

Statement of Work/Specifications

for

Anechoic Chamber Upgrade

1.0 Background

The Naval Research Laboratory (NRL) maintains and operates an Antenna/RCS Measurement Facility consisting of an Anechoic Chamber that facilitates both compact range and near field measurement capabilities. The facility is suitable for characterizing radiation and impedance properties of antenna systems, performing radar cross-section (RCS) measurements, and measuring the s-parameters of RF-system components.

The measurement facility houses a compact range for antenna pattern and RCS measurements. The compact range uses a Scientific Atlanta 5706M Compact Range Reflector capable of producing simulated far-field conditions from 2-110GHz. The simulated far-field conditions produce a cylindrical quiet zone (phase error < 10°) with an 8' diameter and 8' length. The measurement facility is currently outfitted with system electronics capable of supporting antenna measurements from S-Band through mmW frequencies (2-110GHz). RCS measurements can be performed from 2-50GHz using a pulsed CW system. The compact range reflector is housed in an environmentally and mechanically stable room that measures 20' x 20' x 40'.

In addition to a compact range, the Antenna/RCS Measurement Facility also houses a 20'x12' planar near-field scanner from M.I. Technologies. The scanner is currently outfitted to perform measurements up to 100 GHz.

2.0 Project Scope

The Naval Research Laboratory is upgrading an existing measurement facility, see Appendix A. The upgrade is intended to provide updated RF absorber capable of supporting 2 – 110 GHz, a Closed Circuit Television (CCTV) system, and RF characterization of the amplitude and phase distribution within the measurement quiet zone. The contractor shall be required to:

- remove and dispose of existing absorber,
- prepare chamber surfaces (walls, ceiling, etc.) for installation of new absorber,
- deliver and install new absorber and CCTV equipment, and
- test and validate performance of modified measurement facility.

NOTE: Appendix A is provided for informational purposes only, illustrative and not to exact scale. This Appendix is provided as an illustration for potential offerors to determine the scope of the effort and development of technical and price proposal.

2.1 Appendices

Appendix A – Antenna/RCS Measurement Facility Dimensions with critical features of the existing compact range.

Appendix B – Modified Smoldering Test of Urethane Foams Used in Anechoic Chambers (NRL Format Report 8093).

3.0 Project Tasks

The contractor shall perform the following tasks.

3.1 The contractor shall provide new pyramidal and walkway RF absorber in accordance with the specifications set forth under section 4.0. The absorber shall cover all interior surfaces (including doors and vents) of the existing Antenna/RCS Measurement Facility. In addition to covering the interior surfaces, the following absorber treatments are required.

3.1.1. A baffle wall is required in front of the feed area to block feed support structure and existing hardware equipment racks (2' Height x 6' Length).

3.1.2. An absorber skirt is required for covering the base of the compact range reflector.

3.1.3. Absorber panels are required for covering three sides of the near-field scanner Y-axis (vertical tower) as well as the base of the X-axis. The panels are to include a skin to protect the scanner surface from the absorber treatment and associated adhesive.

3.1.4. Absorber treatment(s) are required to enclose the existing AZ/EL/AZ positioner.

3.2. The contractor shall remove the existing absorber from the walls of the Antenna/RCS Measurement Facility and dispose of it according to all applicable laws/regulations. The offerors technical approach should describe actions to minimize the spread of dust/debris to other parts of the building.

3.3. After removal of the absorber, the contractor shall appropriately prepare all interior surfaces of the measurement facility prior to installation of the new absorber. The offerors technical approach should describe actions to minimize the spread of dust/debris to other parts of the building.

3.4. The contractor shall install the new absorber in the Antenna/RCS Measurement Facility. The absorber shall cover the surfaces specified in Paragraph 3.1. The absorber shall be cut/prepared to ensure a tight fit around existing protrusions including vents, sprinkler heads, and doors. The absorber shall be cut/prepared to make sure that all doors, vents, and sprinkler heads maintain operability. The absorber shall be glued to the walls and ceiling with non-flammable adhesive. The absorber shall not be glued to the floor.

3.5. The contractor shall perform acceptance testing on the new absorber to verify the performance of the measurement facility from 2 – 40 GHz and verify that the new configuration meets performance specifications set forth in Section 5.0. The contractor may utilize existing measurement equipment (detailed in Section 6.0). Any additional equipment needed for verification tests must be supplied by the contractor. The contractor shall prepare report documentation detailing the absorber configuration and performance. The report will be the basis for acceptance of the contractor's work.

4.0. Absorber Specifications

The absorber provided by the contractor shall meet or exceed the following minimum specifications.

4.1. Quiet Zone Characterization

The amplitude and phase variation across the quiet zone shall be characterized at multiple frequencies. During these measurements, the compact range feed will be used as the transmitting antenna, and a pyramidal horn at the appropriate waveguide band will be used as the receiving antenna. The measurements will be performed at the front, middle, and back of the quiet zone, and they will include scans of the vertical and horizontal axes of the quiet zone/s circular cross-section. These measurements shall be performed for two orthogonal polarizations (horizontal and vertical) and multiple frequencies (2.0, 10.0, 18.0, 30.0, 40.0 GHz).

4.2. The absorber shall absorb/attenuate RF frequency over the full operational frequency range of the Antenna/RCS Measurement Facility (2 – 110 GHz) to support a cylindrical quiet zone from with 8' diameter and 8' length. The quiet zone must meet or exceed the requirements described in Paragraph 4.1.

4.3. The absorber shall be capable of absorbing 1 W/in^2 without physical or electrical degradation.

4.4. The absorber shall be fire retardant and meet the criteria established in NRL Report 8093 (tests numbered 1, 2, and 3). The report is found in APPENDIX B.

4.5. The back-wall pyramidal absorber shall have an on-axis reflectivity $< -50 \text{ dB}$ over the full operational band of the measurement facility.

4.6. The walkway absorber shall have an on-axis reflectivity <-25 dB over the full operational band of the measurement facility.

4.7. The vent absorber shall have an on-axis reflectivity <-40 dB over the full operational band of the measurement facility.

4.8. The absorber shall effectively reflect light within the measurement facility and facilitate quick exits in the case of an emergency. It is desired that the absorber be a light color. It is desired that the walkway absorber be a dark color. It is desired that the doorway absorber be a different/brighter color than that on the walls.

5.0 Acceptance Testing

Antenna/RCS Measurement Facility Performance Requirements

Upon completion of absorber installation, the contractor shall test and document the measurement facility performance. The performance of the updated facility shall meet or exceed the following minimum requirements:

5.1. The contractor shall validate the performance of the chamber from 2 - 40 GHz through a series of measurements aimed at determining the reflectivity of the measurement facility for varying signal levels. These tests shall include at minimum the following techniques (1) Antenna Pattern Comparison (APC¹) and (2) Advanced VSWR (AVSWR) measurements. These tests will be performed from 2 - 40 GHz using the appropriate standard gain horn in each band as the AUT.

5.2. The Antenna Pattern Comparison measurements shall include multiple measurements of a standard gain horn antenna in the appropriate waveguide band. These measurements should include measurements at various positions within the quiet zone. The measurements will show deviations from the averaged pattern within the bounds indicated in the following table for the given signal level. The following signal levels are denoted in dBp (dB relative to the pattern peak). These measurements will be repeated for the E- and H-plane of each standard gain horn.

Signal Level (dBp)	Allowable Deviation (dB)
-10	0.03 (0.01)
-20	0.1 (0.03)
-30	0.3 (0.10)
-40	0.9 (0.30)
-50	2.4 (1.00)

¹ Appel-Hansen, J., "Reflectivity Level of Radio Anechoic Chambers", IEEE Transactions on Antennas and Propagation, Vol. AP-21, No. 4, July 1973, pp. 490-498.

5.3. Any additional tests that the contractor wishes to use in addition to the tests described in Paragraphs 5.1 – 5.2 must be detailed in the proposal.

6.0 GOVERNMENT FURNISHED PROPERTY/EQUIPMENT

It is anticipated that Government property will be used by the contractor's personnel in the performance of that portion of the contract performed on-site at the U.S. Naval Research Laboratory (NRL). The following Government property will be furnished to the contractor on a rent-free basis for use in performing the contract: The Government will provide physical space for all contractor personnel for staging purposes and access to all required electrical services. Additional equipment provided includes the following minimum set of test equipment shall be made available and can be used during the performance requirement tests.

<p><i>Network Analyzers</i></p> <ul style="list-style-type: none"> ➤ E8364B PNA (10MHz-50GHz) ➤ 8722ES NA (50MHz-40GHz) ➤ 8720B NA (130MHz-20GHz) 	<p><i>Spectrum Analyzers</i></p> <ul style="list-style-type: none"> ➤ 8526A (1kHz-22GHz) 	<p><i>Signal Generators</i></p> <ul style="list-style-type: none"> ➤ E8257D (250kHz-20GHz) ➤ 83651B (10MHz-50GHz) ➤ 83732B (10MHz-20GHz) ➤ 83630A (10MHz-26.5GHz)
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7.0 Delivery and Installation

7.1. The Period of Performance to include delivery, installation, and testing shall be no later than one (1) year from date of award.

7.2 Data Deliverables

7.2.1. Drawings. The contractor shall provide detailed drawings of the proposed absorber configuration.

7.2.2. Acceptance Test Reports. The contractor shall provide documentation detailing the absorber configuration and performance. The report shall include detailed drawings and the results of the analysis set forth in Paragraphs 3.5 and 5.0. The report will be the basis for acceptance of the contractor's work.

7.2.3. Operating and Maintenance Manual. Any manuals required for maintenance of the absorber and any optional items such as the CCTV system

8.0 Warranty

The contractor shall provide the standard commercial warranty offered to the general public, including labor and materials. Extended warranties shall also be offered. The warranty items must be described in the proposal and included in the price. The period of warranty shall begin upon acceptance of the applications CLINs.

8.0 OPTIONS

8.1. Option 1 – CCTV System

Contractors shall propose the option to integrate a CCTV system into the existing Antenna/RCS Measurement Facility. The CCTV system option must include two (2) cameras. The cameras shall be installed to ensure a field of view that include the full quiet zone and include at minimum 10x zoom while maintaining optical clarity. The CCTV system must also include the ability to digitally record video during measurements on the existing data acquisition computer.

8.2. Option 2 Rubberized Absorber

Contractors shall propose the option to install rubberized absorber in the high traffic areas of the existing measurement facility. The high traffic areas are highlighted on Appendix A and also include the surfaces of both access doors to the measurement facility. The performance of the rubberized absorber must meet the specifications noted in Section 4.

8.3. Spare Material

For each type of absorber used in the refurbishment (with the exception of walkway absorber and pyramidal absorber greater than 12" in height), the contractor shall supply 20 square feet of spare material. The spare material shall be boxed or packaged in a manner suitable for long term storage with minimum possibility of damaging the surfaces of the material.