Updated Status on the Telemetry Range Support Aircraft (TRSA) Program

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RSA TPO Lead
The existing Telemetry Range Support Aircraft (TRSA) assigned to Naval Air Warfare Center Weapons Division’s (NAWCWD) Air Test and Evaluation Squadron (VX) 30 requires replacement due to significant service life and sustainment challenges. The TRSA and its installed range systems are required to be fully mission capable of conducting range support operations with an approved Federal Aviation Administration (FAA) amended type certificated (TC) or Supplemental Type Certificated (STC) design to host TM antennas for L, S and C bands mounted to the side of the FAA Certified Gulfstream G550 Airborne Early Warning (AEW) fuselage and contained within its FAA approved outer mold line.
The Navy requires a RSA for Naval Aviation systems at the Naval Air Warfare Center Weapons Division (NAWCWD) ranges to support the following Research, Development, Test and Evaluation (RDT&E) mission areas:

- Range Surveillance (RS)
- Range Clearance (RC)
- Multi-Band Range Communications Relay and Recording (COMM)
- Airborne Telemetry (L, S and C-Bands)
- Flight Termination / Command Destruct (FT/CD)
Walk-A-Round

Vertical Tail Bullet

Tail Radome

Tail Fairing

External Conduits

Instrumentation Hard Point

Liquid Cooling System/Fairing

Side Array Fairings

Nose Radome

External Conduit

Nose Fairing
• Phase 2 mission equipment will only be installed on the left side
• A fairing panel will be installed on RHS to maintain aerodynamic shape and mass balancing as required
• Phase 2 mission equipment will be packaged into a single assembly that will interface to the modified aircraft attachment structure
• Maximum weight of assembly is 700 lbs.

Side assembly thickness is approximately 6in
Max thickness from side array OML to fuselage OML is approximately 8in
Cable Pass Through

- Phase 2 equipment cables will enter the pressure vessel via specially designed panels located at windows 1-5.
- Each window plate can accommodate approximately 80 cable connectors, additional penetrations or alternate patterns are possible. Phase 1 installation will have blank connector panels.
- Windows not needed for cable pass through may be left for visual inspection or replaced with a lighter weight blanking plate.
CBITS Overview

Array Support Structure

Antenna

Frequency Converter

Digital Beam Former

Telemetry

Recorder

Retransmission

Control & Monitor
Non-CBITS Components

- ACTS
- COMM
- RS/RC
Electrical Power

- The production G550 electrical power system uses engine driven, integrated drive generators, one 40 kVA generator per engine, to provide 115/200V, 400 Hertz, 3-phase AC power to the primary aircraft electrical buses. An additional 40 kVA generator on the APU provides ground and emergency power. DC, 28V Power is provided from four 250 amp TRUs.

- With no change to electrical generation, the basic G550 platform has approximately 50 kVA of excess power to supply mission equipment.

- The Phase 1 aircraft has no requirement for additional electrical power. If Phase 2 power requirements exceed 50 kVA, several off the shelf options are available.

- The GAC AEP (Additional Electrical Power) modification includes the addition of two 270 VDC, 60 kVA generators to the engine gear box. Small fairings are required on the lower nacelle to accommodate the generator envelope.

- Other Gulfstream SM aircraft have utilized the APU to provide an additional 40 kVA of AC power in flight.
Mission Cooling

• A liquid cooling system (LCS) is provided with the baseline modification.

• The system can provide up to 72 kW of cooling above 20,000 ft. altitude, ISA +20. Ground cooling requires use of ground support equipment.

• Primary components will be same as previously certified modifications, however, cooling lines will be routed as required.

• A cooling system reservoir and controller will be located on the LHS of the cabin aft of the main entry door.

• No Cabin ECS modifications required for the LCS.
Lav and Galley will be reinstalled on the starboard side of the aircraft to accommodate better access to the 5th window.
<table>
<thead>
<tr>
<th>KPP / KSA</th>
<th>Requirement</th>
<th>Threshold</th>
<th>Objective</th>
<th>Current Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>KPP 1</td>
<td>Airborne TM – Number of beams tracked</td>
<td>Receive TM data and Track at least 7 objects in L, S and C-Bands with a minimum of 5 objects in S-Band</td>
<td>11 objects</td>
<td>&gt;= Threshold</td>
</tr>
<tr>
<td>KSA 1</td>
<td>Airborne TM – Number of beams tracked</td>
<td>Receive and Track with dual polarized beams: Condition 1 – 7 beams in L/S/C Tri-Band Antenna Condition 2 – 5 beams in L/S band &amp; 2 for C-Band Condition 3 – 2 L-Band, 5 S-Band, 2 C-Band</td>
<td>11 L/S/C 8 LS/3 C 3L/7S/3C</td>
<td>&gt;= Threshold</td>
</tr>
<tr>
<td>KPP 2</td>
<td>TM Antenna</td>
<td>Receive and Track multiple TM sources at min ranges of: 100 NM for L-Band; 270 NM for S-Band; 35 NM for C-Band) with a minimum data rate capability</td>
<td>L, S, and C Bands @30Mbs</td>
<td>&gt;= Threshold</td>
</tr>
<tr>
<td>KSA 2</td>
<td>S-Band FOM</td>
<td>S-Band (2.2 – 2.395 GHz) FOM 9.2 dB/°K</td>
<td>10.4 dB/°K</td>
<td>&gt;= Threshold</td>
</tr>
<tr>
<td>KSA 3</td>
<td>L-Band FOM</td>
<td>L-Band (1.435-1.525 GHz) FOM 4.0 dB/°K</td>
<td>10.0 dB/°K</td>
<td>&gt;= Threshold</td>
</tr>
<tr>
<td>KSA 4</td>
<td>C-Band FOM</td>
<td>C-Band (4.4-4.94 GHz &amp; 5.091-5.15 GHz) FOM 12.1 dB/°K</td>
<td>14.0 dB/°K</td>
<td>&gt;= Threshold</td>
</tr>
</tbody>
</table>
### CBITS Key Parameters con’t

<table>
<thead>
<tr>
<th>KSA</th>
<th>Threshold</th>
<th>Objective</th>
<th>Current Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Telemetry (TM) Stream Receive Bandwidth of up to 30 Megabytes per second (Mbps)</td>
<td>Same as Threshold</td>
<td>Threshold</td>
</tr>
<tr>
<td>6</td>
<td>Retransmit 3 L-, S- or C-band TM data streams in real time via line of sight re-radiation (different from received band)</td>
<td>Same as Threshold</td>
<td>Threshold</td>
</tr>
<tr>
<td>7</td>
<td>Provide two TM data streams to SATCOM interface at 256 Kilobytes per second (Kbps) total minimum</td>
<td>Same as Threshold</td>
<td>Threshold</td>
</tr>
<tr>
<td>8</td>
<td>Redundant onboard record capability TM data up to 30 Mbps per channel for 11 channels—Range Commanders Council (RCC) Inter Range Instrumentation Group (IRIG) 106 Chapter 10 compatible</td>
<td>Redundant onboard record capability TM data up to 30 Mbps per channel for 33 channels—RCC IRIG 106 Chapter 10 compatible</td>
<td>Objective</td>
</tr>
<tr>
<td>9</td>
<td>Provide Computer-controlled TM antenna beam steering</td>
<td>Same as Threshold</td>
<td>Threshold</td>
</tr>
<tr>
<td>10</td>
<td>Provide Telemetry activities w/single or multiple units for 2 hours at 1200 nm from airstrip for worldwide ops</td>
<td>Provide Telemetry activities w/single or multiple units for 4 hours at 1200 nm from airstrip for worldwide ops</td>
<td>Threshold</td>
</tr>
<tr>
<td>11</td>
<td>FOR + or - 50 degrees azimuth and +40, -20 degrees elevation</td>
<td>FOR + or - 60 degrees azimuth and +40, -20 degrees elevation</td>
<td>Threshold</td>
</tr>
<tr>
<td>12</td>
<td>Reception of up to 4 Dual polarized streams per tracking source</td>
<td>Same as Threshold</td>
<td>Threshold</td>
</tr>
<tr>
<td>13</td>
<td>Redundant Demodulation, de-commutation, processing, recording and distribution for up to 4 streams of data from PCM/FM, SOQPSK-TG, FQPSK and BPSK modulation schemes</td>
<td>Same as Threshold</td>
<td>Threshold</td>
</tr>
<tr>
<td>14</td>
<td>Telemetry System must be able to operate concurrently with all range mission systems</td>
<td>Same as Threshold</td>
<td>Threshold</td>
</tr>
<tr>
<td>15</td>
<td>The ATS shall include redundant on-board decryption of (4) Telemetry streams</td>
<td>Same as Threshold</td>
<td>Threshold</td>
</tr>
<tr>
<td>16</td>
<td>Ability to integrate one GTP systems</td>
<td>Same as Threshold</td>
<td>Threshold</td>
</tr>
</tbody>
</table>
### CBITS Key Parameters con’t

<table>
<thead>
<tr>
<th>Capability</th>
<th>Threshold</th>
<th>Objective</th>
<th>Current Estimate</th>
</tr>
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<tr>
<td>Antenna Field of Regard (FOR)</td>
<td>• FOR + or - 50 degrees azimuth and + 40, -20 degrees elevation</td>
<td>• FOR + or - 60 degrees azimuth and + 40, -20 degrees elevation</td>
<td>Threshold</td>
</tr>
</tbody>
</table>
| Receive, Record and Retransmit TM Data          | • Reception of 4 Dual polarized streams per tracking source. Demodulation, de-commutation, processing, recording and distribution for up to 4 streams of data  
• Redundant onboard record capability TM data  
• Retransmit 3 L-, S- or C-band TM data streams in real time via line of sight re-radiation & retransmit two TM data streams via satellite. | • Same as Threshold  
• Same as Threshold  
• Retransmit 3 L-, S- or C-band TM data streams in real time via line of sight re-radiation & retransmit two TM data streams via satellite using redundant paths. | Objective        |
Use Case 1

Receive & Track up to 7 TM streams (Threshold); 11 TM (Objective)
Use Case 2

Track MDA missile TM (S-Band) up to 270 nm

RSA Usage:
- Part of a ‘string of pearls’ used to provide Flight Safety
- TM collect from PMRF to Reagan Test Site
- Provided off-axis coverage during boost phases where PMRF was occluded by rocket plume
- On-board MFSO support
- Relayed data to PMRF via INMARSAT
Use Case 3

Track Missile TM (C-Band) up to 35 nm
Use Case 4

Track Targets (L-Band) up to 100 nm

- BQM-74E Low Altitude L-Band TM
- Airborne TM Receive
- A/C Flight Path

For Official Use Only
Use Case 5

Track Missile TM (C-Band) up to 35 nm
Acquisition Strategy

• Phase I – NAVAIR to procure a Gulfstream G550 with AEW modifications
  – FAA Airworthiness Certified
  – Provided to the Phase II Integrator as Government Furnished Equipment (GFE)

• Phase II – Integrator to develop, integrate, install, test and deliver a fully mission capable TRSA. Requirement includes:
  – Development of the airborne telemetry system and the Command Destruct/Flight Termination System (CD/FTS)
  – Incorporation of mission system supplemental power
  – Integration of all mission systems
  – FAA Airworthiness Certified
Phase II Scope

- Development of CBITS (approximately 55% of the contract cost)
- Incorporation of supplemental Mission Systems power
- Procurement of Range Support Mission Systems (ACTS, AUTOCAT, APS-143 Surface Search Radar)
- Integration and Installation of all Mission Systems onto the G550 AEW
- Certification of all systems and integration with FAA Supplemental Type Certificates (STCs) to include all tasking to support an approved Project Specific Certification Plan (PSCP)
  - Development of RSA system architecture and management of system configuration
  - Perform supporting analysis (i.e. electrical, structural etc.)
  - Development of ground and flight test plans
  - Delivery of a technical data package including specifications and drawings
- Development and delivery of applicable Logistics Products for installed mission systems
  - Supplemental flight and maintenance manuals
  - Maintenance Plans
  - Operator and maintainer training
Design Notes:
- C-band installed aft in the fairing
- Obstruction Meets Requirements
Questions

Delivery to VX-30 3 August 2021