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## **1. Introduction**

### **1.1 Purpose**

This document establishes the definitive mechanical, radio frequency (RF), environmental, and interface requirements for the Trident-S Antenna Array. The Trident-S is a high-performance, stabilized antenna system designed for robust satellite communications (SATCOM) in demanding maritime environments. This specification is the primary technical baseline for the system's design, manufacture, verification, and acceptance.

### **1.2 Scope**

This specification applies to all components of the Trident-S Antenna Array, including the pedestal, antenna, and radome assembly. All design, development, and testing activities for this system shall be conducted in accordance with the processes and lifecycle phases defined in **SS-ENG-PLAN-001: Engineering Management Plan**.

### **1.3 System Overview**

The Trident-S Antenna Array is a 3-axis stabilized antenna system designed for installation on naval surface vessels. It provides continuous, high-gain RF performance for SATCOM-on-the-move (SOTM) applications, capable of tracking geostationary satellites even during aggressive ship maneuvers and in severe sea states. The system is designed for high reliability, low maintenance, and a long service life in a corrosive salt-fog environment.

## **2. Applicable Documents**

- **SS-ENG-PLAN-001:** Engineering Management Plan
- **MIL-STD-810G:** Environmental Engineering Considerations and Laboratory Tests
- **MIL-STD-461F:** Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment

## **3. Requirements**

### **3.1 RF Performance Requirements**

#### **3.1.1 Operational Frequency Bands**

The system shall provide simultaneous transmit and receive capabilities in the following

frequency bands:

- **Ku-Band:**
  - Receive (Rx): 10.7 – 12.75 GHz
  - Transmit (Tx): 13.75 – 14.5 GHz
- **Ka-Band:**
  - Receive (Rx): 20.2 – 21.2 GHz
  - Transmit (Tx): 30.0 – 31.0 GHz

### **3.1.2 Antenna Gain**

The system shall meet the following minimum gain requirements, measured at the flange of the antenna feed, referenced to a circular polarization:

- **Ku-Band (Rx):**  $\geq 41$  dBi
- **Ku-Band (Tx):**  $\geq 43$  dBi
- **Ka-Band (Rx):**  $\geq 45$  dBi
- **Ka-Band (Tx):**  $\geq 48$  dBi

### **3.1.3 Beamwidth**

The Half Power Beamwidth (-3 dB) shall be:

- **Ku-Band:**  $\leq 1.5$  degrees
- **Ka-Band:**  $\leq 0.6$  degrees

### **3.1.4 Polarization**

The system shall support software-selectable Left-Hand Circular Polarization (LHCP) and Right-Hand Circular Polarization (RHCP) for both transmit and receive bands.

### **3.1.5 G/T (Gain-to-Noise-Temperature)**

The system G/T shall be  $\geq 20$  dB/K in the Ku-Band at a 30-degree elevation angle.

## **3.2 Mechanical Requirements**

### **3.2.1 Physical Dimensions**

The fully assembled Trident-S system shall be contained within the following dimensional envelope:

- **Radome Diameter:**  $\leq 2.5$  meters
- **Overall Height:**  $\leq 2.8$  meters (from mounting base to top of radome)
- **Swing Circle Diameter:**  $\leq 2.6$  meters

### **3.2.2 Weight**

The total weight of the above-deck equipment (pedestal, antenna, and radome) shall

not exceed 200 kg.

### **3.2.3 Pedestal and Pointing System**

- **Stabilization:** The system shall utilize a 3-axis (azimuth, elevation, cross-level) stabilization system.
- **Pointing Accuracy:** The system shall maintain a pointing accuracy of  $\leq 0.2$  degrees RMS under the dynamic conditions specified in Section 3.3.
- **Travel Range:**
  - Azimuth: Continuous 360 degrees
  - Elevation: -20 degrees to +110 degrees

### **3.2.4 Materials and Finish**

All external surfaces shall be manufactured from corrosion-resistant materials (e.g., marine-grade aluminum, stainless steel 316) or treated with a multi-layer marine-grade paint system. The finish shall be matte grey (FED-STD-595, color 36231).

## **3.3 Environmental Requirements**

### **3.3.1 Operational Wind Loading**

The system shall meet all specified RF performance requirements in winds up to 80 knots.

### **3.3.2 Survival Wind Loading**

The system shall survive, without permanent damage, winds up to 120 knots (stowed position).

### **3.3.3 Shock and Vibration**

The system shall withstand the shock and vibration profiles for 'Naval Surface Ship Equipment' as specified in **MIL-STD-810G, Method 516.6 (Shock)** and **Method 514.6 (Vibration)**. The system shall remain operational during and after exposure to these conditions.

### **3.3.4 Operating Temperature**

The system shall operate within an ambient temperature range of -30°C to +60°C.

### **3.3.5 Salt Fog**

The system shall withstand exposure to a salt fog environment as defined in **MIL-STD-810G, Method 509.5**, without degradation of performance or evidence of

corrosion.

### **3.3.6 Enclosure Sealing**

The radome and pedestal assembly shall be sealed to a minimum rating of IP67, protecting internal components from water and dust ingress.

## **3.4 Interface Requirements**

### **3.4.1 RF Interfaces**

The system shall provide WR-75 waveguide flanges for Ku-Band interfaces and WR-28 waveguide flanges for Ka-Band interfaces.

### **3.4.2 Power Interface**

The system requires a 208 VAC, 3-Phase, 60 Hz power source. Peak power consumption shall not exceed 3 kW.

### **3.4.3 Data Interface**

A single 1000BASE-T Ethernet port (RJ45) shall be provided for all monitor and control functions.

## **4. Verification**

All requirements specified in this document shall be formally verified through a combination of test, demonstration, analysis, and inspection. A verification cross-reference matrix (VCRM) shall be created to map each requirement to a verification event. The formal test campaign shall be defined in **SS-TRI-TEST-001: Environmental Stress Screening (ESS) Procedure** and executed in accordance with the framework established in the **SS-TEST-PLAN-001: Test & Evaluation Master Plan (TEMP)**.

## **5. Document Control**

This document is a controlled document. Any changes must be approved by the Configuration Control Board (CCB) in accordance with the **SS-CM-PLAN-001: Configuration Management Plan**.