit, ductwork, fiber etc. shall not be routed through NASA secure boundary. |

| | | | | |
|---|---|---|---|---|
| | 2 | Access/Access Devices | Limited access based on NASA/SANSA approved access requirements. Rough in electrical and low-voltage connection for key card/PIV access control | |
| C | | **Fire Protection** | | **Notes** |
| | 1 | Extinguishers | | Refer to NASA-STD-8719.11B STANDARD FOR FIRE PROTECTION AND LIFE SAFETY |
| | 2 | System | NASA specific areas Equipment, Operations, Storage Rooms, and SANSA/NASA shared Telecommunications Rooms shall be protected with a NFPA 75, NFPA 76, NFPA 2001, compliant, primary, clean agent fire suppression system zoned appropriately for the protected spaces. The system shall be released by the air sampling smoke detections system. Agent selection shall be approved by the NASA AHJ. Pre-discharge and post discharge audible and visual notification appliances, and associated signage, shall be approved by the NASA AHJ. | Primary NASA fire protection & life safety requirements document is NASA Standard 8719.11B, SAFETY STANDARD FOR FIRE PROTECTION Other referenced requirements documents include, but are not limited to, NFPA 13, NFPA 72, NFPA 75, NFPA 76, NFPA 101, and NFPA 2001 Wherever requirements conflict or there is an interpretation question, the final decision rests with the NASA AHJ Should local requirement direct the installation of a building-wide sprinkler systems, NASA requires a separately valved pre-action sprinkler system with double interlock, and separate water flow indication |

| | | | | |
|---|---|---|---|---|
| | 3 | Detection and alarm | NASA specific areas Equipment, Operations, Storage Rooms, and SANSA/NASA shared Telecommunications Rooms areas shall be protected with an air sampling type, very early warning smoke detections systems (VESDA preferred) with not less than three alert/action levels and signal outputs<br>This system shall be connected to the building fire alarm system according to local requirements | All NASA fire protection systems trouble, alarm, water flow, and multiple supervisory signals shall be transmitted to a constantly attended location reporting to a designated NASA authority. (WSC) Building monitoring system shall provide notifications to a WSC monitoring system by dry contact designed to isolate the two systems. All NASA areas shall be provided with audible and visual building fire alarm notification appliances according to local requirements |
| E | | **Thermal Environment** | **Response** | **Notes** |
| | 1 | Temp set points & tolerances | 18-25°C (65-75°F) | |
| | 2 | Humidity control (%Range) | 50-60% | |
| | 3 | HVAC System(s) | Climate controlled redundant system | |
| F | | **Electrical** | **Response** | **Notes** |
| | 1 | Power Requirements | Building system | |
| | 2 | Grounding | Per NEC, Building system | |
| G | | **Lighting** | **Response** | **Notes** |
| | 1 | Area Illumination level (FC) | SANSA shall apply OSHA and NASA Procedural Requirements when considering lighting for areas where personnel will be staffed. Considerations such as task lighting and ability to dim lights shall be considered. | OSHA 29 CFR 1926.26, NPR 1620.3B, Illuminating Engineers Society Handbook |

| | | | | |
|---|---|---|---|---|
| | 2 | Area lamp/fixture type(s) | LED's | |
| H | | **Communications** | **Response** | **Notes** |
| | 1 | Telephone | VOIP | |
| I | | **Electronic Safety and Security** | **Response** | **Notes** |
| | 1 | Video surveillance | Design by NASA, Conduit infrastructure by SANSA | Separate NASA/SANSA systems. Camera systems to have adjustable framerates if adjacent to LED's. |
| | 2 | Detection/alarms | Design by NASA, Conduit infrastructure by SANSA | Separate NASA/SANSA systems |
| | 3 | Mass Notification System Audible/ visual warning system: | The SANSA facility shall have a building mass notification system that interfaces with the LEGS 2 antenna, equipment and operation rooms. (i.e., a PA system or loud-speaker system that broadcasts safety alerts to the site) | BMS shall provide notifications to a WSC monitoring system by dry contact designed to isolate the two systems. |

### 4.3 Telecommunication room

The telecommunication room data sheet is provided below.

| Telecommunications Room | | | | |
|---|---|---|---|---|
| A | | **Space Requirements** | **Response** | **Notes** |
| | 1 | Occupants | None | |
| | 2 | Equipment and furniture | Locate secured NASA cabinet in shared telecommunications room. | Locking rack or cabinet. Secured room with camera inside and PIV controlled access door to the room. |
| | 3 | Minimum floor area | Sufficient space for NASA cabinet and access to cabinet. | |
| | 4 | Floors | per Building Design | Provide moisture control in slab on grade to prevent excess moisture release. |
| | 5 | Walls and Partitions | Wall framing, gypsum board, sound attenuation insulation extend fully from slab to underside of deck. Minimum 1hr rated walls and openings. | Refer to NASA-STD-8719.11B STANDARD FOR FIRE PROTECTION AND LIFE SAFETY.<br>-Penetrations in the fire resistance rated barrier shall be kept to a minimum in number<br>-All penetrations in the fire resistance rated barrier shall be protected with a U.L Listed, through penetration, fire stop system appropriate for the penetrating object and barrier construction<br>-All air duct openings in the fire resistance rated barrier shall be protected with U.L. Listed, combination, smoke/fire dampers<br>-Provide non-combustible blocking in walls where required for wall mounted equipment and furniture.<br>-Seal all penetrations with minimum acoustical sealant / fire rated sealant if required.<br>-Provide textured and painted finish.<br>-Provide Sound Transmission Class Rating walls of STC 50 or better. |

| | | | | |
|---|---|---|---|---|
| | 6 | Ceilings | per Building Design | Minimum dimensions are .91 (3') slab to top/raised floor, 2.74m (9') top/raised floor to finish ceiling. Provide equivalent of a 2'x2' suspended square pattern acoustical tile finish ceiling system at 3.65m (12'-0"). Ensure adequate space in building design for the MEP and FP systems above suspended ceiling. |
| | 7 | Windows | None | |
| | 8 | Doors | per Building Design | All doors in the fire resistance rated barrier shall be self-closing, positive latching, U.L. Listed fire door assemblies |
| B | | **Physical Security** | **Response** | **Notes** |
| | 1 | Access/Access Devices | Keyed Lock, may require PIV/badge reader access | Keyed lock not sufficient for NASA security requirements. |
| C | | **Fire Protection** | **Response** | **Notes** |
| | 1 | Extinguishers | | Refer to NASA-STD-8719.11B STANDARD FOR FIRE PROTECTION AND LIFE SAFETY |

| | | | | |
|---|---|---|---|---|
| | 2 | System | NASA specific areas Equipment, Operations, Storage Rooms, and SANSA/NASA shared Telecommunications Rooms shall be protected with a NFPA 75, NFPA 76, NFPA 2001, compliant, primary, clean agent fire suppression system zoned appropriately for the protected spaces. The system shall be released by the air sampling smoke detections system. Agent selection shall be approved by the NASA AHJ. Pre-discharge and post discharge audible and visual notification appliances, and associated signage, shall be approved by the NASA AHJ. | Primary NASA fire protection & life safety requirements document is NASA Standard 8719.11B, SAFETY STANDARD FOR FIRE PROTECTION Other referenced requirements documents include, but are not limited to, NFPA 13, NFPA 72, NFPA 75, NFPA 76, NFPA 101, and NFPA 2001 Wherever requirements conflict or there is an interpretation question, the final decision rests with the NASA AHJ Should local requirement direct the installation of a building-wide sprinkler systems, NASA requires a separately valved pre-action sprinkler system with double interlock, and separate water flow indication |
| | 3 | Detection and alarm | NASA specific areas Equipment, Operations, Storage Rooms, and SANSA/NASA shared Telecommunications Rooms areas shall be protected with an air sampling type, very early warning smoke detections systems (VESDA preferred) with not less than three alert/action levels and signal outputs This system shall be connected to the building fire alarm system according to local requirements | All NASA fire protection systems trouble, alarm, water flow, and multiple supervisory signals shall be transmitted to a constantly attended location reporting to a designated NASA authority. (WSC) Building monitoring system shall provide notifications to a WSC monitoring system by dry contact designed to isolate the two systems. All NASA areas shall be provided with audible and visual building fire alarm notification appliances according to local requirements |
| E | | **Thermal Environment** | **Response** | **Notes** |

| | | | | |
|---|---|---|---|---|
| | 1 | ASHRAE 2021 Equipment Thermal Guidelines for Telecommunications | These requirements assume SN electronic equipment operates in a Class A1 environment defined as follows: "*Typically a data center with tightly controlled environmental parameters (dew point, temperature, and relative humidity) and mission critical operations.*" | Plan for a contingency of a 25% expansion capability for future NASA needs. Increase in capability to span across all mechanical and electrical systems. |
| | 2 | Temp set points & 18-23°C (65-70°F) tolerances | | |
| | 3 | Humidity control 45-55% (%Range) | | |
| | 4 | HVAC System(s) | The SANSA HVAC design shall provide Tier 3 redundancy for HVAC equipment feeding the Telecommunications Room | |
| F | | **Electrical** | **Response** | **Notes** |
| | 1 | Power Requirements | Building System | Plan for a contingency of a 25% expansion capability for future NASA needs. Increase in capability to span across all mechanical and electrical systems. |
| | 2 | Grounding | The SANSA facility infrastructure shall provide LEGS equipment grounding in the LEGS 2 equipment rooms in adherence to 452-STD-SN-003 Grounding System Standard for Space Network Ground Stations. Metal floor support systems shall be grounded as well. | |
| | 3 | Electrostatic Control | Provide static dissipative (ESD) floor tiles on raised floor | Provide grounding system under the raised floor for racks and floor. |
| G | | **Lighting** | **Response** | **Notes** |

| | | | | |
|---|---|---|---|---|
| | 1 | Area Illumination level (FC) | SANSA shall apply OSHA and NASA Procedural Requirements when considering lighting for areas where personnel will be staffed. Considerations such as task lighting and ability to dim lights shall be considered. | OSHA 29 CFR 1926.26, NPR 1620.3B, Illuminating Engineers Society Handbook |
| | 2 | Area lamp/fixture type(s) | LED's | |
| H | | **Communications** | **Response** | **Notes** |
| | 1 | NASA MOVE System | Design by NASA, Conduit infrastructure by SANSA | Secure system, Operations, Equipment Rooms and Antenna |
| | 2 | Telephone | VOIP | To Antenna |
| | 3 | Conduit | Dedicated conduit to NASA Equipment Room and Operations Room | |
| I | | **Electronic Safety and Security** | **Response** | **Notes** |
| | 1 | Video surveillance | Design by NASA, Conduit infrastructure by SANSA | Separate NASA/SANSA systems. Camera systems to have adjustable framerates if adjacent to LED's. |
| | 2 | Detection/alarms | Design by NASA, Conduit infrastructure by SANSA | Separate NASA/SANSA systems |
| | 3 | Mass Notification System Audible/ visual warning system: | The SANSA facility shall have a building mass notification system that interfaces with the LEGS 2 antenna, equipment and operation rooms. (i.e., a PA system or loud-speaker system that broadcasts safety alerts to the site) | BMS shall provide notifications to a WSC monitoring system by dry contact designed to isolate the two systems. |

### 4.4 SHARED STORAGE SPACE IN LOGISTICS

The logistics room data sheet is provided below.

| Logistics Space | | | | |
|---|---|---|---|---|
| A | | **Space Requirements** | **Response** | **Notes** |
| | 1 | Function / Equipment | SANSA shall provide access to environmentally controlled, equipment/spares storage areas in the SANSA logistics area which can support large equipment. This storage space shall be accessible by mobile equipment. | **Supply deck to deck locking cage area** for NASA equipment in Logistics Room. Access through person gate and mobile lift gate. (manlift, pallet jack etc.) Plan for a contingency of a 25% expansion capability for future NASA needs. |
| | 2 | Functional adjacencies | Access to loading dock, shipping and receiving, workshop | |
| | 3 | Minimum floor area | 27.9m² (300sqft) | TBR with final equipment layout. |
| | 4 | Min. plan dimension(s) (ft-in) | 27.9m² (15ft x 20ft)+- | TBR with final equipment layout. |
| | 5 | Floors | Slab w/moisture control. | Provide moisture control in slab to prevent excess moisture release into space. |

| | | | | |
|---|---|---|---|---|
| | 6 | Walls and Partitions - Logistics Room | Wall framing, gypsum board, extend fully from slab to underside of deck. Minimum 1hr rated walls and openings. | Refer to NASA-STD-8719.11B STANDARD FOR FIRE PROTECTION AND LIFE SAFETY.<br>-Penetrations in the fire resistance rated barrier shall be kept to a minimum in number<br>-All penetrations in the fire resistance rated barrier shall be protected with a U.L Listed, through penetration, fire stop system appropriate for the penetrating object and barrier construction<br>-All air duct openings in the fire resistance rated barrier shall be protected with U.L. Listed, combination, smoke/fire dampers<br>-Provide non-combustible blocking in walls where required for wall mounted equipment and furniture. |
| | 7 | Ceilings | Minimum Height - +/- 3.3m (10ft) +- CLEAR | Not to interfere with mobile lift |
| B | | **Physical Security** | **Response** | **Notes** |
| | 1 | Access/Access Devices | Limited access based on NASA/SANSA approved access requirements. Rough in electrical and low-voltage connection for key card/PIV access control | |
| C | | **Fire Protection** | **Response** | **Notes** |
| | 1 | Extinguishers | | Refer to NASA-STD-8719.11B STANDARD FOR FIRE PROTECTION AND LIFE SAFETY |
| | 2 | System | Building system | Refer to NASA-STD-8719.11B STANDARD FOR FIRE PROTECTION AND LIFE SAFETY |

| | | | | |
|---|---|---|---|---|
| | 3 | Detection and alarm | NASA specific areas Equipment, Operations, Storage Rooms, and SANSA/NASA shared Telecommunications Rooms areas shall be protected with an air sampling type, very early warning smoke detections systems (VESDA preferred) with not less than three alert/action levels and signal outputs This system shall be connected to the building fire alarm system according to local requirements | All NASA fire protection systems trouble, alarm, water flow, and multiple supervisory signals shall be transmitted to a constantly attended location reporting to a designated NASA authority. (WSC) Building monitoring system shall provide notifications to a WSC monitoring system by dry contact designed to isolate the two systems. All NASA areas shall be provided with audible and visual building fire alarm notification appliances according to local requirements |
| E | | **Thermal Environment** | **Response** | **Notes** |
| | 1 | Temp set points & tolerances | Tempered | Standard for conditioned storage |
| | 2 | Humidity control (%Range) | Tempered | Standard for conditioned storage |
| | 3 | HVAC System(s) | | |
| F | | **Electrical** | **Response** | **Notes** |
| | 1 | Power requirements | Utility | |
| G | | **Lighting** | **Response** | **Notes** |
| | 1 | Area Illumination level (FC) | SANSA shall apply OSHA and NASA Procedural Requirements when considering lighting for areas where personnel will be staffed. Overhead and task lighting required | OSHA 29 CFR 1926.26, NPR 1620.3B, Illuminating Engineers Society Handbook |
| | 2 | Area lamp/fixture type(s) | LED's | |
| H | | **Communications** | **Response** | **Notes** |
| | 1 | NASA MOVE System | Design by NASA, Conduit infrastructure by SANSA | Secure system, Telecom Room to Operations, Equipment Rooms and Antenna |
| | 2 | Telephone | VOIP | |

| I | | Electronic Safety and Security | Response | Notes |
|---|---|---|---|---|
| | 1 | Video surveillance | Design by NASA, Conduit infrastructure by SANSA | Separate NASA/SANSA systems. Camera systems to have adjustable framerates if adjacent to LED's. |
| | 2 | Detection/alarms | Design by NASA, Conduit infrastructure by SANSA | Separate NASA/SANSA systems |
| | 3 | Mass Notification System Audible/ visual warning system: | The SANSA facility shall have a building mass notification system that interfaces with the LEGS 2 antenna, equipment, and operation rooms. (i.e., a PA system or loud-speaker system that broadcasts safety alerts to the site) | BMS shall provide notifications to a WSC monitoring system by dry contact designed to isolate the two systems. |



## 4.5 OFFICE TOUCHDOWN SPACE

The office/touchdown space room data sheet is provided below. This date sheet is intended to detail the need for an area for NASA to sit/occupy within the existing SANSA administrative/office area. It is requested that SANSA provide one lockable office and one touchdown space/area outside of the office.

| Office and Touchdown Space | | | | |
|---|---|---|---|---|
| A | | **Space Requirements** | **Response** | **Notes** |
| | 1 | Occupants | Office - One (1) occupant<br>Touchdown Cubicle - One (1) occupant | Office - one occupant, and room for up to four (4) guests<br>Separate office and touchdown space desired |
| | 2 | Equipment and furniture | Office - Sit/Stand desk, credenza, ergonomic desk chair, locking file cabinet, table and chairs for four people. Provide whiteboard, 1.651m (65in) TV monitor, audio system<br><br>Touchdown area - Cubicle partitions equivalent to 3.04m x 3.04m x 1.65m (10ft x 10ft x 65in) high cubicle wall system. Full length panels three sides, half-length panel fourth side. Solid fabric walls with removable panels. Supply desk, credenza, one ergonomic desk chair, one guest chair. | |
| | 3 | Functional adjacencies | Office and Touchdown to be adjacent to each other, near the Operations Room but not behind the secure boundary | |
| | 4 | Minimum floor area | Office - 18.5m² (200sqft)<br>Touchdown large enough cubicle partitions equivalent to 3.04m x 3.04m x 1.65m (10ft x 10ft x 65in) high cubicle wall system | TBR with final layout of equipment and furniture |
| | 5 | Min. plan dimension(s) (ft-in) | Office - 4m x 4.5m (13ft x 15ft)+- | TBR with final layout of equipment and furniture |
| | 6 | Floors | Slab w/moisture control. Carpet tile finish. | Provide moisture control in slab to prevent excess moisture release into space. Supply 10% of carpet tiles in excess of installation for future use. |

| | | | | |
|---|---|---|---|---|
| | 7 | Walls and Partitions | Wall framing, gypsum board, sound attenuation insulation extend fully from slab to underside of deck. | Refer to NASA-STD-8719.11B STANDARD FOR FIRE PROTECTION AND LIFE SAFETY.<br>-Provide non-combustible blocking in walls where required for wall mounted equipment and furniture.<br>-Seal all penetrations with minimum acoustical sealant / fire rated sealant if required.<br>-Provide textured and painted finish.<br>-Provide Sound Transmission Class Rating walls of STC 50 or better. |
| | 8 | Ceilings | Height 2.43m (8ft) minimum CLEAR | Provide equivalent of a suspended 0.61m x 0.61m (2ft x 2ft) acoustical tile ceiling system at 2.43m (8ft). Ensure adequate space in building design for MEP and FP systems above suspended ceiling. |
| | 9 | Windows | Office - Yes | Provide minimum double pane thermal windows, with ventilator, Low-E. Provide thermal blinds for heat and light control. |
| | 10 | Doors | Office - Provide equivalent of 2.13m x 0.61m (7ft x 3ft) door, solid wood, natural finish, with sidelight. Welded metal frame, painted. | Provide blinds for visual access control at sidelight. |
| B | | **Physical Security** | **Response** | **Notes** |
| | 1 | Access/Access Devices | Office - Keyed Lock | Provide lever handle with keyed deadbolt. Key distribution to adhere to NASA/SANSA access plan. |
| C | | **Fire Protection** | **Response** | **Notes** |
| | 1 | Extinguishers | | Refer to NASA-STD-8719.11B STANDARD FOR FIRE PROTECTION AND LIFE SAFETY |
| | 2 | System | Building System | Refer to NASA-STD-8719.11B STANDARD FOR |

| | | | | |
|---|---|---|---|---|
| | | | | FIRE PROTECTION AND LIFE SAFETY |
| | 3 | Detection and alarm | Building System | Refer to NASA-STD-8719.11B STANDARD FOR FIRE PROTECTION AND LIFE SAFETY |
| E | | **Thermal Environment** | **Response** | **Notes** |
| | 1 | Temp set points & tolerances | 18-25°C (65-77°F) | Standard for office use occupancy |
| | 2 | Humidity control (%Range) | 40-60% | Standard for office use occupancy |
| | 3 | HVAC System(s) | Climate controlled systems | |
| F | | **Electrical** | **Response** | **Notes** |
| | 1 | Power Requirements | | Office - Supply power for 2 computers, two monitors, printer, VOIP telephone, wall mounted video screen, 4 guest computers at table. Convenience outlets per electrical code. Touchdown Cubicle - Supply power through panels for 2 computers, two monitors, printer, VOIP telephone. Convenience outlets per NEC. Supply 60hZ power strips for US equipment |
| | 2 | Grounding | Per NEC | |
| G | | **Lighting** | **Response** | **Notes** |
| | 1 | Area Illumination level (FC) | SANSA shall apply OSHA and NASA Procedural Requirements when considering lighting for areas where personnel will be staffed. Considerations such as task lighting and ability to dim lights shall be considered. | OSHA 29 CFR 1926.26, NPR 1620.3B, Illuminating Engineers Society Handbook |
| | 2 | Area lamp/fixture type(s) | LED's | |
| | 3 | Switching/Dimming | Dimming required | |
| H | | **Communications** | **Response** | **Notes** |

| | | | | |
|---|---|---|---|---|
| | 1 | NASA MOVE System | Design by NASA, Conduit infrastructure by SANSA | Secure system, Telecom Room to Operations, Equipment Rooms and Antenna |
| | 2 | Telephone | VOIP | |
| | 3 | Internet | Per building network | |
| I | | **Electronic Safety and Security** | **Response** | **Notes** |
| | 1 | Video surveillance | Design by NASA, Conduit infrastructure by SANSA | Separate NASA/SANSA systems. Camera systems to have adjustable framerates if adjacent to LED's. |
| | 2 | Detection/alarms | Design by NASA, Conduit infrastructure by SANSA | Separate NASA/SANSA systems |
| | 3 | Mass Notification System Audible/ visual warning system: | The SANSA facility shall have a building mass notification system that interfaces with the LEGS 2 antenna, equipment and operation rooms. (i.e., a PA system or loud-speaker system that broadcasts safety alerts to the site) | BMS shall provide notifications to a WSC monitoring system by dry contact designed to isolate the two systems. |



### 4.6 SANSA OFFICE SPACE

The SANSA office room data sheet is provided below.

| Office Space | | | | |
|---|---|---|---|---|
| A | | **Space Requirements** | **Response** | **Notes** |
| | 1 | Occupants | Office - One (1) occupant<br>Touchdown Cubicle - One (1) occupant | Office - one occupant, and room for up to four (4) guests<br>Separate office and touchdown space desired |
| | 2 | Equipment and furniture | Office - Sit/Stand desk, credenza, ergonomic desk chair, locking file cabinet, table and chairs for four people. Provide whiteboard, 1.651m (65in) TV monitor, audio system<br><br>Touchdown area - Cubicle partitions equivalent to 3.04m x 3.04m x 1.65m (10ft x 10ft x 65in) high cubicle wall system. Full length panels three sides, half-length panel fourth side. Solid fabric walls with removable panels. Supply desk, credenza, one ergonomic desk chair, one guest chair. | |
| | 3 | Functional adjacencies | Office and Touchdown to be adjacent to each other, near the Operations Room but not behind the secure boundary | |
| | 4 | Minimum floor area | Office - 18.5m² (200sqft)<br>Touchdown large enough cubicle partitions equivalent to 3.04m x 3.04m x 1.65m (10ft x 10ft x 65in) high cubicle wall system | TBR with final layout of equipment and furniture |
| | 5 | Min. plan dimension(s) (ft-in) | Office - 4m x 4.5m (13ft x 15ft)+- | TBR with final layout of equipment and furniture |
| | 6 | Floors | Slab w/moisture control. Carpet tile finish. | Provide moisture control in slab to prevent excess moisture release into space. Supply 10% of carpet tiles in excess of installation for future |

| | | | | |
|---|---|---|---|---|
| | | | | use. |
| | 7 | Walls and Partitions | Wall framing, gypsum board, sound attenuation insulation extend fully from slab to underside of deck. | Refer to NASA-STD-8719.11B STANDARD FOR FIRE PROTECTION AND LIFE SAFETY.<br>-Provide non-combustible blocking in walls where required for wall mounted equipment and furniture.<br>-Seal all penetrations with minimum acoustical sealant / fire rated sealant if required.<br>-Provide textured and painted finish.<br>-Provide Sound Transmission Class Rating walls of STC 50 or better. |
| | 8 | Ceilings | Height 2.43m (8ft) minimum CLEAR | Provide equivalent of a suspended 0.61m x 0.61m (2ft x 2ft) acoustical tile ceiling system at 2.43m (8ft). Ensure adequate space in building design for MEP and FP systems above suspended ceiling. |
| | 9 | Windows | Office - Yes | Provide minimum double pane thermal windows, with ventilator, Low-E. Provide thermal blinds for heat and light control. |
| | 10 | Doors | Office - Provide equivalent of 2.13m x 0.61m (7ft x 3ft) door, solid wood, natural finish, with sidelight. Welded metal frame, painted. | Provide blinds for visual access control at sidelight. |
| B | | **Physical Security** | **Response** | **Notes** |
| | 1 | Access/Access Devices | Office - Keyed Lock | Provide lever handle with keyed deadbolt. Key distribution to adhere to NASA/SANSA access plan. |
| C | | **Fire Protection** | **Response** | **Notes** |

| | | | | |
|---|---|---|---|---|
| | 1 | Extinguishers | | Refer to NASA-STD-8719.11B STANDARD FOR FIRE PROTECTION AND LIFE SAFETY |
| | 2 | System | Building System | Refer to NASA-STD-8719.11B STANDARD FOR FIRE PROTECTION AND LIFE SAFETY |
| | 3 | Detection and alarm | Building System | Refer to NASA-STD-8719.11B STANDARD FOR FIRE PROTECTION AND LIFE SAFETY |
| E | | **Thermal Environment** | **Response** | **Notes** |
| | 1 | Temp set points & tolerances | 18-25°C (65-77°F) | Standard for office use occupancy |
| | 2 | Humidity control (%Range) | 40-60% | Standard for office use occupancy |
| | 3 | HVAC System(s) | Climate controlled systems | |
| F | | **Electrical** | **Response** | **Notes** |
| | 1 | Power Requirements | | Office - Supply power for 2 computers, two monitors, printer, VOIP telephone, wall mounted video screen, 4 guest computers at table. Convenience outlets per electrical code. Touchdown Cubicle - Supply power through panels for 2 computers, two monitors, printer, VOIP telephone. Convenience outlets per NEC. Supply 60hZ power strips for US equipment |
| | 2 | Grounding | Per NEC | |
| G | | **Lighting** | **Response** | **Notes** |
| | 1 | Area Illumination level (FC) | SANSA shall apply OSHA and SANSA Procedural Requirements when considering lighting for areas where personnel will be staffed. Considerations such as task lighting and ability to dim lights shall be considered. | OSHA 29 CFR 1926.26, NPR 1620.3B, Illuminating Engineers Society Handbook |
| | 2 | Area lamp/fixture type(s) | LED's | |

| | | | | |
|---|---|---|---|---|
| | 3 | Switching/Dimming | Dimming required | |
| H | | **Communications** | **Response** | **Notes** |
| | 1 | NASA MOVE System | Design by SANSA, Conduit infrastructure by SANSA | Secure system, Telecom Room to Operations, Equipment Rooms and Antenna |
| | 2 | Telephone | VOIP | |
| | 3 | Internet | Per building network | |
| I | | **Electronic Safety and Security** | **Response** | **Notes** |
| | 1 | Video surveillance | Design by SANSA, Conduit infrastructure by SANSA | Separate NASA/SANSA systems. Camera systems to have adjustable framerates if adjacent to LED's. |
| | 2 | Detection/alarms | Design by SANSA, Conduit infrastructure by SANSA | Separate NASA/SANSA systems |
| | 3 | Mass Notification System Audibl/ visual warning system: | The SANSA facility shall have a building mass notification system that interfaces with the LEGS 2 antenna, equipment and operation rooms. (i.e., a PA system or loud-speaker system that broadcasts safety alerts to the site) | BMS shall provide notifications to a WSC monitoring system by dry contact designed to isolate the two systems. |



### 4.7 GEN HOUSE

The Generator house room data sheet is provided below.

| Generator house | | | | |
|---|---|---|---|---|
| A | | **Space Requirements** | **Response** | **Notes** |
| | 1 | Occupants | Office - One (1) occupant<br>Touchdown Cubicle - One (1) occupant | Office - one occupant, and room for up to four (4) guests<br>Separate office and touchdown space desired |
| | 2 | Equipment and furniture | Office - Sit/Stand desk, credenza, ergonomic desk chair, locking file cabinet, table and chairs for four people. Provide whiteboard, 1.651m (65in) TV monitor, audio system<br><br>Touchdown area - Cubicle partitions equivalent to 3.04m x 3.04m x 1.65m (10ft x 10ft x 65in) high cubicle wall system. Full length panels three sides, half-length panel fourth side. Solid fabric walls with removable panels. Supply desk, credenza, one ergonomic desk chair, one guest chair. | |
| | 3 | Functional adjacencies | Office and Touchdown to be adjacent to each other, near the Operations Room but not behind the secure boundary | |
| | 4 | Minimum floor area | Office - 18.5m² (200sqft)<br>Touchdown large enough cubicle partitions equivalent to 3.04m x 3.04m x 1.65m (10ft x 10ft x 65in) high cubicle wall system | TBR with final layout of equipment and furniture |
| | 5 | Min. plan dimension(s) (ft-in) | Office - 4m x 4.5m (13ft x 15ft)+- | TBR with final layout of equipment and furniture |
| | 6 | Floors | Slab w/moisture control. Carpet tile finish. | Provide moisture control in slab to prevent excess moisture release into space. Supply 10% of carpet tiles in excess of installation for future use. |

| | | | | |
|---|---|---|---|---|
| | 7 | Walls and Partitions | Wall framing, gypsum board, sound attenuation insulation extend fully from slab to underside of deck. | Refer to NASA-STD-8719.11B STANDARD FOR FIRE PROTECTION AND LIFE SAFETY.<br>-Provide non-combustible blocking in walls where required for wall mounted equipment and furniture.<br>-Seal all penetrations with minimum acoustical sealant / fire rated sealant if required.<br>-Provide textured and painted finish.<br>-Provide Sound Transmission Class Rating walls of STC 50 or better. |
| | 8 | Ceilings | Height 2.43m (8ft) minimum CLEAR | Provide equivalent of a suspended 0.61m x 0.61m (2ft x 2ft) acoustical tile ceiling system at 2.43m (8ft). Ensure adequate space in building design for MEP and FP systems above suspended ceiling. |
| | 9 | Windows | Office - Yes | Provide minimum double pane thermal windows, with ventilator, Low-E. Provide thermal blinds for heat and light control. |
| | 10 | Doors | Office - Provide equivalent of 2.13m x 0.61m (7ft x 3ft) door, solid wood, natural finish, with sidelight. Welded metal frame, painted. | Provide blinds for visual access control at sidelight. |
| B | | **Physical Security** | **Response** | **Notes** |
| | 1 | Access/Access Devices | Office - Keyed Lock | Provide lever handle with keyed deadbolt. Key distribution to adhere to NASA/SANSA access plan. |
| C | | **Fire Protection** | **Response** | **Notes** |
| | 1 | Extinguishers | | Refer to NASA-STD-8719.11B STANDARD FOR FIRE PROTECTION AND LIFE SAFETY |
| | 2 | System | Building System | Refer to NASA-STD-8719.11B STANDARD FOR |

| | | | | |
|---|---|---|---|---|
| | | | | FIRE PROTECTION AND LIFE SAFETY |
| | 3 | Detection and alarm | Building System | Refer to NASA-STD-8719.11B STANDARD FOR FIRE PROTECTION AND LIFE SAFETY |
| E | | **Thermal Environment** | **Response** | **Notes** |
| | 1 | Temp set points & tolerances | 18-25°C (65-77°F) | Standard for office use occupancy |
| | 2 | Humidity control (%Range) | 40-60% | Standard for office use occupancy |
| | 3 | HVAC System(s) | Climate controlled systems | |
| F | | **Electrical** | **Response** | **Notes** |
| | 1 | Power Requirements | | Office - Supply power for 2 computers, two monitors, printer, VOIP telephone, wall mounted video screen, 4 guest computers at table. Convenience outlets per electrical code. Touchdown Cubicle - Supply power through panels for 2 computers, two monitors, printer, VOIP telephone. Convenience outlets per NEC. Supply 60hZ power strips for US equipment |
| | 2 | Grounding | Per NEC | |
| G | | **Lighting** | **Response** | **Notes** |
| | 1 | Area Illumination level (FC) | SANSA shall apply OSHA and SANSA Procedural Requirements when considering lighting for areas where personnel will be staffed. Considerations such as task lighting and ability to dim lights shall be considered. | OSHA 29 CFR 1926.26, NPR 1620.3B, Illuminating Engineers Society Handbook |
| | 2 | Area lamp/fixture type(s) | LED's | |
| | 3 | Switching/Dimming | Dimming required | |
| H | | **Communications** | **Response** | **Notes** |

| | | | | |
|---|---|---|---|---|
| | 1 | NASA MOVE System | Design by SANSA, Conduit infrastructure by SANSA | Secure system, Telecom Room to Operations, Equipment Rooms and Antenna |
| | 2 | Telephone | VOIP | |
| | 3 | Internet | Per building network | |
| I | | **Electronic Safety and Security** | **Response** | **Notes** |
| | 1 | Video surveillance | Design by SANSA, Conduit infrastructure by SANSA | Separate NASA/SANSA systems. Camera systems to have adjustable framerates if adjacent to LED's. |
| | 2 | Detection/alarms | Design by SANSA, Conduit infrastructure by SANSA | Separate NASA/SANSA systems |
| | 3 | Mass Notification System Audibl/ visual warning system: | The SANSA facility shall have a building mass notification system that interfaces with the LEGS 2 antenna, equipment and operation rooms. (i.e., a PA system or loud-speaker system that broadcasts safety alerts to the site) | BMS shall provide notifications to a WSC monitoring system by dry contact designed to isolate the two systems. |

## 4.8 PHYSICAL SECURITY

Security room data sheet is provided below.

| **Security room** |
|---|

| A | | Space Requirements | Response | Notes |
|---|---|---|---|---|
| | 1 | Occupants | Office - One (1) occupant<br>Touchdown Cubicle - One (1) occupant | Office - one occupant, and room for up to four (4) guests<br><br>Separate office and touchdown space desired |
| | 2 | Equipment and furniture | Office - Sit/Stand desk, credenza, ergonomic desk chair, locking file cabinet, table and chairs for four people. Provide whiteboard, 1.651m (65in) TV monitor, audio system<br><br>Touchdown area - Cubicle partitions equivalent to 3.04m x 3.04m x 1.65m (10ft x 10ft x 65in) high cubicle wall system. Full length panels three sides, half-length panel fourth side. Solid fabric walls with removable panels. Supply desk, credenza, one ergonomic desk chair, one guest chair. | |
| | 3 | Functional adjacencies | Office and Touchdown to be adjacent to each other, near the Operations Room but not behind the secure boundary | |
| | 4 | Minimum floor area | Office - 18.5m² (200sqft)<br><br>Touchdown large enough cubicle partitions equivalent to 3.04m x 3.04m x 1.65m (10ft x 10ft x 65in) high cubicle wall system | TBR with final layout of equipment and furniture |
| | 5 | Min. plan dimension(s) (ft-in) | Office - 4m x 4.5m (13ft x 15ft)+- | TBR with final layout of equipment and furniture |
| | 6 | Floors | Slab w/moisture control. Carpet tile finish. | Provide moisture control in slab to prevent excess moisture release into space. Supply 10% of carpet tiles in excess of installation for future use. |
| | 7 | Walls and Partitions | Wall framing, gypsum board, sound attenuation insulation extend fully from slab to underside of deck. | Refer to NASA-STD-8719.11B STANDARD FOR FIRE PROTECTION AND LIFE SAFETY. -Provide non-combustible blocking in walls where required for wall mounted equipment and |

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| | | | | furniture.<br>-Seal all penetrations with minimum acoustical sealant / fire rated sealant if required.<br>-Provide textured and painted finish.<br>-Provide Sound Transmission Class Rating walls of STC 50 or better. |
| | 8 | Ceilings | Height 2.43m (8ft) minimum CLEAR | Provide equivalent of a suspended 0.61m x 0.61m (2ft x 2ft) acoustical tile ceiling system at 2.43m (8ft). Ensure adequate space in building design for MEP and FP systems above suspended ceiling. |
| | 9 | Windows | Office - Yes | Provide minimum double pane thermal windows, with ventilator, Low-E. Provide thermal blinds for heat and light control. |
| | 10 | Doors | Office - Provide equivalent of 2.13m x 0.61m (7ft x 3ft) door, solid wood, natural finish, with sidelight. Welded metal frame, painted. | Provide blinds for visual access control at sidelight. |
| B | | **Physical Security** | **Response** | **Notes** |
| | 1 | Access/Access Devices | Office - Keyed Lock | Provide lever handle with keyed deadbolt. Key distribution to adhere to NASA/SANSA access plan. |
| C | | **Fire Protection** | **Response** | **Notes** |
| | 1 | Extinguishers | | Refer to NASA-STD-8719.11B STANDARD FOR FIRE PROTECTION AND LIFE SAFETY |
| | 2 | System | Building System | Refer to NASA-STD-8719.11B STANDARD FOR FIRE PROTECTION AND LIFE SAFETY |
| | 3 | Detection and alarm | Building System | Refer to NASA-STD-8719.11B STANDARD FOR FIRE PROTECTION AND LIFE SAFETY |

| E | | **Thermal Environment** | **Response** | **Notes** |
|---|---|---|---|---|
| | 1 | Temp set points & tolerances | 18-25°C (65-77°F) | Standard for office use occupancy |
| | 2 | Humidity control (%Range) | 40-60% | Standard for office use occupancy |
| | 3 | HVAC System(s) | Climate controlled systems | |
| F | | **Electrical** | **Response** | **Notes** |
| | 1 | Power Requirements | | Office - Supply power for 2 computers, two monitors, printer, VOIP telephone, wall mounted video screen, 4 guest computers at table. Convenience outlets per electrical code. Touchdown Cubicle - Supply power through panels for 2 computers, two monitors, printer, VOIP telephone. Convenience outlets per NEC. Supply 60hZ power strips for US equipment |
| | 2 | Grounding | Per NEC | |
| G | | **Lighting** | **Response** | **Notes** |
| | 1 | Area Illumination level (FC) | SANSA shall apply OSHA and SANSA Procedural Requirements when considering lighting for areas where personnel will be staffed. Considerations such as task lighting and ability to dim lights shall be considered. | OSHA 29 CFR 1926.26, NPR 1620.3B, Illuminating Engineers Society Handbook |
| | 2 | Area lamp/fixture type(s) | LED's | |
| | 3 | Switching/Dimming | Dimming required | |
| H | | **Communications** | **Response** | **Notes** |
| | 1 | NASA MOVE System | Design by SANSA, Conduit infrastructure by SANSA | Secure system, Telecom Room to Operations, Equipment Rooms and Antenna |
| | 2 | Telephone | VOIP | |

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| | 3 | Internet | Per building network | |
| I | | **Electronic Safety and Security** | **Response** | **Notes** |
| | 1 | Video surveillance | Design by SANSA, Conduit infrastructure by SANSA | Separate NASA/SANSA systems. Camera systems to have adjustable framerates if adjacent to LED's. |
| | 2 | Detection/alarms | Design by SANSA, Conduit infrastructure by SANSA | Separate NASA/SANSA systems |
| | 3 | Mass Notification System Audibl/ visual warning system: | The SANSA facility shall have a building mass notification system that interfaces with the LEGS 2 antenna, equipment and operation rooms. (i.e., a PA system or loud-speaker system that broadcasts safety alerts to the site) | BMS shall provide notifications to a WSC monitoring system by dry contact designed to isolate the two systems. |

# 5 REQUIREMENT VERIFICATION

Table 6 below provides the verification cross reference matrix for the requirements in Section 3

**Table 4:NASA SANSA Requirement Matrix**

| # | ID | Text | Verify Method | Verification details |
|---|---|---|---|---|
| 1 | REQ_1 | **Inherent availability:** The SANSA Matjiesfontein ground station shall have the 99,95% availability. | Analysis | Verify that the site has power always with back up available. |
| 2 | REQ_2 | **Relevant legislations**: The SANSA Matjiesfontein ground station site shall comply to the following legislations:<br>• Facilities Regulations GNR .924 OF 2004.<br>• National Buildings Regulations R1081 of 1988.<br>• Environmental Regulations for Workplaces GNR.2281 of 1998. | Inspection | Verify that the site complies to the specified regulations and standards. |
| 3 | REQ_3 | **Operation availability:** The SANSA Matjiesfontein ground station site shall enable the operation of the site 24/7 during LEGS critical events. | Inspection | Verify that SANSA has enough staff available to change shifts. |
| 4 | REQ_4 | **RF safety standard:** The SANSA Matjiesfontein site shall comply with NASA RF Safety requirements and the NPR 2570.1C NASA Radio Frequency (RF) Spectrum Management Manual. | Inspection | Confirm that there is compliance to the mentioned standard. |
| 5 | REQ_5 | **RF analysis:** SANSA shall conduct an RF analysis for building /antenna blockages from the LEGS 2 antenna asset. NASA shall conduct a concurrent analysis. | Analysis /Test | Verify that the Analysis has been conducted and reviewed for accuracy. |
| 6 | REQ_6 | **Manlift/Craneduct:** The SANSA Matjiesfontein facilities shall have | Inspection | Verify that there is Manlift or |

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| | | manlift or crane to be for use by LEGS 2 personnel. Lift shall be able to fit through a redone entrance door. | | crane on site. |
| 7 | REQ_7 | **Generator:** SANSA shall provide information on Diesel generator fuel supply, including, capacity, and delivery time. Diesel shelf life is six months as per SIRD draft document. | Inspection | Verify that the information on the Diesel document has been provided as per the SIRD draft document. |
| 8 | REQ_8 | **Construction documents:** SANSA shall provide Matjiesfontein ground station construction documents to NASA for QA/QC review prior to final issue for construction. | Inspection | Verify that the documents have been submitted. |
| 9 | REQ_9 | **Design schedules:** SANSA shall provide design schedule with design milestones and description of deliverables at each milestone. | Inspection | Verify that the design schedule has been provided. |
| 10 | REQ_10 | **Build history:** SANSA shall provide as-built record documents of the Matjiesfontein ground station site. | Inspection | Confirm that the as-build documents has been reviewed and submitted. |
| 11 | REQ_11 | **Infrastructure code analysis:** SANSA shall provide an infrastructure code analysis that references the latest editions of the following codes and/or standards. | Analysis | Verify that the analysis has been completed. |
| 12 | REQ_12 | **As-build records:** As-built records that include design changes after project construction is completed shall be provided. | Inspection | Confirm that the as-build documents has been reviewed and submitted. |
| 13 | REQ_13 | **Design schedule:** A design schedule which includes design milestones and deliverable descriptions for each milestone shall be provided. | Inspection | Verify that the design schedule has been provided. |

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| 14 | REQ_14 | **Design milestone:** Design milestones shall include a Programming Review, 30% Design, 60% Design,90% Design, and Final Design. | Inspection | Confirm that the design milestones has programming reviews. |
| 15 | REQ_15 | **Documentation:** Documentation and deliverables shall be provided to NASA a minimum of 10 business days prior to each milestone for a joint team review at a Technical Interchange Meeting (TIM). | Inspection | Confirm that the documentation and deliverables have been delivered as specified. |
| 16 | REQ_16 | **Programmatic review:**<br>The following shall be provided at the Programming Review in addition to the design documents:<br>• Specifications table of contents<br>• Submittal matrix.<br>• NASA to identify material submittals they wish to review | Inspection | Verify that the programmatic review has the table of contents and submittal matrix. |
| 17 | REQ_17 | **Operations and maintenance:** Operations and maintenance manuals, of equipment installed shall be provided in AutoCAD, PDF, Word-doc format | Inspection | Verify that the operation and maintenance manuals of the installed equipment has been provided in the required format |
| 18 | REQ_18 | **Site analysis:** Analysis shall be conducted to determine impacts to the watercourse traversing the facility access roads as a result of the LEGS antenna construction. | Analysis | Confirm that the has been conducted and reviewed. |
| 19 | REQ_19 | **Landscape plan:** SANSA shall provide a landscape plan integrated with the site plan shall be provided. | Inspection | Confirm that the Landscape plan has been submitted |

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| 20 | REQ_20 | **Site Plan:** A site plan that includes all structure locations and future site development shall be provided. | Inspection | Confirm that the site plan has been submitted |
| 21 | REQ_21 | **Site Utility Plan:** A site utility plan indicating power, domestic/potable water, fire water, and wastewater treatment shall be provided. | Inspection | Confirm that the site utility plan has been submitted. |
| 22 | REQ_22 | **Antenna Visibility:** A LEGS 2 antenna location study for technical viability of the proposed antenna site shall be conducted. | Analysis | Verify that the LEGS 2 antenna location study has been conducted and verified |
| 23 | REQ_23 | **Antenna location**: The LEGS 2 antenna shall be installed at the SANSA ground station site in a mutually agreed upon location. | Inspection | Verify that the LEGS 2 antenna has been installed as per the agree location |
| 24 | REQ_24 | **Site Access:** Access to the site shall be 24hr x 7days x 365 days and include access to the LEGS 2 antenna and LEGS 2 related facilities to NASA approved personnel. | Inspection | Confirm that there's 24hr x 7 days x 365 site access as required. |
| 25 | REQ_25 | **Weather Station:** The SANSA facility shall include a weather station that provides weather data required for antenna operations. | Inspection/Test | Confirm that the weather station has been installed and tested |
| 26 | REQ_26 | **Site Survey:** SANSA shall provide a site survey by a licensed firm with control points for design and construction. The survey shall delineate the location of NASA facilities. | Inspection | Confirm that the weather station has been installed and tested. |
| 27 | REQ_27 | **Topographic survey**: A topographic survey in AutoCAD Civil 3D of 1m Digital Elevation Map (DEM) or better shall be conducted:<br>• The ground survey shall locate existing utilities, and geometry (edge of road, runway, buildings, drainage features etc.).<br>• If a LIDAR survey can be performed, a 0.5m (1.64ft) accuracy is | Inspection | Confirm that the topographic survey has been conducted and verified. |

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| | | desired (1m (3.28ft) is satisfactory). | | |
| 28 | REQ_28 | **Ground clearance:** The SANSA Matjiesfontein ground station site shall provide a cleared and levelled antenna field and installation area for the LEGS 2 antenna. | Inspection/Testing | Confirm that the MTJ ground station site is cleared and level and has been tested as required |
| 29 | REQ_29 | **Inclination profile:** The Matjiesfontein ground station antenna shall be <10 for lunar/deep space profile and <5 around for near earth. | Inspection/Testing | Confirm that the site meets the described inclination profile |
| 30 | REQ_30 | **Storm water:** The SANSA Matjiesfontein ground station site shall provide positive stormwater runoff away from antenna sites and handholes. The foundation must be, as a minimum height, to the equivalent elevation of the adjacent buildings. | Inspection | Confirm that the site has positive stormwater requirements has been addressed |
| 31 | REQ_31 | **Water ways:** Naturally occurring waterways shall be diverted or channeled away from the LEGS 2 antenna sites. | Inspection | Verify that LEGS 2 antenna site is free from natural water ways |
| 32 | REQ_32 | **Antenna site:** The LEGS 2 antenna site and antenna install area shall be cleared and grubbed of all existing vegetation. | Inspection | Verify that the all existing vegetation has been removed from LEGS 2 antenna site |
| 33 | REQ_33 | **Staging area:** The SANSA Matjiesfontein ground station site shall provide an equipment and antenna assembly staging area approximate size 324m² (approx. 60ft x 60ft). Equipment pad shall have grounding connection to be used during antenna assembly. | Inspection/Testing | |
| 34 | REQ_34 | **Construction:** The SANSA Matjiesfontein ground station site shall provide construction access to the antenna field. | Inspection | Confirm that there is clear access to the antenna field. |

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| 35 | REQ_35 | **Access roads:** SANSA Matjiesfontein ground station access roads shall be as follows: **See the full requirement** | Inspection | Confirm that the access road is as specified |
| 36 | REQ_36 | **Safety practices:** SANSA shall implement RF safety practices to avoid radiating over buildings and other structures. | Inspection | Confirm that the RF safety practices or standards has been implemented. |
| 37 | REQ_37 | **Visitors parking:** SANSA shall provide a minimum of 5 parking spaces for LEGS 2 personnel and visitors. | Inspection | Verify that NASA LEGS 2 personnel has been allocated 5 parking bays |
| 38 | REQ_38 | Site development: SANSA Matjiesfontein ground station Site development plans shall be as follows:<br>• SANSA shall provide planned structures locations and future site development plans.<br>• The SANSA ground station site shall provide a minimum setback from existing structures, roadways, fence lines NPR 1620.3a Section 3.9.1.h, Fence lines 30ft and perimeter lighting. | Inspection | Confirm that the specified site development plan has been submitted |
| 39 | REQ_39 | **Frequency spectrum:** The SANSA Matjiesfontein ground station site shall have clear radio frequency spectrum in the following bands:<br>• S: 2025- 2120MHz, 2200 – 2300MHz.<br>• X: 7145 – 7250MHz 8400 – 8500 MHz.<br>• Ka: 25500-27000MHz 34200-24700MHz. | Inspection/Testing | Confirm that the site has been allocated the specified frequency range |
| 40 | REQ_40 | Environmental conditions: The SANSA Matjiesfontein ground station site shall have the following environmental condition throughout the year: | analysis | Confirm that the site has the specified environmental condition |

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| | | • Rainfall < 200mm/y.<br>• Rain rate: 10cm/h.<br>• Wind: Operational < 75km/h.<br>• Survivable < 130 km/h.<br>• Cloudy days < 5days/month.<br>• -25 < Temp < 50C.<br>• Solar radiation: < 300BTU/ft^2.<br>• Hail < 1" in 48km/h wind.<br>• Snow 30psf.<br>• Ice 19mm in winds of 64km/h. | | |
| 41 | REQ_41 | **Location:** The distance form nearest town shall not be more than 50km and the distance from nearest port shall be less than 300km. | Inspection | Verify that the distance to the nearest town is not more than 50Km and the distance to the nearest airport is less than 300km |
| 42 | REQ_42 | **Seismic activity:** SANSA Matjiesfontein ground station site shall have IBC 2009 seismic design category C requirement. | Inspection | |
| 43 | REQ_43 | **Soil condition:** The soil resistivity in SANSA Matjiesfontein ground station site shall be less than 10 ohms. | Testing | Verify that the resistivity of the site is less than 10 ohms |
| 44 | REQ_44 | **EIA:** Environmental impact assessments shall be completed with no block elements prior before starting construction. | Inspection | Confirm that EIA has Been completed with no block elements and the reports has been submitted. |

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| 45 | REQ_45 | **Medical equipment:** Provision for medical equipment shall be made at SANSA Matjiesfontein ground station site as per OSHAS and first aid kits. | Inspection | Confirm that there's medical equipment on site as per the OSHAS |
| 46 | REQ_46 | **Ownership duration:** SANSA shall have access to the Matjiesfontein ground station site for at least 40 years | Inspection | Confirm that Sansa has signed 40-year lease agreement with the land owners |
| 47 | REQ_47 | **Lightning protection/grounding/EMC:** All SANSA Matjiesfontein ground station facilities shall be designed such that it ensures adequate lightning protection based on international best practices with limited electrical interconnection between facilities (FO preferred). Interconnection between facilities to ensure acceptable isolation for lightning ingress. | Inspection/Testing | |
| 48 | REQ_48 | **Encapsulated area:** SANSA Matjiesfontein ground station site shall have Encapsulated area to ensure the elevation mask during the duration of the installation considering future expansion of the site. | Inspection/Testing | Confirm that the site has an Encapsulated area for the elevation mask |
| 49 | REQ_49 | **Garden services:** Natural environment around the facilities at the SANSA Matjiesfontein ground station site shall be maintained to agreed standard. | Inspection | Confirm that gardening service personnel has been appointed to ensure that the natural environment in the site is always maintained to the agreed standards |
| 50 | REQ_50 | **Civil plan:** SANSA team shall provide a landscape plan integrated with the site/civil plan. | Inspection | Review and verify that the landscape plan is well integrated with the site/civil plan |

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| 51 | REQ_51 | **Preservation:** SANSA shall preserve natural landscape as much as possible. | Inspection | Ensure that the landscape plan is preserved |
| 52 | REQ_52 | **Vegetations:** There shall be no combustibles built or vegetation within 10 (TBR) meters from the LEGS antenna. | Inspection/Testing | Confirm that there are no combustible built or vegetation within 10m from the LEGS antenna |
| 53 | REQ_53 | **Perimeter fence (National Key Point Compliant):** SANSA Matjiesfontein site shall have a clear view 3m high fence as per the EIA. | Inspection/Testing | Verify that the security fence is a 3m high clear-view fence |
| 54 | REQ_54 | **Foundation:** The SANSA Facility shall provide the foundation to support the LEGS 2 antenna. | Inspection | Verify that the Civil contractor has made provision for LEGS 2 antenna foundation on site during construction |
| 55 | REQ_55 | **Geotechnical study:** The SANSA Facility will conduct a geotechnical study with borings and soils report by professional engineer and copy of report shall be provided to NASA. | Inspection | Confirm that geotechnical studies has been done and the report addresses the specify requirement |
| 56 | REQ_56 | **Seismic loads:** The seismic loads for the LEGS 2 facility structural design shall be determined in accordance with IBC 2021, based on the maximum considered ground motion accelerations for the location. | Inspection/Testing | Confirm that seismic loads has been determined according to the IBC 2021 standards |
| 57 | REQ_57 | **Wind loads**: The wind loads for structural design shall be determined in accordance with SEI/ASCE 7-22 Risk Category IV. Basic wind speed shall be upgraded to 120 mph (approx. 194km/hr) at antenna stow position. | Inspection/Testing | Confirm that the structural design can withstand 194km/hr wind and has been designed according to the SEI/ASCE 7-22 Risk |

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| | | | | Category IV |
| 58 | REQ_58 | **Drainage system:** SANSA shall ensure that the foundation surface is to have positive drainage. | Inspection | Verify that the foundation surface has a positive drainage |
| 59 | REQ_59 | **ADA compliance:** SANSA shall provide ADA compliant bathrooms available to Ops, maintenance personnel and visitors. | Inspection/Testing | Confirm that the ADA compliance standard is applied for bathrooms, ops, maintenance personnel and visitors |
| 60 | REQ_60 | **Distance:** SANSA shall ensure that the LEGS 2 antenna is at a maximum distance of 500m from the LEGS 2 operations and equipment rooms. (TBR). | Inspection/Testing | Verify and ensure that the LEGS 2 antenna is 500m distance from the operation and equipment room |
| 61 | REQ_61 | **Logistics area:** SANSA Matjiesfontein ground station site shall make the following provisions for the logistics area:<br>• If applicable, the SANSA site shall allow for equipment/spare's storage areas in the SANSA logistics area.<br>• SANSA shall ensure that any LEGS 2 personnel or visitors have access and use of use of common shipping, receiving, and logistics areas | Inspection | Confirm that the specified logistic requirements has been met and verified |
| 62 | REQ_62 | **NASA required access.**<br>NASA shall have access to the following:<br>• Conference Room for twenty occupants minimum. Provide electrical circuits suitable for US electronic devices.<br>• Sleeping Quarters for four people (in shifts). | Inspection | Confirm that NASA has been granted access to the conference room, sleeping quarters, restroom with showers etc. |

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| | | • Restrooms with showers.<br>•Staff Amenities such as kitchen, breakroom, laundry facilities.<br>• Workshop. | | |
| 63 | REQ_63 | **Enclosed office:** NASA shall have access to one enclosed office and one touchdown space outside of the NASA secure area. These spaces will have access to local Wi-Fi. | Inspection | Verify that NASA has access to the enclosed office |
| 64 | REQ_64 | **ADA standards:** SANSA shall ensure that the facility design adheres to the latest ADA standards. | Inspection | Verify that the facility design is compliant with ADA standard |
| 65 | REQ_65 | **Buildings compliance:**<br>The minimum distance required between buildings shall comply with the latest edition of the IBC. All buildings shall adjoin or have access to a public way or yard on not less than one side as defined by the latest edition of the IBC (IBC 2021). | Inspection/Testing | Verify that the building has been built according to building standard including conforming to IBC 2021 standards |
| 66 | REQ_66 | **Occupational health and safety:**<br>SANSA facility design shall implement the OSHA 29 Part 1910 Occupational Health and Safety standards. | Inspection | Confirm that the facility design does implement OSHA 29-part 1910 occupational health and safety standards |
| 67 | REQ_67 | **Interface :**<br>The SANSA facilities shall have the following interface requirement:<br>• Interface the LEGS 2 antenna smoke detectors with the main SANSA facility smoke detection system.<br>• Interface the LEGS 2 antenna fire alarms. | Inspection | Confirm that the site complies to the specified interface requirement |

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| 68 | REQ_68 | **IT** : SANSA shall ensure Information Technology Equipment Rooms shall be protected with clean agent system, in accordance with NFPA 75, NFPA 76. | Inspection | Confirm that the IT equipment room has been protected according to the NFPA 75,NFPA 76 |
| 69 | REQ_69 | **Facilities compliance:**<br>All SANSA facilities shall comply with requirements of NFPA 101 Life Safety Code and NASA- STD-8719.11B. | Inspection | Confirm that facilities comply with NFPA 101 life safety code and NASA- STD-8719.11B |
| 70 | REQ_70 | **Fire sprinkler:**<br>All SANSA facilities shall be protected with fire sprinkler systems where required by NFPA standards. | Inspection | Verify that all Sansa facilities has been protected with fire sprinkler systems where required by NFPA standard |
| 71 | REQ_71 | **Fire compliance:**<br>Fire protection water supply and firewater pumping shall be provided in accordance with and NFPA 20. | Inspection | Verify that the site has a fire protection water supply and fire water pumping according to NFPA 20 |
| 72 | REQ_72 | **VESDA :** The SANSA facilities shall ensure that the LEGS 2 equipment, operations and antenna smoke detection is provided by a VESDA (Very Early Smoke Detection Apparatus) system. | Inspection | Verify that the LEGS2 has smoke detection system provided by VESDA (very early smoke detection apparatus) system |
| 73 | REQ_73 | **Redundancy:** The SANSA site shall implement redundancy into their smoke and fire alarm system. (Class A signaling line and notification circuits.). | Inspection | Confirm that the is redundancy within the smoke and fire alarm system |
| 74 | REQ_74 | **Firewall:** SANSA shall provide fire wall of rating as required by NFPA101 and NASA-STD8719.11B at Matjiesfontein ground station site | Inspection | Confirm that the site has a firewall that comply to the specified standard |

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| 75 | REQ_75 | **Antenna radome:** If applicable SANSA shall ensure that LEGS 2 antenna Radome has positive slope for drainage or floor drain to storm sewer system or daylight. | Inspection/Testing | Verify that the antenna radome has a positive slope for drainage |
| 76 | REQ_76 | **Redundant cooling:** A site HVAC plan that details redundant cooling and coverage of the LEGS equipment, operations, and antenna areas shall be provided to NASA. | Inspection/Testing | Confirm that there is redundant cooling within the HVAC design |
| 77 | REQ_77 | **Tier 3 redundancy: The** SANSA HVAC design shall provide Tier 3 redundancy (as defined by the Uptime Institute's Data Center Site Infrastructure Tier Standard) for HVAC equipment feeding the LEGS equipment, operations, and antenna areas. | Inspection | Confirm that the HVAC design has tier 3 redundancy |
| 78 | REQ_78 | **Humidity and temperature:** Humidity and temperature requirements shall be provided in the NASA provided room data sheets. | Inspection | Confirm the humidity and temperature data can be recorded and be provided in the data sheet |
| 79 | REQ_79 | **HVAC failure:** The HVAC system shall be sized to support the full load of the facility with no single points of failure. | Inspection | Confirm the HVAC systems has been sized to support full load of the facility with no point of failure |
| 80 | REQ_80 | **Antenna HVAC:** The LEGS 2 antenna HVAC shall be powered by the LEGS facility's utility power bus (TBR) The LEGS antenna high power amplifiers (HPAs) and drive system shall be powered by the LEGS facility technical power bus. | Inspection | Confirm the LEGS 2 HVAC systems can be powered by the facility utility power bus and LEGS antenna high power amplifiers is power by the facility technical power |
| 81 | REQ_81 | **HVAC (N+1) configuration:** The minimum level of the HVAC system redundancy shall be an (N+1) configuration. | Inspection | Confirm the LEGS 2 HVAC systems has the N+1 redundancy configuration |

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| 82 | REQ_82 | **HVAC cooling:** The HVAC systems shall be configured to automatically restore cooling to their spaces upon failure of the primary unit(s). | Inspection/Testing | Verify that the HVAC system has ability top restores cooling upon failure of the primary units |
| 83 | REQ_83 | **Facility Infrastructure:** The SANSA facilities infrastructure shall provide HVAC with sufficient capacity to maintain room temperature of the LEGS 2 ground equipment area with a heat dissipation of 171 kBTU/hr (TBR). | Inspection/Testing | Verify that the HVAC systems have the capacity to maintain room temperature of the LEGS 2 equipment area with heat dissipation of 171 kbTU/hr (TBR). |
| 84 | REQ_84 | **LEGS 2 humidity:** The SANSA facility shall ensure that the LEGS 2 equipment room has a humidity of 40 -60% (TBR). | Testing | Verify that the humidity on the LEGS 2 equipment room has a humidity of 40 -60% (TBR). |
| 85 | REQ_85 | **Operational rooms HVAC:** SANSA facility shall ensure that the LEGS 2 equipment and operational rooms HVAC maintain a room temperature set point of 65 – 70 degrees F (TBR) approx. 18 – 23 degrees C. | Testing | Verify by testing that the LEGS2 equipment and operational rooms HVAC maintain a room temperature of 18-23 degrees |
| 86 | REQ_86 | **Equipment rack standard:** SANSA Matjiesfontein ground station equipment racks shall be as follows:<br>• The LEGS 2 rack equipment hot aisle shall be at the rear of the equipment racks. (In accordance with 452-STD-SN-001 Equipment Rack Standard) .<br>• If applicable, The LEGS 2 cold aisle shall be in front of the equipment racks. (In accordance with 452-STD-SN-001). | Inspection | Confirm that the equipment rack confirms to the 452-STD-SN-001 and 452-STD-SN-001 |

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| 87 | REQ_87 | **HVAC design:** The SANSA HVAC design shall provide N+1 redundancy for HVAC equipment feeding the LEGS equipment and antenna areas. | Inspection | Confirm that the HVAC design has N+1 redundancy for the HVAC equipment feeding the LEGS equipment and antenna areas |
| 88 | REQ_88 | **BMS:**<br>• All LEGS building spaces (Ops room, Equipment Spaces, etc) shall be monitored and controlled by SANSA facility BMS. BMS shall report to centralized BMS monitoring systems located at WSC including trouble alarms for both facilities and security systems.<br>• The LEGS 2 antenna HVAC shall be incorporated into the SANSA facility building management system. | Inspection | Verify that the BMS controlled the specified rooms and equipment's |
| 89 | REQ_89 | **Site Electrical Utility Plan:** A Site Electrical Utility Plan shall be provided to NASA. | Inspection | Confirm that the site electrical utility plan has been reviewed and submitted. |
| 90 | REQ_90 | **Distribution model:** A site power distribution model with power conditioning and backup generation at the appropriate voltages and capacity for LEGS equipment shall be provided | Inspection/Testing | Confirm that the power distribution model is as specified in the requirement |
| 91 | REQ_91 | **Tier-3 reliability requirement:** The SANSA facility electrical requirements shall meet Tier-3 reliability requirements for 24/7/365 LEGS 2 operations as defined by the UPTIME Institute. | Inspection/Testing | Verify that the electrical requirements meet Tier-3 reliability requirements for 24/7/365 LEGS 2 operations as defined by the UPTIME Institute. |
| 92 | REQ_92 | **Separate utility:** A separate utility power and technical power distribution shall be provided. | Inspection/Testing | Verify that a separate utility power and technical power |

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| | | | | distribution has been provided. |
| 93 | REQ_93 | **Diesel Generators:** Data on diesel generator fuel supply, including source, capacity, and delivery time shall be provided to NASA. (Diesel shelf life is six (6) months per SIRD draft document) | Inspection/Testing | |
| 94 | REQ_94 | **Diesel fuel quality**: Maintenance of the diesel fuel quality for the diesel generators shall be provided. | Inspection/Testing | |
| 95 | REQ_95 | **Distribution system**:<br>SANSA Matjiesfontein ground station electrical distribution system shall comply with the following standards:<br>• 452-STD-SN-002, Electrical Power Standard for Space Network Ground Stations and.<br>• 452-STD-SN-001 Equipment Rack Standard for Space Network Ground Stations. | Inspection | |
| 96 | REQ_96 | **Ground impedance :** A ground impedance test in conjunction with the design of the antenna grounding system shall be conducted. | Testing | Confirm that a ground impedance test in conjunction with the antenna grounding system's design has been conducted and results reviewed |
| 97 | REQ_97 | **Grounding system:**<br>Grounding systems at SANSA Matjiesfontein ground station site shall be as follows:<br>• The SANSA facility grounding system shall comply with 452-STD-SN-003, Grounding System Standard for Space Network Ground Stations. | Inspection | Confirm that the site grounding system meets the specified standards |

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| | | • The SANSA facility electrical distribution system shall provide technical power to technical loads at 120/208V, 60Hz.<br>The SANSA facility shall provide a technical UPS backed power source and a utility commercial power source. | | |
| 98 | REQ_98 | **Final design:** A short circuit and relay coordination study on the final electrical system design shall be conducted. | Inspection | Verify that a short circuit and relay coordination study on the final electrical system design has been conducted and verified. |
| 99 | REQ_99 | **Electrical Compliance:** All electrical work and installs shall follow NFPA 70E. | Inspection/Testing | Confirm that all electrical work and installs follow NFPA 70E standards. |
| 100 | REQ_100 | **Power design configuration:**<br>SANSA Matjiesfontein ground station design shall include the NASA provided specification/ requirements for the UPS and ensure that NASA concurs with the power design configuration prior to installation. | Inspection | Verify that site design includes the NASA-provided specification/ requirements for the UPS and confirm that NASA concurs with the power design configuration before installation. |
| 101 | REQ_101 | **Power restoration:** The electrical power distribution scheme shall be designed to automatically restore power to the LEGS-2 systems within 10 seconds of a loss of commercial/normal power to the load. | Testing | Confirm that The electrical power distribution scheme has be designed to automatically restore power to the LEGS-2 systems within 10 seconds of a loss of commercial/normal power to the load. |
| 102 | REQ_102 | **Power redundancy:** | Inspection | Confirm that the site has a |

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| | | The SANSA Matjiesfontein ground station technical power source and the utility power source shall provide N+1 power redundancy. | | technical power source and the utility power source that provide N+1 power redundancy. |
| 103 | REQ_103 | **Outages prevention:**<br>The SANSA ground station site shall provide power backup generators with sufficient fuel storage to eliminate effects of commercial power outages for up to 2 weeks. (TBR). | Inspection/Testing | Verify that the site provides power backup generators with sufficient fuel storage to eliminate the effects of commercial power outages for up to 2 weeks. |
| 104 | REQ_104 | **South African Standard voltage:**<br>The electrical power (technical and utility ) shall be delivered at the South Africa standard voltages of 400/230V, 50Hz, and will utilize South African standard receptacles (Type M or N). | Inspection/Testing | Verify that the electrical power is delivered at the South Africa standard voltages of 400/230V, 50Hz, and it utilize South African standard receptacles (Type M or N). |
| 105 | REQ_105 | **Facilities power source:**<br>The SANSA Matjiesfontein ground station technical power source shall provide power to the LEGS antenna, antenna HVAC, antenna security, LEGS indoor HVAC, lighting, and LEGS equipment. | Inspection/Testing | Confirm that facilities power source meets the requirements as specified |
| 106 | REQ_106 | **TVSS :**The SANSA Matjiesfontein ground station electrical power infrastructure shall provide transient voltage surge suppression (TVSS) on the LEGS 2 antenna/equipment technical power feed. | Inspection/Testing | Confirm that TVSS requirement is met as specified |
| 107 | REQ_107 | **Voltage drops:**<br>The maximum voltage drop of the antenna technical power feeder shall be less than 3% of the nominal rated voltage. | Inspection/Testing | Verify by testing that the maximum voltage drop of the antenna technical power feeder is less than 3% of the |

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| | | | | nominal rated voltage. |
| 108 | REQ_108 | **Automated Switching:** Electrical switching operations shall be continuous and automated. | Testing | Verify by testing that Electrical switching operations continuous and automated. |
| 109 | REQ_109 | **UPS specifications:**The SANSA facility design shall include NASA provided UPS specification/requirements. | Inspection | Verify that the SANSA facility design includes NASA provided UPS specifications/requirements |
| 110 | REQ_110 | **arc-flash:** SANSA ground station facility shall provide appropriate arc-flash calculations and labelling of incident energy levels for the technical power and utility power distribution equipment. | Inspection | Confirm by inspection that the site provides appropriate arc-flash calculations and labeling of incident energy levels for the technical power and utility power distribution equipment. |
| 111 | REQ_111 | **Single point of failures:**<br>The SANSA Matjiesfontein ground station power and electrical design shall eliminate technical power distribution single point of failures to the greatest extent possible. | Inspection/Testing | Confirm by inspection and testing that the power and electrical design eliminates technical power distribution single point of failures to the greatest extent possible. |
| 112 | REQ_112 | **Dual power feeds:** SANSA ground station technical power design shall accommodate dual power feeds (a side and b side power) to the antenna and the LEGS 2 equipment racks. | Inspection | Confirm by inspection that site technical power design accommodates dual power feeds (a side and b side power) to the antenna and the LEGS 2 equipment racks. |

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| 113 | REQ_113 | **Technical power feeds:** The technical power shall have redundant technical power feeds provided for the SANSA main building. | Inspection | Confirm by inspection The technical power have redundant technical power feeds provided for the SANSA main building. |
| 114 | REQ_114 | **Back-up generator:**<br>Technical and utility power shall be backed by the back-up generators. | Inspection | Verify that technical and utility power have be backed by the backup generators. |
| 115 | REQ_115 | **Perimeter lighting encompassing:**<br>SANSA ground station shall provide perimeter lighting encompassing the LEGS antenna field in accordance with NPR 1620.3B. | Inspection | Verify by inspection that the site provides perimeter lighting encompassing the LEGS antenna field in accordance with NPR 1620.3B. |
| 116 | REQ_116 | **UPS feeder power fails:**<br>SANSA Matjiesfontein ground station UPS feeder power fails shall be as follows:<br>• The SANSA facility technical power design shall consider method to provide power to LEGS critical equipment in the case that the UPS feeder power fails.<br>• The SANSA electrical design shall consider N+1 redundancy in the equipment used to power the critical load in the event of a UPS feeder power failure.<br>• The SANSA electrical design shall provide UPS system(s) sized to provide backup power to technical loads in the event of a UPS input feeder power failure for at least 30minutes. The | Inspection | Confirm by inspection that the site UPS feeder power fails meets the specified requirement |

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| | | UPS systems shall contain VRLA battery strings. | | |
| 117 | REQ_117 | **Power and telecommunication cable:**<br>SANSA shall provide the Matjiesfontein ground station with the following:<br>• SANSA to provide power and telecommunication cable trays as required per design.<br>• SANSA shall provide cable and signal tray design that separates power and signal cables. | Inspection | Confirm by inspection that the site has the following:<br>• SANSA provides power and telecommunication cable trays as required per design.<br>• SANSA provides cable and signal tray design that separates power and signal cables. |
| 118 | REQ_118 | **Power load:**<br>• SANSA technical power load shall provide at least 70kVA technical power to the LEGS 2 equipment/antenna.<br>• SANSA utility power load shall provide at least 120kVA utility power for the LEGS 2 equipment/rooms/antenna areas. | Inspection/Testing | Confirm by Testing that the technical power load provides at least 70kVA technical power to the LEGS 2 equipment/antenna and 120KVA utility power to the LEGS 2 equipment/rooms/antenna areas. |
| 119 | REQ_119 | **Emergency shut off:**<br>SANSA shall provide a means to turn off power to all LEGS 2 equipment and antenna areas. (i.e. emergency shut off). | Testing | Confirm by inspection and testing that the provides a means to turn off power to all LEGS 2 equipment and antenna areas. |
| 120 | REQ_120 | **Floodlighting** :<br>The SANSA facility shall provide floodlighting around the LEGS 2 antenna. | Inspection/Testing | Confirm by inspection that the site provides floodlighting around the |

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| | | | | LEGS 2 antenna |
| 121 | REQ_121 | **Power distinction:**<br>SANSA shall ensure that there will be a distinction between utility power and technical power | Inspection/Testing | Confirm by inspection and testing that there is a a distinction between utility power and technical power |
| 122 | REQ_122 | **NASA Power config:**<br>It shall be ensured that NASA concurs with the site power design configuration prior to installation. | Inspection | Confirm by inspection that NASA concurs with the site power design configuration prior to installation. |
| 123 | REQ_123 | **UPS batteries:**<br>The UPS batteries shall be sized for 30-minute backup at UPS full load capacity. | Inspection/Testing | Confirm that the UPS batteries sized for 30-minute backup at UPS full load capacity. |
| 124 | REQ_124 | **Power transition:**<br>Commercial power to run on UPS power for up to 15 minutes (TBR) before transition to diesel generator power. Require two weeks of diesel run time. | Testing | Verify by testing that the Commercial power runs on UPS power for up to 15 minutes before transitioning to diesel generator power. |
| 125 | REQ_125 | **Work lights:**<br>SANSA shall ensure that NASA has the ability to connect work lights within antenna enclosure. | Inspection/Testing | Confirm and verify that SANSA ensures NASA has the ability to connect work lights within the antenna enclosure. |
| 126 | REQ_126 | **Lightning protection:**<br>SANSA shall ensure to implement lightning protection in their facility design. NASA may provide lightning detection – TBD. | Inspection/Testing | Confirm that the site implements lightning protection in its facility design. |

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| 127 | REQ_127 | **Technical power loads:**<br>The SANSA technical power load shall provide at least 200 kVA technical power to the LEGS 2 equipment/antenna. (Rough power estimate additional margin of 25% was included to get 102kVA and then an additional 98kVA in the estimates for multiple unknowns,). | Testing | Confirm that the technical power loads requirement has been met as specified. |
| 128 | REQ_128 | **Utility power loads:**<br>The SANSA utility power load shall provide at least 250 kVA utility power for the LEGS 2 equipment/rooms/antenna areas (Includes 25 percent margin for growth and 41Kva for unknowns). | Testing | Verify that Utility power loads requirement has been met as specified |
| 129 | REQ_129 | **Required circuit:**<br>SANSA Matjiesfontein antenna shall have the following power configuration.: ***See full requirement.*** | Inspection/Testing | Verify by inspection and testing that the required circuit power requirement is fully me |
| 130 | REQ_130 | **Antenna power and heating requirement:**<br>SANSA Matjiesfontein antenna shall have the following power and heating requirement: ***see the full requirement*** | Inspection/Testing | Confirm by Inspection that the antenna has the specified power and heating requirement |
| 131 | REQ_131 | **Concrete duct bank:**<br>• The SANSA facility shall provide a 6-way reinforced concrete duct bank to provide power and communications to the LEGS 2 antenna.<br>• The LEGS 2 antenna duct bank(s) shall be installed in accordance with 452-STD-SN-002.<br>• Communications and power runs in the LEGS 2 duct bank shall be placed in independent conduits.<br>• The duct bank for the LEGS 2 antenna shall contain a | Inspection | Verify by inspection that the concrete duct bank meets the specified requirements |

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| | | minimum of two spare power conduits.<br>• The duct bank for LEGS 2 shall contain a minimum of one spare communication conduit. | | |
| 132 | REQ_132 | **US power plugs:**<br>SANSA shall provide US plugs power type for use by LEGS 2 personnel in at least one conference room. | Inspection | Verify by inspection that SANSA provides US plugs power type for use by LEGS 2 personnel in at least one conference room. |
| 133 | REQ_133 | **Conveyances:**<br>• The SANSA facility shall provide independent conveyances for technical and utility power.<br>• A minimum of one communication conveyance shall be provided to interconnect the SANSA LEGS 2 rooms/building(s) and LEGS 2 antenna. | Inspection | Verify that the conveyances requirement is met |
| 134 | REQ_134 | **Telephone:**<br>The SANSA facility shall provide the means/the ability to connect a telephone to the inside of the LEGS antenna pedestal. | Inspection | Verify that SANSA facility provides the means/the ability to connect a telephone to the inside of the LEGS antenna pedestal. |
| 135 | REQ_135 | Mission voice key set:<br>The SANSA facility shall provide the means to install a mission voice keyset in the LEGS antenna pedestal and Ops rooms. | Inspection | Verify that the SANSA facility provides the means to install a mission voice keyset in the LEGS antenna pedestal and Ops rooms |
| 136 | REQ_136 | **Bandwidth:**<br>• The SANSA facility shall provide Short/Medium Term: 10Gbps (international bandwidth usage approximately 2.6 Gbps), with | Inspection/Testing | Verify that the Bandwidth requirement is met |

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| | | dual (2 x links) for full redundancy. Additional 100Mbps line for additional redundancy.<br>• The SANSA facility shall provide Ethernet Category 6aCat6a cable can handle up to 500 MHz frequency with bandwidth support of up to 10 Gbps efficiently for 100 meters. | | |
| 137 | REQ_137 | **Stormwater Management Master Plan:**<br>A Stormwater Management Master Plan shall be provided to NASA. And Analysis in the storm water management master plan shall include 2,10, and 100-year storm events or intervals as recommended. | Inspection | Verify that the Stormwater Management Master Plan has been submitted |
| 138 | REQ_138 | **Watercourse Analysis:**<br>Watercourse analysis shall be conducted to determine LEGS 2 construction impacts throughout the site (including roads, buildings, fencing, antenna, etc.). | Inspection | Verify that the Watercourse analysis has been conducted to determine LEGS 2 construction impacts throughout the site. |
| 139 | REQ_139 | **Water Ways:**<br>The SANSA site/facility shall be graded so waterways and storm/water runoff will not impact the LEGS2 antenna and related buildings. | Inspection/Demonstration | Verify by inspection that the SANSA site has been graded so waterways and storm/water runoff |
| 140 | REQ_140 | **Communication frequency:**<br>The SANSA facility shall support LEGS 2 antenna X-band and Ka-band RF communication. | Testing | Verify that the SANSA facility supports LEGS 2 antenna X-band and Ka-band RF communication. |
| 141 | REQ_141 | **NASA RF safety:**<br>SANSA shall comply with NASA RF Safety requirements and the NPR 2570.1C NASA Radio Frequency (RF) Spectrum Management Manual. | Inspection | Verify that SANSA complies with NASA RF Safety requirements and the NPR 2570.1C NASA Radio |

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| | | | | Frequency (RF) Spectrum Management Manual |
| 142 | REQ_142 | **RF analysis:**<br>An RF analysis for building/antenna blockages from the LEGS 2 antenna asset shall be conducted while NASA conduct a concurrent RF analysis. | Inspection | Verify by inspection that An RF analysis for building/antenna blockages from the LEGS 2 antenna asset has been conducted while NASA conduct a concurrent RF analysis. |
| 143 | REQ_143 | **RFI interferences:**<br>Existing or planned buildings in the SANSA facility shall not interfere with the LEGS 2 antenna RF communication. | Inspection/Demonstration | Verify that Existing or planned buildings in the SANSA facility does not interfere with the LEGS 2 antenna RF communication. |
| 144 | REQ_144 | **Antenna security fence:**<br>The antenna security fence shall not interfere with the LEGS 2 antenna RF communication. | Inspection/Testing | Verify that the antenna security fence does not interfere with the LEGS 2 antenna RF communication. |
| 145 | REQ_145 | **Planned future Antennas:** Planned or future antennas in the SANSA facility shall not interfere with the LEGS 2 antenna RF communication | Analysis/Testing | Verify by visual inspection and Analysis that planned or future antennas in the SANSA facility will not interfere with the LEGS 2 antenna RF communication |
| 146 | REQ_146 | **X and Ka band collimation:** The facilities and infrastructure to perform X-band and Ka-band collimation shall be provided for LEGS 2. | Inspection/Testing | Confirm that The X-band and Ka-band collimation has been be provided and verified for LEGS 2 |

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| 147 | REQ_147 | **Antenna RF mask:**<br>It shall be ensured that trees and vegetation outside the antenna security fence and perimeter security fence not interfere with the LEGS 2 antenna RF mask. | Inspection/Testing | Verified that trees and vegetation outside the antenna security fence and perimeter security fence does not interfere with the LEGS 2 antenna RF mask. |
| 148 | REQ_148 | **Connectivity:**<br>The LEGS 2 operations and equipment rooms shall have telephone/VOIP connectivity to the LEGS antenna. | Inspection/Testing | Verify that LEGS 2 operations and equipment rooms have telephone/VOIP connectivity to the LEGS antenna |
| 149 | REQ_149 | **Antenna and Equipment room:**<br>Network routing cable trays and fiber duct bank shall be provided between the LEGS 2 antenna and equipment room. | Inspection | Confirm that Network routing cable trays and fibre duct bank has been provided between the LEGS 2 antenna and equipment room. |
| 150 | REQ_150 | **Network standard:**<br>SANSA and NASA networks shall be secured/hardened in accordance with NASA standards and requirements NIST 800-53 Rev 5. | Inspection | Confirm and verify that SANSA and NASA networks has been secured/hardened in accordance with NASA standards and requirements NIST 800-53 Rev 5. |
| 151 | REQ_151 | **Network routing paths:**<br>NASA shall install network cabling from the LEGS 2 antenna and equipment room utilizing the providing network routing paths. | Inspection | Verify that NASA has install network cabling from the LEGS 2 antenna and equipment room utilizing the providing network routing paths. |

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| 152 | REQ_152 | **NASA Mission Voice system:**<br>Conduits and cable routing between the telecom, operations, equipment, and antenna pedestal shall be provided for the NASA mission voice system | Inspection | Verify that Conduits and cable routing between the telecom, operations, equipment, and antenna pedestal has been provided for the NASA mission voice system |
| 153 | REQ_153 | **NASA Mission Voice system cabling:**<br>NASA to provide cabling and NASA mission voice system installation/configuration in these areas. | Inspection | Verify that NASA has provided cabling and NASA mission voice system installation/configuration in these areas. |
| 154 | REQ_154 | **Rooms Network:**<br>The connection between the rooms shall be separate from SANSA networks. | Inspection | Verify that the connection between the rooms is separate from SANSA networks |
| 155 | REQ_155 | **BMS Network**:<br>The SANSA facility network infrastructure shall be separate from NASA networks except for the BMS which shall provide notifications to a WSC monitoring system by dry contact designed to isolate the two systems. | Inspection | Verify that the BMS configuration is as specified |
| 156 | REQ_156 | **BMS Netowk:**<br>The SANSA facility network infrastructure shall be separate from NASA networks except for the BMS which shall provide notifications to a WSC monitoring system by dry contact designed to isolate the two systems. | Inspection | Verify that the network infrastructure meets the specified requirements |
| 157 | REQ_157 | **Dual redundant:** | Inspection/Testing | Verify that the SANSA facility |

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| | | The SANSA facility shall provide dual redundant 10 Gbps network connections between the LEGS equipment room and operations room. | | provides dual redundant 10 Gbps network connections between the LEGS equipment room and operations room. |
| 158 | REQ_158 | **Dual redundant global network:**<br>The SANSA facility shall provide a high availability, dual redundant 10 Gbps connection (international bandwidth usage is expected to be approximately 2.6 Gbps) from the LEGS equipment room to a global network. | Inspection/Testing | Verify that the Dual redundant global network is met |
| 159 | REQ_159 | **Cable routing:**<br>All cable routing in rooms shall be by cable tray and cable routing between rooms shall be via conduit. | Inspection | Verify that all cable routing in room has been by cable tray and cable routing between rooms has been via conduit. |
| 160 | REQ_160 | **Physical/geographical diversity:**<br>This connection from the LEGS equipment room to a global network shall be separate from SANSA networks.<br>• Physical/geographical diversity should be considered if available for the dual connections. | Inspection | Verify that the Physical/geographical diversity requirement Is met as specified. |
| 161 | REQ_161 | **Static electricity:**<br>SANSA shall ensure that control of static electricity in the equipment room may be controlled by electro-static dissipative flooring, humidity levels, grounding etc. | Inspection/Testing | Confirm that SANSA ensure that the control of static electricity in the equipment room may be controlled by electro-static dissipative flooring, humidity levels, grounding etc. |

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| 162 | REQ_162 | **Lighting:**<br>SANSA shall apply OSHA standard 29 Part 1910 when considering lighting for areas where personnel will be staffed. Considerations such as task lighting and ability to dim lights shall be considered. | Inspection | Confirm that the Lighting meets the OSHA standards |
| 163 | REQ_163 | **Operations room:**<br>The Dedicated Operations Room for NASA inside NASA security boundary shall have the following specifications: ***See the full room datasheet.*** | Inspection/Testing | Confirm that the Operations room meets the data sheet requirement |
| 164 | REQ_164 | **Equipment room(s):**<br>The Dedicated Signal processing room for NASA inside NASA security boundary shall have the following specifications: ***See the full room datasheet.*** | Inspection/Testing | Confirm that the Equipment room(s) meets the data sheet requirement |
| 165 | REQ_165 | **Offices:**<br>The Dedicated Office Room for NASA inside NASA security boundary shall have the following specifications: ***See the full room datasheet.*** | Inspection/Testing | Confirm that the Offices meets the data sheet requirement. |
| 166 | REQ_166 | **Auditorium:**<br>The Dedicated Auditorium Room for NASA inside NASA security boundary shall have the following specifications: ***See the full room datasheet.*** | Inspection/Testing | Confirm that the Auditorium meets the data sheet requirement. |
| 167 | REQ_167 | **Bathrooms:**<br>The Dedicated Bathrooms Room for NASA inside NASA security boundary shall have the following specifications: ***See the full room datasheet.*** | Inspection/Testing | Confirm that the Bathrooms meets the data sheet requirement. |
| 168 | REQ_168 | **Sleeping Quarters: Number of rooms: 5** | Inspection/Testing | Confirm that the Sleeping Quarters meets the data |

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| | | The Dedicated sleeping quarters Room for NASA inside NASA security boundary shall have the following specifications: ***See the full room datasheet.*** | | sheet requirement. |
| 169 | REQ_169 | **Kitchen:**<br>The Dedicated Kitchen Room for NASA inside NASA security boundary shall have the following specifications: ***See the full room datasheet.*** | Inspection/Testing | Confirm that the Kitchen meets the data sheet requirement. |
| 170 | REQ_170 | **Breakout area:**<br>**Indoor:**<br>Indoor break area TBD m^2 with suitable furniture to support food consumption and general relaxation.<br>**Outdoor:**<br>Covered outdoor break area TBD m^2 with suitable furniture to support food consumption and general relaxation. | Inspection/Testing | Confirm that the Breakout area meets the data sheet requirement. |
| 171 | REQ_171 | **Power generation building:**<br>SANSA propose that all gensets collocated in an open plan hanger type facility designed with noise reduction and in the style as per EIA. | Inspection/Testing | Confirm and verify that proposed gensets collocated in an open plan hanger type facility designed with noise reduction and in the style as per EIA. |
| 172 | REQ_172 | **Lifting capability Overhead crane:**<br>The SANSA Matjiesfontein site shall have a crane with lifting capacity of 15-20T reaching whole area. Motorized both axes. | Inspection/Testing | Confirm and verify that the SANSA Matjiesfontein site have a crane with a lifting capacity of 15-20T reaching the whole area. Motorized both axes. |

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| 173 | REQ_173 | **Rooms:**<br>Provision for the following rooms shall be made with size and floors to match the power station: ***See the full room datasheet.*** | Inspection/Testing | Confirm that the room meets the data sheet requirement |
| 174 | REQ_174 | **Garage:**<br>See parking. | Inspection | Verify that the Garage meets the standard requirements |
| 175 | REQ_175 | **Storage both at Mechanical and electronic workshops:**<br>The workshops shall have the height of Height +/- 6m with Heavy concert flooring Spares warehouse, equipment storage and maintenance building (such as man-lifts, fork-lifts, etc.). | Inspection/Testing | Verify that the Mechanical and electrical workshop meets the required requirements |
| 176 | REQ_176 | **Lockable Shelving:**<br>SANSA Matjiesfontein site shall have Shelving Lockable with key/biometric access for the following storage:<br>• Equipment.<br>• Spares.<br>• Inventory. | Inspection/Testing | Verify that site have Shelving Lockable with key/biometric access for the following storage: |
| 177 | REQ_177 | **Flammable/Hazardous store:**<br>SANSA Matjiesfontein site shall have a separate building for flammables. | Inspection | Verify by inspection that site shall have a separate building for flammables. |
| 178 | REQ_178 | **Possible effluent plant**<br>Provision for Effluent plant shall be made depending on the regulations. | Inspection | Confirm that Provision for Effluent plant has been made depending on the regulations. |
| 179 | REQ_179 | **Reception:**<br>The Dedicated reception Room for NASA inside NASA security | Inspection/Testing | Confirm that the reception meets the data sheet |

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| | | boundary shall have the following specifications: ***See the full room datasheet.*** | | requirement. |
| 180 | REQ_180 | **Renewable power:**<br>The Dedicated renewable power Room for NASA inside NASA security boundary shall have the following specifications: ***See the full room datasheet.*** | Inspection/Testing | Confirm that the Renewable power room meets the data sheet requirement. |
| 181 | REQ_181 | **Security Room:**<br>The Dedicated security Room for NASA inside NASA security boundary shall have the following specifications: ***See the full room datasheet.*** | Inspection/Testing | Confirm that the Security Room meets the data sheet requirement. |
| 182 | REQ_182 | **Renewable power:**<br>The Dedicated renewable power Room for NASA inside NASA security boundary shall have the following specifications: ***See the full room datasheet.*** | Inspection/Testing | Confirm that the Renewable power room meets the data sheet requirement. |
| 183 | REQ_183 | **Security Room:**<br>The Dedicated security Room for NASA inside NASA security boundary shall have the following specifications: ***See the full room datasheet.*** | Inspection/Testing | Confirm that the Security Room meets the data sheet requirement. |
| 184 | REQ_184 | **Waiting Area:**<br>The Dedicated waiting area Room for NASA inside NASA security boundary shall have the following specifications: ***See the full room datasheet.*** | Inspection/Testing | Confirm that the Waiting Area meets the data sheet requirement. |
| 185 | REQ_185 | **Workshop(s) (Co-located with power generation):**<br>The SANSA Matjiesfontein site shall have the following workshops | Inspection/Testing | Confirm and verify that the workshop requirement is met as specified. |

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| | | which are co-located with the power generation:<br>• Mechanical/Electrical: size of 100 m² Location: Co-located with power gen/stores?<br>• Electronic: Size of 100 m² Location: Co-located with equipment rooms?<br>• Tools: TBD (lathe, drill, sander, milling machine…)<br>• Special requirements based on tools: I.e., special requirement for ventilation/ power noise etc. | | |
| 186 | REQ_186 | **Fuel Storage:**<br>SANSA Matjiesfontein site shall have appropriate facility to store the following fuel:<br>• Diesel: 300,000L on site Stored above ground (*as per EIA) near Greenhouse as per fuel storage regulations.<br>• Coolant TBD. | Inspection | Confirm and verify that the site have the appropriate facility to store the following fuel: |
| 187 | REQ_187 | **Parking:**<br>Provision for parking as the "South African Parking Standards T.C. MACKEY, O.A.W. VANZYL, AND J. C. VORSTER" shall be made as follows: | Inspection | Verify and confirm that parking utilizes the following standard "South African Parking Standards T.C. MACKEY, O.A.W. VANZYL, AND J. C. VORSTER" |
| 188 | REQ_188 | **Water:**<br>SANSA Matjiesfontein site shall have water for the following use:<br>• General use: Access to sustainable water with flow rate of at least xl/min.<br>• Potable: Access to potable water with flow rate of at least | Inspection/Testing | Verify and confirm that the site has Water as specified in the requirement |

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| | | xl/min.<br>• Storage: Fire protection: 750,000L.<br>• Distribution Boreholes ????: General use water to be distributed continuously to pre-determined points across site. Potable water to be distributed continuously to all the inhabited buildings. | | |
| 189 | REQ_189 | **Sanitation:**<br>SANSA Matjiesfontein facilities shall have Ablutions available at all the inhabited buildings: Number of persons to be served: x.<br>• Access for all genders and all levels of ability as per OSHAS.<br>• Each main building to include at least two private shower stalls for use by all staff. | Inspection | Verify and confirm that the site has sanitation facilities as specified in the requirement |
| 190 | REQ_190 | **Wastewater management:**<br>SANSA Matjiesfontein site shall have No access to municipal sewer. | Inspection | Verify that the waste management plan has been provided. |
| 191 | REQ_191 | **Fire protection:**<br>SANSA MTJ site shall have water-based fire protection system with Objective: 3 hours of water supply at 250,000L/hour automatic-start diesel backup water pumps that can deliver 250,000L/hr delivery 750,000L water storage tanks. | Inspection/Testing | Verify that the site has fire protection system as specified |
| 192 | REQ_192 | **Power:**<br>Power availability 99.99%. | Analysis/inspection | Verify by analysis and inspection that the power availability is 99.99% |
| 193 | REQ_193 | **Renewable energy:** | Inspection/Testing | Verify that the renewable energy is as specified in the |

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| | | Provision for renewal energy shall be made that augment national grid with at least TBD kVA local generated renewable energy. (Integrated power generation design required to address interaction between power sources). | | requirement |
| 194 | REQ_194 | **Back-up:**<br>The SANSA Matjiesfontein site shall provide backup power capabilities using the following systems:<br>• Generators: Full synchronized generator backup for complex (N+1) 2x 1MW (expandable to 4) dependent on outcome of availability analysis.<br>• UPS: Full UPS to maintain the complex (N+1) for 2min UPS for antenna installation to be located at the antenna UPS for main control room will be located in the Gen House TBD. | Inspection/Testing | Verify that the provision for backup power has been made as specified in the requirement |
| 195 | REQ_195 | **Distribution:**<br>The distribution systems for SANSA Matjiesfontein site shall use the 11kV 3phase ring feed, step down transformers at each cluster of antennas, main buildings. Size of transformers: TBD based on power budget for each installation. | Inspection/Testing | Verify that the distribution system is as specified in the requirement |
| 196 | REQ_196 | **Communications:**<br>The following communication systems shall be use as the means to provide internet access: | Inspection/Demonstration | Verify that the communication system for the internet is as specified in the requirement |
| 197 | REQ_197 | **Waste disposal:**<br>The Site shall have waste disposal TBD Separated with an agreement to dispose in an environmentally responsible way (re-cycle + hazardous waste policy). | Inspection | Verify that the site has waste disposal system as specified in the requirement |

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| 198 | REQ_198 | **General safety program:**<br>The SANSA facility design shall comply with NPR 8715.3D NASA General Safety Program Requirements. | Inspection | Verify that the facility design complies with NPR 8715.3D NASA General Safety Program Requirements. |
| 199 | REQ_199 | **SANSA Fire detection system:**<br>A site fire detection and suppression plan detailing coverage of LEGS equipment, operation, and antenna areas shall be provided. | Inspection/Testing | Verify that a site fire detection and suppression plan detailing coverage of LEGS equipment, operation, and antenna areas has been provided. |
| 200 | REQ_200 | **SANSA NASA fire detection system:**<br>The SANSA facility fire detection system (smoke and fire alarms) shall provide LEGS 2 equipment and operations room status to WSC. | Inspection/Testing | Verify that the facility fire detection system (smoke and fire alarms) provides LEGS 2 equipment and operations room status to WSC. |
| 201 | REQ_201 | **Fire alarm system redundancy:**<br>Redundancy shall be incorporated into the smoke and fire alarm system. | Inspection/Testing | Verify by inspection and testing that the Redundancy has bee incorporated into the smoke and fire alarm system. |
| 202 | REQ_202 | **Fire break:**<br>Fire breaks shall be maintained within the LEGS antenna security fence and perimeter security fence. | Inspection | Confirm that the Fire breaks has been maintained within the LEGS antenna security fence and perimeter security fence. |
| 203 | REQ_203 | **Smoke/fire dampers:**<br>All air duct openings in the fire resistance rated barrier shall be | Testing/Demonstration | Verify by inspection and confirm that All air duct |

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| | | protected with U.L. Listed, combination, smoke/fire dampers | | openings in the fire resistance rated barrier has been protected with U.L. Listed, combination, smoke/fire dampers |
| 204 | REQ_204 | **LEGS 2 lighting protection:**<br>The LEGS 2 antenna shall be protected with a lightning protection system in accordance with 452-STD-SN-003. | Inspection/Testing | Confirm that The LEGS 2 antenna been protected with a lightning protection system in accordance with 452-STD-SN-003. |
| 205 | REQ_205 | **Self closing doors:**<br>All doors in the fire resistance rated barrier shall be self-closing, positive latching, U.L. Listed fire door assemblies. | Inspection/Testing | Confirm that All doors in the fire resistance rated barrier is self-closing, positive latching, U.L. Listed fire door assemblies. |
| 206 | REQ_206 | **ISO standard:**<br>All safety signage shall follow ISO standard 3864-1 2019, and 7010:2019. | Inspection | Verify that All safety signage follows ISO standard 3864-1 2019, and 7010:2019. |
| 207 | REQ_207 | **Facility NASA protection system:**<br>The facility shall adhere to the primary NASA fire protection & life safety requirements documents: NASA Standard 8719.11B, SAFETY STANDARD FOR FIRE PROTECTION:<br>• Other referenced requirements documents include, but are not limited to, NFPA 13, NFPA 72, NFPA 75, NFPA 76, NFPA 101, and NFPA 2001. | Inspection | Verify and confirm that the Facility NASA protection system confirms to the requirement. |
| 208 | REQ_208 | **NASA Authority Having Jurisdiction:** | Inspection | Verify that NASA Authority has jurisdiction requirement |

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| | | Wherever requirements conflict or there is an interpretation question, the final decision shall be made by the NASA Authority Having Jurisdiction (AHJ). | | has been met as specified |
| 209 | REQ_209 | **Fire resistance:**<br>Penetrations in the fire-resistance-rated barrier shall be kept to a minimum in number. | Inspection/Testing | Confirm that Penetrations in the fire-resistance-rated barrier has been be kept to a minimum in number. |
| 210 | REQ_210 | **Resistance rated barrier:**<br>All penetrations in the fire resistance rated barrier shall be protected with a U.L Listed, through penetration, fire stop system appropriate for the penetrating object and barrier construction. | | Verify that the Resistance barrier requirement has been met |
| 211 | REQ_211 | **NASA separated structure:**<br>NASA areas to include the operations, telecommunications, and equipment rooms, (Mission Critical Equipment and Mission Critical Infrastructure) shall be separated from the rest of the structure by U.L. listed design, fire resistance rated barriers of not less than 1 hour rating. | Inspection/Demonstration | Verify and confirm that NASA separated structurer requirement has been met as specified |
| 212 | REQ_212 | **Smoke detections system:**<br>The clean agent system shall be released by the air sampling smoke detections system. | | Verify and confirm that the clean agent system can be released by the air sampling smoke detections system. |
| 213 | REQ_213 | **Clean agent system:**<br>The clean agent system, agent selection shall be approved by the NASA AHJ. | Inspection/Demonstration | Verify that the clean agent system, agent selection has been be approved by the NASA AHJ. |
| 214 | REQ_214 | **Discharge audible:** | Inspection/Testing | Confirm that Discharge audible requirement has |

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| | | Pre-discharge and post discharge audible and visual notification appliances, and associated signage, shall be approved by the NASA AHJ. | | been met as specified |
| 215 | REQ_215 | **Air sampling system:**<br>The air sampling system shall be connected to the building fire alarm system according to local requirements. | Inspection/Testing | Confirm that the air sampling system has been connected to the building fire alarm system according to local requirements. |
| 216 | REQ_216 | **Pre-action sprinkler system:**<br>Should local requirement direct the installation of a building-wide sprinkler systems, NASA shall require separately valved pre-action sprinkler system with double interlock, and separate water flow indication. | Inspection/Testing | Verify that the Pre-action sprinkler system requirement has been met as specified |
| 217 | REQ_217 | **Multiple supervisory signals:**<br>All NASA fire protection systems trouble, alarm, water flow, and multiple supervisory signals shall be transmitted to a constantly attended location reporting to a designated NASA authority. | | Verify that the Multiple supervisory signals requirement has been met as specified |
| 218 | REQ_218 | **NASA areas:**<br>All NASA areas shall be provided with audible and visual building fire alarm notification appliances according to local requirements. | Inspection/Testing | Verify NASA areas has been provided with audible and visual building fire alarm notification appliances according to local requirements. |
| 219 | REQ_219 | **SANSA BMS:**<br>The SANSA facility shall have a building mass notification system that interfaces with the LEGS 2 antenna, equipment, and operation rooms. (i.e., a PA system or loud-speaker system that broadcasts | Inspection/Testing | Verify that SANSA BMS requirements is met as specified |

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| | | safety alerts to the site). | | |
| 220 | REQ_220 | **Perimeter security fence:**<br>The SANSA site shall provide a perimeter security fence around the facility according to NPR 1620.3B NASA Physical Security Requirements for NASA facilities and properties. | Inspection/Testing | Confirm that Perimeter security fence requirement is as specified |
| 221 | REQ_221 | **Perimeter LEGS security fence:**<br>A LEGS 2 antenna security fence shall be installed a minimum of 30m (98.4ft) from the antenna. | Inspection/Testing | Confirm that A LEGS 2 antenna security fence has been installed a minimum of 30m (98.4ft) from the antenna. |
| 222 | REQ_222 | **Vegetation:**<br>All vegetation in a 9.14m (30ft) clear zone inside/outside the perimeter security fence. | Inspection/Testing | Confirm and verify that All vegetation in a 9.14m (30ft) clear zone inside/outside the perimeter security fence. |
| 223 | REQ_223 | **Antenna vegetation:**<br>All vegetation between the antenna security fence and the perimeter security fence shall be removed. | Inspection/Testing | Verify that All vegetation between the antenna security fence and the perimeter security fence has been be removed. |
| 224 | REQ_224 | **LEGS 2 antenna fence:**<br>The SANSA site shall provide an antenna security fence around the LEGS 2 antenna according to NPR 1620.3B. | Inspection/Testing | Verify that the SANSA site provides an antenna security fence around the LEGS 2 antenna according to NPR 1620.3B. |
| 225 | REQ_225 | **LEGS 2 antenna fence:**<br>The SANSA site shall provide an antenna security fence around the | Inspection/Testing | Verify that the SANSA site provides an antenna security fence around the LEGS 2 |

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| | | LEGS 2 antenna according to NPR 1620.3B. | | antenna according to NPR 1620.3B. |
| 226 | REQ_226 | **LEGS 2 Minimum Elevation:**<br>The LEGS 2 antenna shall not impact the antenna security fence when the antenna is at minimum elevation. | Inspection | Confirm that the LEGS 2 antenna does not impact the antenna security fence when the antenna is at minimum elevation. |
| 227 | REQ_227 | **Antenna security fence lighting:**<br>Perimeter security fence and antenna security fence lighting in accordance with NPR 1620.3B shall be provided. | Inspection/Testing | Confirm that Perimeter security fence and antenna security fence lighting in accordance with NPR 1620.3B has been provided. |
| 228 | REQ_228 | **Antenna security fence width :**<br>The perimeter security fence and antenna security fence shall include an entrance/exit gate with a minimum width of 5m (16.4ft) (sufficient for cranes, semi trucks, etc.). | Inspection/Testing | Verify that Antenna security fence width meets the requirement as specified |
| 229 | REQ_229 | **Access to LEGS 2 facility:**<br>Access to the LEGS 2 antenna and LEGS 2 related facilities shall be limited to NASA approved personnel. | Inspection/Demonstration | Verify that Access to the LEGS 2 antenna and LEGS 2 related facilities is limited to NASA approved personnel. |
| 230 | REQ_230 | **Separate security system:**<br>SANSA and NASA shall provide separate security systems (cameras and sensors) for the antenna security fence and perimeter security fence. | Inspection/Testing | Verify that site has NASA SANSA Separate security system requirement has been met as specified |
| 231 | REQ_231 | **Separate security network:**<br>Verify that the SANSA and NASA security systems has been on | Inspection | Verify that the SANSA and NASA security systems has |

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| | | separate networks. | | been on separate networks. |
| 232 | REQ_232 | **NASA cleared list :**<br>All security systems shall be on the NASA approved and cleared list. | Inspection | Verify that All security systems is on the NASA approved and cleared list. |
| 233 | REQ_233 | **Certified SANSA contractors:**<br>Certified SANSA contractors shall install the security systems & shall be validated/tested by NASA. | Inspection/Testing | Confirm that the Certified SANSA contractors has install the security systems & it has validated/tested by NASA. |
| 234 | REQ_234 | **Interior/exterior LEGS 2 security:**<br>NASA shall provide a security system to monitor the interior/exterior of the LEGS 2 antenna, equipment room, and operations room. | Inspection/Testing | Verify that the Interior/exterior LEGS 2 security requirement has been met |
| 235 | REQ_235 | **WSC security systems:**<br>The NASA security system shall be connected to the WSC security system. | Inspection/Testing | Confirm and verify that the NASA security system has been connected to the WSC security system. |
| 236 | REQ_236 | **NASA SANSA security system:**<br>The NASA security system shall not be connected to the SANSA security system. | Inspection/Testing | Confirm that the NASA security system is not connected to the SANSA security system. |
| 237 | REQ_237 | **Monitoring security cameras:**<br>SANSA shall provide a security system (security cameras) to monitor the LEGS 2 antenna, equipment room, and operations room exteriors. | Inspection/Testing | Verify that Monitoring security cameras requirement has been met as specified |
| 238 | REQ_238 | **SANSA security system Elements:**<br>No SANSA security system elements shall be in the LEGS 2 antenna, | Inspection | Confirm that No SANSA security system elements is in the LEGS 2 antenna, |

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| | | equipment room, and operations room. | | equipment room, and operations room. |
| 239 | REQ_239 | **NASA security systems:**<br>A NASA security system shall monitor the interior of the LEGS 2 antenna, equipment room, and operations rooms. | Inspection | Confirm and verify that A NASA security system monitors the interior of the LEGS 2 antenna, equipment room, and operations rooms. |
| 240 | REQ_240 | **SANSA physical security:**<br>SANSA site security shall physically monitor the SANSA security systems and respond to physical security issues. | Inspection | Confirm and verify that SANSA site security can physically monitor the SANSA security systems and respond to physical security issues. |
| 241 | REQ_241 | **Security incidents:**<br>SANSA shall notify NASA of any security incidents in near real-time. | Inspection/Demonstration | Verify that SANSA notify NASA of any security incidents in near real-time. |
| 242 | REQ_242 | **Security:**<br>The SANSA MTJ site shall have the following security measures: ***See the full requirement.*** | Inspection | Verify that security requirements is as specified |
| 243 | REQ_243 | **Cyber security requirement:**<br>SANSA's MTJ site shall have network that must meet or exceed NIST 800-53 standards or provide evidence of compensating controls to which NASA has the obligation to accept or provide additional measures. From antenna spec: NPR 2810.1A, NASA Procedural Requirements Security of Information Technology, and all applicable NASA IT Security Handbooks and NASA Interim Technical Directives. | Inspection/Demonstration | Confirm and verify that the Cyber security requirement has been met as specified |

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| 244 | REQ_244 | **LEGS 2 access road:**<br>The SANSA facility shall include an improved road to the LEGS 2 antenna area. | Inspection | Verify that SANSA facility includes an improved road to the LEGS 2 antenna area. |
| 245 | REQ_245 | **Minimum Setbacks:**<br>The SANSA site shall provide a minimum setback from existing structures, roadways, fence lines per NPR 1620.3a Section 3.9.1.h - Fence lines, 9.14m (30ft) and perimeter lighting. | Inspection | Confirm and verify that Minimum Setbacks requirement has been met as specified |
| 246 | REQ_246 | **Vendors road requirements:**<br>It shall be ensured that the roads can accommodate the antenna vendor width, loading, turn-around, and unloading requirements for cranes. | Inspection/Demonstration | Confirm Vendor's Road requirements has been met as specified |
| 247 | REQ_247 | **Access Roads specification:**<br>SANSA MTJ site shall have the following road access requirements: ***See the full requirement.*** | Inspection | Verify that Access Roads specification requirement has been met as specified. |
| 248 | REQ_248 | **Shipping:**<br>SANSA Matjiesfontein facilities shall have the Ability to send and receive equipment and documents internationally with maximum delay of TBD hours. | Analysis/Demonstration | Verify that Shipping requirement has been met as specified |
| 249 | REQ_249 | **Vehicles:**<br>Provision for the following vehicles shall be made to be used during and after construction: ***See the full requirement.*** | Inspection | Verify that the Vehicles requirement has been met as specified |
| 250 | REQ_250 | **Security:**<br>Refer to security requirements. | Inspection | Verify that the Security requirement has been met as specified |

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| 251 | REQ_251 | **Lightning detection:**<br>SANSA Matjiesfontein facility shall be able to Detect lightning strikes in 100km radius. | Inspection/Testing | Verify that SANSA facility is be able to Detect lightning strikes in 100km radius. |
| 252 | REQ_252 | **Weather station:**<br>Provision for Weather station shall be made on SANSA Matjiesfontein site in order to record and monitor the following parameters: | Inspection | Verify that the Weather station requirement has been met as specified |
| 253 | REQ_253 | **Building monitor system**<br>SANSA Matjiesfontein facilities shall have BMS with the ability to monitor and control the following: **See the full requirement**. | Inspection/Testing | |
| 254 | REQ_254 | **Antenna Physical Specifications:**<br>NASA shall provide the LEGS 2 antenna physical specifications to SANSA | Inspection | Verify that NASA provides the LEGS 2 antenna physical specifications to SANSA |
| 255 | REQ_255 | **Antenna Vendors Foundation:**<br>NASA shall provide SANSA with the LEGS 2 antenna vendor's foundation requirements/conceptual design. | Inspection | Verify that NASA provides SANSA with the LEGS 2 antenna vendor's foundation requirements/conceptual design |
| 256 | REQ_256 | **LEGS 2 Antenna Foundation:**<br>A LEGS 2 antenna foundation shall be provided by SANSA. | Inspection | Confirm that A LEGS 2 antenna foundation is provided by SANSA. |
| 257 | REQ_257 | **Antenna foundation height**:<br>The LEGS 2 antenna foundation height above grade shall be a minimum of 10.2cm (4 in) and maximum of 17.8cm (7 in). | Inspection/Testing | Confirm that the LEGS 2 antenna foundation height above grade is a minimum of 10.2cm (4 in) and maximum |

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| | | | | of 17.8cm (7 in). |
| 258 | REQ_258 | **Antenna foundation slope:**<br>The LEGS 2 antenna foundation shall be sloped away from the antenna pedestal to ensure water does not pool next to the antenna. | Inspection/Demonstration | Verify that Antenna foundation slope requirement has been met and verified |
| 259 | REQ_259 | **Foundation construction:**<br>On-site NASA or NASA delegate presence during the antenna foundation construction shall be accommodated. | Inspection | Verify that On-site SANSA or NASA delegate presence during the antenna foundation construction has been accommodated. |
| 260 | REQ_260 | **Antenna spicification document:**<br>The proposed foundation design, specifications and materials documents/artifacts shall be provided to NASA. | Inspection | Confirm that the proposed foundation design, specifications, and materials documents/artifacts has been provided to NASA. |
| 261 | REQ_261 | **Specification review:**<br>NASA shall review and provide approval of the proposed foundation design, specifications and materials documents/artifacts prior to the foundation implementation. | Inspection | Verify that the specification review requirement has been met as specified |
| 262 | REQ_262 | **Water detection system:**<br>A water detection system that detects water in the antenna area where electrical equipment is located shall be provided. | Inspection/Testing | Confirm that a water detection system that detects water in the antenna area where electrical equipment is located has been provided. |
| 26 | REQ_263 | **Distance to the antenna:**<br>SANSA Matjiesfontein site shall be the following distance from the | Inspection/Testing | Confirm and verify the distance to the antenna |

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| | | following facilities: ***See the full requirement.*** | | requirement has been met |
| 264 | REQ_264 | **Antenna Interfaces:**<br>Antenna shall have the following interfaces: ***See the full requirement.*** | Inspection/Testing | Verify and confirm that Antenna Interfaces requirement has been met as specified |
| 265 | REQ_265 | **Antenna separation:**<br>SANSA antenna shall maintain 5-degree horizontal mask separation for antenna. | Inspection/Testing | Verify that Antenna separation requirement has been met and verified |
| 266 | REQ_266 | **Antenna foundation:**<br>SANSA antenna shall have foundation TBD. | Inspection | Confirm and verify that Antenna foundation requirement has been met as specified |
| 267 | REQ_267 | **Test and measurement equipment & calibration requirement:**<br>SANSA Matjiesfontein site shall have but not limited to the following test and calibration equipment:<br>• Spectrum analyser (Site analyser).<br>• Signal generators<br>• Oscilloscope.<br>• FO testing, splicing.<br>• Phase noise measurement equipment | Inspection/Testing | Verify and confirm that test and measurement equipment & calibration requirement has been met as specified |
| 268 | REQ_268 | **Site preparation areas :**<br>SANSA Matjiesfontein site shall have Xm2 flat area for construction of sub-assemblies. | Inspection | Verify and confirm that site have Xm2 flat area for construction of sub-assemblies. |

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| 269 | REQ_269 | **Collimation tower:**<br>SANSA Matjiesfontein site shall have colimitation tower. TBD (MTJ site Selection Assessment: Revision 3: 2.1.7.5). | Inspection/Testing | Verify and confirm that SANSA Matjiesfontein site have a colimitation tower. TBD (MTJ site Selection Assessment: Revision 3: 2.1.7.5). |
| 270 | REQ_270 | **Antenna Pad:**<br>A clear and levelled area around the antenna foundation pad area, approximately 40m x 40m (131.2ft x 131.2ft) shall be provided. | Inspection | Verify that A clear and levelled area around the antenna foundation pad area, approximately 40m x 40m (131.2ft x 131.2ft) has been provided. |
| 271 | REQ_271 | **Antenna UPS:**<br>The antenna room shall have UPS room and renewable Co located with the Antenna. Size will be specified according to battery capacity. | Inspection | Verify that the Antenna UPS requirement has been met as required. |
| | REQ_272 | **Antenna Foundation:**<br>Two staging areas contiguous to the antenna foundation to provide room for antenna assembly, reflector assembly, parking for shipping containers, and crane access shall be **Clear and levelled.**<br>The staging areas shall be approximately:<br>• One 15m x 25m (49.2ft x 82ft) for approximately 5 shipping containers and antenna assembly<br>• The second 25m x 25 m (82ft x 82ft) for antenna reflector assembly. | Inspection/Testing | Verify that Antenna Foundation requirement has been met and verified |
| 273 | REQ_273 | **Antenna Staging Area:** | Testing | Verify that site antenna Staging Area requirement |

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| | | The staging areas shall be capable of supporting 31.8 - 36.3 metric ton (70,000-80,000 lb.) for shipping containers and supporting heavy machinery (cranes, man-lifts, etc.). | | has been met |
| 274 | REQ_274 | **Electrical Reticulation for (Generation, storage and distribution):**<br>- Generation<br>• 2 MVA, 132kV step down to 11kv Main substation and 2km overhead/underground lines to a 2MVA step-down 400v substation<br>• Renewables (1 MVA) to tie in<br>• 2 x 500kVA Generators parallel configuration (Upgradable to 4) Standards to be provided.<br>• Fuel storage bunded tanks 60000lt<br>- Battery Storage<br>• Capacity to sustain load for 24 hours.<br>-Reticulation HT ring feed 3km with 7x 350kva minisubs placed as per plan<br>-All systems to be monitored and controlled remotely.<br>-Solar panels per requirement (1 MVA) battery room as per design<br>-Renewable power conversion and distribution interlinked.<br>-Total system to be scalable (Modular) | Inspection/Testing | Confirm and verify that the Electrical reticulation requirement is met as specified |