ANTENNA SYSTEM SPECIFICATION

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HRIT ANTENNA SYSTEM SPECIFICATION

1. PURPOSE

This specification describes requirements for the design, fabrication, installation and testing of one parabolic antenna and low noise amplifiers that shall track and receive signals from meteorological satellites in geostationary orbits. The systems shall be compatible with receive path equipment provided by the Contractor and the pad provided by the Government. The system will be required for the NOAA/NESDIS Command and Data Acquisition (CDA) Station at Wallops Station, Virginia.

2. GOVERNMENT DOCUMENTS

The following documents form a part of this specification to the extent specified herein.

a. NOAA/NESDIS

Standard No. S24.802:	General Requirements for Command and Data Acquisition Station Electronic Equipment
Standard No. S24.803:	Cable and Wire Identification
Standard No. S24.805:	Spare Parts
Standard No. S24.809:	Grounding

b. NASA/STDN

NASA document:	X-810-71-289, Timing
NASA Standard:	STDN No. 724

The above documents are provided as part of this procurement package.

3. GENERAL REQUIREMENTS

This specification is intended for a complete TriPoint Global 7.2KXL-7.2m parabolic prime focus antenna system. The Government will provide foundations for the antenna and shelter, antenna service pad, access road, power to a single interface point, and the in-ground portion of the grounding and lightning protection system at the antenna location.

3.1 Installation and Test

This procurement includes installation of the entire designated system(s) at the location(s) specified in the statement of work and a formal test to show that all specifications are met. All tools and test equipment required for the installation shall be provided by the contractor. Installation shall not interfere with the normal operation of the CDA except as permitted by

specific agreement with designated station management personnel. Any such agreements shall be coordinated through the Contracting Officer's Technical Representative.

3.2 Operating Frequency Ranges

The antenna shall operate in the frequency bands of 1670-1710 MHz (receive L-Band).

3.3 System Figure of Merit

The system shall have a G/T greater than or equal to 16.0 dB/K for all frequencies greater than 1670 MHz. This G/T requirement shall be met when the LNA is connected to a receiving equipment chain with a noise figure of 20 dB. Offerors shall provide a detailed analysis showing how this requirement will be met.

3.4 Environmental Conditions

The system shall operate in accordance with specified requirements when subjected to any realizable combination of the following conditions:

- The environmental conditions specified in Paragraphs 3.14 through 3.14.7 of NOAA/NESDIS Standard No. S24.802, except the operating lower temperature limit shall be -10^{o} C. (Heaters may be used, if desired at the lower temperatures.)
- Precipitation, from fog or mist up to rain at 50 mm per hour (1.97 in per hour).
- All external surfaces coated with 12.5 mm (0.5 in) of ice.
- If the antenna is positioned such that it will collect snow, it shall withstand a 30 centimeter (11.8 in) accumulation.
- Low wind: steady velocity of up to 45 km per hour (28.0 mph) with maximum pointing accuracy.
- Medium wind: a one minute mean wind speed between 45 km per hour (28.0 mph) and 70 km per hour (43.5 mph), with gusts of up to 95 km per hour (59 mph).
- High wind: the equipment shall operate in winds up to 130 km per hour (81 mph).
- Survival: 125 mph in the stowed position.

3.5 Lightning Protection

The contractor shall install a local lightning protection system for the antenna and associated equipment, in accordance with S24.809, subsection 4.3, and connect it to the ground system provided by the Government. The Contractor shall provide all above-ground equipment.

3.6 Equipment Mounting

All equipment shall be mounted in standard 42.26 cm (19 inch) rack panels and shall be installed in contractor supplied slide racks, whenever possible.

3.7 Environmental Protection

The contractor shall meet all federal, state, and local environmental requirements, with special attention to fluid run-off to any nearby streams, both during construction phase and during the life of the antenna system.

3.8 Monitor and Control System

Offerors shall provide full details of the monitor and control system supplied and show how it will provide the necessary functions for the intended operation.

4. ANTENNA REQUIREMENTS

4.1 General

The antenna system shall be configured with an elevation over azimuth mount, able to track spacecraft in nominally geostationary orbits, with essentially zero relative angular motion, and with inclinations up to at least 10 degrees.

4.2 Operating Modes

The antenna system shall provide the operating modes listed below as a minimum. The main tracking mode shall provide an orbital determination algorithm utilizing step track to gather data. The algorithm shall be adaptive to provide immunity to scintillation, orbital maneuvers, and mean wind perturbation.

4.2.1 Step Track Mode

The step track mode shall provide the capability to optimize the antenna position with respect to the desired satellite by monitoring the satellite signal strength via a step track receiver.

The following parameters shall be adjustable by the operator:

a. Step size for each axis
b. Integration time
c. Scan cycle time
d. Signal degradation required to re-start step track
e. Threshold signal level required for step track operation

4.2.2 Program Track Mode

In program track mode, the antenna system is driven to follow a sequence of angles in a specific time sequence, calculated from acquisition data stored in the antenna control unit. The acquisition data may be in accordance with any of the following formats:

a. North American Air Defense Command (NORAD) 2 line orbital element data referenced by Spacecraft Identification (ID) and epoch time. (Ref. NASA Standard STDN No. 724, paragraph 3.2.1.5.)

b. Improved Interrange Vectors (IIRV) referenced by spacecraft ID, vehicle ID, message type, and epoch time. (Ref. NASA Standard STDN No. 724, paragraph 3.2.1.3.)

c. Right Ascension Declination. This format shall be used to track selected stars in order to check the antenna system performance.

The information shall be in the format HR.,MR.,SR.,DD.,MD.,SD.
where: HR.,MR.,SR. = right ascension in hours, minutes, seconds
DD.,MD.,SD. = declination in degrees, minutes, seconds

4.2.3 Manual Position

The operator shall be able to change the orientation of the antenna system via the "manual controls" (type-in position commands, move slider bars on the screen, etc.) or equivalent.

4.2.4 Standby

Any drive signal is reduced to zero. Power is then removed from as much of the antenna system as possible, provided an operator, or computer control system, shall be able to switch the antenna system to any other mode whenever desired.

4.2.5 Calibration

Provision shall be made to calibrate the antenna pointing using known reference points such as a GFE collimation tower.

4.2.6 Auxiliary

The operator shall select any one of at least 40 pre-defined sets of pointing angles, or enter specific angles via the keyboard. Each set shall include azimuth, elevation, and polarization angles. They may be implemented as part of the manual position mode, if desired.

4.3 GFE Foundation and Access

The Government shall provide an antenna foundation conforming to the specifications for a TriPointGlobal Model 7.2KXL- 7.2m antenna, adequate to support the antenna structure and equipment enclosure. Access requirements for cable and conduit locations are provided.

4.4 Support Structure and Pedestal

The pedestal shall be tall enough to provide at least 0.68 meters (2.3 feet) of clearance between the rim of the reflector and the ground, or top of the foundation, when the antenna is pointed horizontally.

4.5 Axis Travel Range

The antenna mount shall provide at least ±100 degrees of travel for the azimuth axis referenced to due south and at least 0 to +90 degrees for the elevation axis, with the zero point as true horizontal. Azimuth travel may consist of two overlapping 120 degree sectors.

4.6 Axis Accuracy

Each axis shall be adjustable such that it can be positioned within 10 seconds of arc from its true reference position. This adjustment shall also be capable of correcting for reasonable settlement of supports. The initial alignment shall also be within this accuracy.

The pedestal position sensors and indicators shall indicate the position of the main RF beam, relative to the true axes with a maximum error of 0.005 degree in each axis. The resolution of the angle position indicators shall be 0.001 degree. The differential error between any two indicated positions shall be a maximum of 0.002 degrees.

4.7 Mechanical Stops

Mechanical stops shall be provided at each extreme position of each axis able to absorb the full kinetic energy of the antenna moving at maximum velocity plus the full drive torque of the motors, so that there will be no contact of the antenna reflector with the ground, the pedestal, or any associated structure.

4.8 Reflector Surface Accuracy

The reflector surface shall be adjusted to the theoretical shape in the field after assembly. Any reduction in gain due to deviation from the theoretical shape, due to all causes, shall be not more than 0.1 dB.

4.9 Stairs and Ladder

Stairs, ladders, or scaffolding shall be provided for maintenance personnel working on mechanical or electronics assemblies mounted on the antenna. Provision for access to the antenna feed assembly.

4.10 Obstruction Lights

Two red dual-lamp obstruction light fixtures shall be mounted on the antenna reflector structure. One fixture shall be at the tip of the feed or subreflector support and the other on the reflector

rim, so that it will be at the zenith point when the antenna is directed at the horizon. Power shall be supplied through weatherproof metallic conduit.

4.11 Antenna-Mounted Equipment Enclosures

All equipment mounted on or near the antenna, shall be enclosed in a waterproof box. Offerors shall describe in writing the steps required to replace an item in this box. The outer conductor of all cables and waveguides shall be sealed and grounded to the outer surface of the cable entrance plate via a "feed thru" connector. Any conductor without an outer conductor that can be grounded shall be run in metallic pipe or conduit, which shall be grounded at the cable entrance plate.

Any electronic equipment enclosures provided shall incorporate climate control sufficient to maintain reliable operation of the enclosed equipment not to exceed (100deg F) or fall below (50 deg F). All doors and openings shall be weatherproof and allow easy access to all mounted equipment for maintenance and troubleshooting. Any openings are required to be covered with a mesh that is insect, rodent, and bird proof.

4.12 Drive Velocity and Acceleration

The maximum velocity shall be at least 0.5 degree/second in azimuth and 0.25 degree/second in elevation. The maximum acceleration shall be at least 1 degree/second^2 for both axes. Each axis shall have independently adjustable software limits for velocity and acceleration to restrict these parameters to lower values when desired.

4.13 Emergency Drive

A hand crank shall be provided for each antenna axis so the antenna may be moved even when all power has been lost.

4.14 Electro-Magnetic Interference (EMI)

EMI noise generated by the drive system at the antenna port of the RF filter system shall be less than or equal to -140 dBm in any 10 kHz bandwidth over the frequency range 1650 to 1730 MHz.

4.15 Antenna Performance

The antenna system shall comply with the following characteristics at all pointing angles.

4.15.1 Polarization

The antenna system shall provide rotatable linear polarization of at least 180 degrees. The polarization drive shall provide a maximum velocity of at least 0.5 degree/second.

4.15.2 Pointing Accuracy

The drive system shall be capable of providing a pointing accuracy of ±10% of the 3 dB bandwidth at the highest operating frequency in low wind conditions. This accuracy may be reduced to ±20% for medium winds.

4.16 Emergency Stop

An emergency stop button shall be installed at the base of the antenna. The emergency stop shall be a mushroom style red button mounted on the outdoor drive cabinet .

When the emergency stop switch is in the safe position, the drive system shall remove all servo drive power and control units for the antenna shall be disabled.

4.17 Warning Horn and Warning Light

A warning horn and warning light shall be provided. The horn shall be audible at all points on or near the antenna structure. The horn shall sound for a period selectable between at least 5 and 30 seconds when the antenna is placed in a control mode that will allow antenna movement. The warning light shall be turned on whenever the antenna is in a control mode that will allow antenna movement. The light shall be readily visible, in full sunlight, from any position within 30.48 m (100 ft) of the antenna.

5. EQUIPMENT ENCLOSURE

5.1 General

The exact location of any required equipment enclosures shall be provided to the Government by the Contractor at contract award. The enclosures must fit on the antenna mounting pad supplied by the Government that interfaces to the antenna base mounting plate.

5.2 RF Shielding

Any required enclosures shall include RFI shielding that will provide at least 60 dB attenuation to frequencies between 100 and 3000 MHz between the inside and the outside of the enclosure. SAFE'N'60®, manufactured by the Veratec Division of International Paper, is an example of a suitable material.

5.3 AC Power

Offerors shall provide a summary of the AC power requirements for the antenna and enclosure, including all electronic equipment. There are two power systems on station: utility for motors, lights, heating and similar loads; and technical for electronic equipment. Offerors shall provide their power requirements in accordance with this division.

The Government will provide the technical and utility electrical power cables which shall be connected by the Contractor to Government Furnished Equipment (GFE) power distribution boxes. All conductors shall be copper. The requirements for primary power and power supplies as specified in Paragraphs 3. 10 through 3.10.7 of Standard No. S24.802 are incorporated into this specification. All electrical work shall comply with the applicable requirements of the National Electrical Code and any local requirements.

5.4 Voltage and Load

The available power interfaces for each system shall be 208/120 volts, 60 hertz, 3 phase, 5 wire, wye-connected. The technical power system shall be capable of handling 10 kVA at 0.8 power factor in addition to the loads required by all the equipment to be supplied. The utility system shall be capable of handling the worst case practical combination of the loads dictated by all the other requirements of these specifications plus a 50% margin.

5.5 Power Cable Protection

The offeror shall provide suitable devices to be used for transient suppression on the wires between the antenna drive motors and their control circuits. The contractor shall recommend device types and mounting locations to the COTR, or his designee, and obtain his approval before ordering these devices.

No connection between the neutral and ground conductors shall be permitted except at the secondary of any power transformer in the power distribution system. No connection shall be permitted between the two distribution systems, except the ground connections.

6. RF SYSTEM REQUIREMENTS

6.1 Introduction

The receive path equipment defined in this specification is limited to the redundant LNAs with their associated switches and the step-track receiver. The receive system shall be able to simultaneously receive L-Band signals with redundant, hot standby, paths.

6.2 LNA Requirements

6.2.1 Gain

The gain of each LNA shall be at least 50 dB. The 1 dB compression point of the output shall be such that enough RF drive exists to suitably drive the input of the Contractor-provided IF downconvertor.

6.2.2 Bandwidth

The 1 dB bandwidth for each LNA shall be at least 40 MHz (1670-1710MHz) for the L-Band. Ripple within this bandwidth shall be a maximum of 1.0 dB p-p.

6.3 RF Filter Requirements

The filters shall provide the following:

The desired path insertion loss shall be 0.5 dB maximum. The input/output impedance of the filter shall be matched to the LNA for maximum power transfer.

Protection to prevent receiver de-sensitization by an out-of-band signal received from another antenna, at a level of 500 watts in the band 2025 MHz to 2110 MHz. The gain suppression produced by any one such signal shall be less than 0.1 dB.

The filter works with passband 1670-1710 MHz (L-band).

6.4 Directional Couplers

The filter system shall include a dual directional coupler at the antenna port. The coupling shall be 35 dB nominal, with a maximum variation of 0.5 dB over any of the desired frequency bands. The directivity shall be at least 20 dB in each coupled direction. Each coupled port shall have a type N female connector with a screw-on cap and retaining chain. retaining chain shall be provided for the coupled port.

6.5 Wires, Cables and Waveguide

The Contractor shall supply and install all necessary antenna system wiring, cabling and waveguide. All cables and connectors shall be in accordance with Standard No. S24.803 and paragraphs 3.6 through 3.7.3 of Standard No. S24.802.

6.6 Fiber Optic Links

All contractor provided control and RF signal connections between the antenna location and the operations room shall be by fiber optic cables.

6.7 Cable Marking

All cables shall be permanently identification marked as specified in Standard S24.803. Individual conductors in multi-conductor cables shall be color coded or otherwise identified and traceable at any point on their length. The COTR shall provide the Contractor with a block of suitable cable numbers that are compatible with the existing cables for the CDA.

7. SYSTEM SUPPORT REQUIREMENTS

7.1 Special Tools and Test Equipment

The provisions of paragraphs 3.18 and 3.19 of Standard S24.802 are incorporated into this requirement, except that the list of special tools and test equipment required to run the acceptance tests and to perform normal maintenance procedures shall be included with the response to this specification. One set of special tools and test equipment is required. Special tools and test equipment are defined as those items not listed in the Federal Supply Catalog or available from multiple domestic sources.

7.2 Spares

The Contractor shall provide a listing of the recommended spare parts, with the quantities needed, in accordance with the requirements of Standard S24.805. A preliminary list shall be provided in the proposal.

7.3 Documentation

Those documents to be delivered to the Government shall be in a form capable of being displayed for viewing on a PC or printed using Corel WordPerfect (Microsoft Word or PDF also acceptable). Two paper copies and two identical copies of the electronic document shall be provided on separate media. The media should be read-only types or write-locked to assure integrity and shall be compatible with IBM PC drives. Any graphic parts of these documents shall be provided imbedded in the WordPerfect document (whenever possible) and in the format used by the native drawing package. Formats that are acceptable to the government include

Autocad, Visio, and Corel Draw. Other formats may be proposed by the Contractor for approval by the COTR. Graphics files that are delivered separately shall be named in a consistent manner with their names in the parent document.

The contractor will provide five (5) complete sets of maintenance and operation manuals in hard copy and one (1) soft copy. Also the contractor will provide hard and soft copy of antenna drawings showing all antenna assemblies including the antenna, structures, cables, and electronics.

7.4 Training

The Contractor shall develop and submit a training plan not later than three months after contract award. This plan shall define courses of study recommended by the Contractor to qualify Government O&M personnel on the new system. The plan shall identify course locations, schedules, durations, and recommended training aids. Upon Government approval of the training plan, the Contractor shall develop courses of instruction. Each Offeror shall provide a list in its proposal the courses they consider applicable to the system they propose. Each course shall provide for at least ten students. The Government shall have the right to videotape any training class.

7.5 Test Plans and Acceptance Tests

The Contractor shall prepare and submit to the COTR for review and approval, an In-plant Test Plan and a Final Acceptance Test Plan. Development of the test plans shall commence at the time of contract award, with the first draft submitted within 30 days of contract award and revised two weeks prior to any testing. In-plant tests shall be performed on equipment prior to shipment and final acceptance tests shall be performed after equipment installation. These tests shall demonstrate compliance with all claims of performance made by the Contractor.

8. QUALITY ASSURANCE PROVISIONS

8.1 General

Unless otherwise specified the Contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the Contractor may utilize his own facilities or any commercial laboratory acceptable to the Contracting Officer's Technical Representative.

8.2 Witness of Tests

The Government shall have the right to witness any and all tests associated with this contract. The Contractor shall notify the Government two weeks in advance of any tests, of the date, time, place and the tests to be conducted. If the Government chooses to attend or send a representative, it will notify the Contractor at least one week in advance of the test date.

8.3 Acceptance

Acceptance shall occur when the installed equipment has successfully passed the approved on site tests, and the Special Tools, Operating Spares, Operation and Maintenance Manuals and Training have been delivered.