System Requirements Document

Mobile Ku Antenna

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1.0 INTRODUCTION

1.1 General

The Global Hawk project has a requirement for a four port (2 uplink & 2 return links) mobile COTS antenna system that shall provide for Bi-directional satellite operations in the commercial Ku frequency band (RX 10.95-12.75 GHz/TX 13.75-14.50 GHz). The system shall be capable of meeting all commercial satellite transmission standards. The antenna shall be a trailer based system. The system design shall facilitate ease of mobility, assembly and disassembly, operation, and maintenance. The system shall provide a moderate level of software control for pre-mission setup and calibrations, mission support operations, and system diagnostics. The system shall have the capability to be remotely controlled.

The anticipated delivery of the system is six months from ARO. The system delivery will factor into the procurement decision.

1.2 Scope

This positioner specification will cover the operational environment, system design expectations, and the overall positioner requirements.

2.0 REFERENCE DOCUMENTS

The documentation referenced below is meant as guidelines for the design, fabrication and performance for a tracking system.

3.0 FABRICATION AND WORKMANSHIP

Best commercial practices will be used in all phases of this development, especially but not limited to: workmanship and materials.

4.0 STANDARDS

International Telecommunications Union –Remote Sensing System (ITU-RS) S.580

International Telecommunications Union –Remote Sensing System (ITU-RS) S.465

FCC Sec. 25.209 - Antenna performance standards.

5.0 NON-GOVERNMENT DOCUMENTS

NASA will provide as Government Furnished Equipment (GFE) the existing GFE L-3 Communications West Generation 3 SATCOM modem with appropriate documentation. Modifications may be made to accommodate new equipment or design changes.

6.0 REQUIREMENTS

6.1 Safety

6.1.1 Warning Lights

The tracking system shall include two warning lights; one for "**SERVOS ENGAGED"** and one for **"RF RADIATION**".

6.1.1.1 Warning Light Colors

The **"SERVOS ENGAGED"** warning light shall be red in color and the **"RF RADIATION"** warning light shall be blue in color.

6.1.1.2 Warning Light Placement

The warning lights shall be placed in a position clearly visible from an unobstructed location, not to exceed 50 feet from the positioner. The vendor shall be responsible for the installation.

6.2 Maintenance

6.2.1 Line Replaceable Units (LRU)

The tracking system shall be designed to limit mean time to repair (MTTR) of 1hour for LRUs.

6.3 Environmental

6.3.1 Operating Conditions

The positioner shall operate within performance requirements listed below:

a. Outside temperature from -26 to +130 deg F.
b. Relative humidity from 0 to 95%, non-condensing and effects due to condensation caused by temperature changes.
c. Wind velocity at a continuous 30 miles per hour (mph) wind speed, gusting to 50 mph.
d. Rain shall not penetrate the positioner system.

6.3.2 Non-Operating Conditions

The positioner shall sustain no damage when subjected to any combinations of the conditions listed below:

a. Outside temperature from -26 to +130 deg F.
b. Relative humidity from 0 to 95%, non-condensing and effects due to condensation caused by temperature changes.
c. Rainfall at the rate of 4 inches per hour.
d. Wind survival in any position with outriggers fully extended 65 mph gusting to 85 mph

6.4 Positioner Description

6.4.1 Positioner Type

The positioner shall be an elevation over azimuth design.

6.4.2 Reflector

Precision spun aluminum or composite

6.5 Antenna Controller

The antenna controller shall provide the following capabilities

6.5.1 Fiber Optic Interface between the antenna controller and the antenna

6.5.2 Beacon or Carrier Signal Power Density tracking

6.5.3 Memory Tracking

6.5.4 Open Source Interface Control Software

6.5.5 2-Line Element (NORAD) Tracking

6.5.6 Flux Gate Compass, GPS and Tilt Sensor Interfaces

6.5.7 Auto-Acquisition

6.5.8 Auto Track Capability

6.5.9 Selectable tracking algorithms based on satellite frequency band

6.5.10 Azimuth and Elevation Bias Inputs

6.5.11 Polarization Axis control

6.5.12 Local and Remote Control

6.5.13 Up to 500 stored satellites

6.5.14 L- Band receiver

6.5.15 Spectrum Analyzer

6.5.16 Hand held maintenance controller

6.5.17 Variable speed Azimuth and Elevation control Monitor and Control.

6.5.18 SNMP external interface

6.6 Handheld Maintenance Controller

The positioner shall be provided with a manual hand held controller.

6.6.1 Handheld Maintenance Controller Range

The handheld maintenance controller shall have a 50 ft command and control cable, allowing the operator to walk completely around the tracking system with the manual handheld controller.

6.6.2 Handheld Maintenance Controller Functions

The handheld maintenance controller shall have an on/off switch that will give the operator control of the azimuth and elevation rotation of the positioner.

6.6.3 Handheld Maintenance Controller Operation

If the handheld maintenance controller is being used to control the positioner, it shall maintain exclusive control of the system.

6.7 Positioner

6.7.1 G/T Performance

The positioner shall meet a G/T requirement of 32dB/K at 11.85 GHz when referenced to +20 degrees elevation, clear sky.

6.7.2 Received Gain

The antenna shall have the following gains (referenced to the feed waveguide flange at the rear of the main reflector).

53.2 dBi receive (11.85 GHz)

6.7.3 Transmit Gain

The antenna shall have the following gains (referenced to the feed waveguide flange at the rear of the main reflector).

55.0 dBi receive (14.125 GHz)

6.8 Power

6.8.1 Power Requirements

The positioner and all subsystems shall operate on three-phase 120/208 VAC power.

7.0 INTERCOMMUNICATIONS

The positioner shall include a closed circuit intercom capability between the positioner and the ACU location.

8.0 REDUNDANCY

The system shall have at a minimum the following backup capabilities.

8.1.1 SSPAs

Units shall be in a hot standby mode.

8.1.2 LNBs/LNAs

Spares, field replaceable under the LRU guidelines above.

8.1.3 Upconverters/Downconverters

Units shall be in a hot standby mode, if active component.

9.0 SPARES

Vendor shall provide actual MTBF data for major components. Based upon data, NASA and vendor will agree upon a recommended spares list.

10.0 TRAILER

10.1 The trailer shall be capable of being transported in a USAF C-5/C-17 cargo aircraft without any special equipment for loading and unloading

10.2 The trailer shall provide tie down points for securing the Ku trailer system during air transport.

10.3 The trailer shall provide anchor points for securing the Ku trailer system during operation. This shall include outriggers as needed to comply with operational wind limits above.

10.4 The trailer shall have a pintle hook hitch towing connection.

10.5 The Ku antenna trailer system is anticipated to be towed on unapproved road surfaces. The Ku antenna trailer system shall be capable of full operation on these road surfaces.

10.6 The braking system shall be a surge break design with the ability to disable the breaks during aircraft loading operations.

11.0 EXTERNAL INTERFACES

11.1 The antenna trailer shall have an external interface panel for 5-wire, 120/208 VAC, 3-phase input power, RF signals, antenna control and earth ground.

11.2 A 120 foot multi-mode (62.5 / 125 micron) fiber optic interface cable shall be provided. The fiber optic interface cable shall be armored (Kevlar) to protect it from damage and contain no metallic shielding that could conduct energy through the shelter's RF shielding.

11.3 The power, warning lights, and fiber optic cables shall be stored on the trailer.

11.4 The antenna trailer shall provide two (2) GFCI protected, weatherproof, 110 VAC, 1-phase outlets at the front and rear of the trailer.

11.5 The antenna shall provide a GFCI protected, four (4) outlets, weatherproof, 110 VAC, 1-phase outlet near the feed electronics.

11.6 The antenna shall have removable lightning rods, associated arrestors, cabling and grounding rods.

12.0 DOCUMENTATION

The contractor shall provide the following documentation in electronic and in hard copies for the antenna and trailer:

The Contractor shall provide 2 copies of all description and procedural documents in the Contractors format

The Contractor shall provide 2 copies of all drawings in Level II format.

12.1 Maintenance Manual to include the following:

12.1.1 General Information

12.1.2 Maintenance Logging Requirements

12.1.3 Pre-deployment Maintenance

12.1.4 Trailer Systems Maintenance

12.1.5 Antenna Systems Maintenance

12.1.6 Fault Isolation/Troubleshooting

12.2 Operations Manual to include the following:

12.2.1 Systems Functions and Capabilities

12.2.2 System Hardware

12.2.3 System Interfaces

12.2.4 System Wiring Diagram

12.2.5 Pre-deployment Preparations

12.2.6 System Set-up

12.2.7 System Teardown

12.2.8 Air Cargo Transport Preparations

12.2.9 Long Term Storage

Appendix A – Government Furnished Equipment

The following equipment shall be provided for the positioner integration:

A. L-3 Communications West Generation 3 SATCOM modem

The interoperability parameters of the NASA GH Airborne SATCOM Terminal are provided below:

1. Transmit Freq Range: 14.0 GHz to 14.5 GHz
2. Receive Freq Range: 10.95 GHz to 12.75 GHz
3. Frequency Tuning Steps: 1 kHz Steps
4. Modulation: Compatible with ViaSAT MD-1366
5. FEC: Compatible with ViaSAT MD-1366
6. Encapsulated Ethernet Framing: Compatible with ViaSAT MD-1366 EBEM Ethernet Service Expansion Module (ESEM)
7. Encryption: None