

ADVANCED MEASUREMENTS OPTICAL RANGE SUPPORT  
SCOPE OF WORK (SOW)  
SOW RC-TC-MT-K-16-03  
10-9-03

U.S. Army Space and Missile Defense Command  
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## 1.0 BACKGROUND

1.1 The Army anti-ballistic missile program sponsored a study by the Signature Measurements Planning Committee during the 1973 timeframe. The committee, composed of MICOM, McDonnell Douglas, United Aircraft Research Laboratory, Boeing, Raytheon, AVCO, and Optical Sciences Consultants, indicated an urgent need for laser signature measurements. The measurements data were needed to: (1) determine cross sections of ballistic targets to permit laser radar sensor sizing and (2) establish object characteristics on which to base the derivative discrimination techniques. The committee recommended a facility be built which measures the far field properties of full scale targets, avoids atmospheric effects, is dedicated to signature measurements and which gives correct results independent of the specular/diffuse nature of the target.

1.2 The Advanced Measurements Optical Range (AMOR) was built in the late 1970's through funding by the Ballistic Missile Defense Advanced Technology Center (BMDATC). The AMOR is a unique facility which is the only indoor optical range that provides accurate far-field simulation and measurement of target signatures.

1.3 The utility of laser imagers in ballistic missile defense was defined in the "Fletcher Committee" Defense Technologies Study Team (DTST) report of 1983. The sensor requirements for post boost and midcourse discrimination and the laser imager technology status were further evaluated during the Defense Advanced Research Project Agency (DARPA) sponsored Optical Discrimination Study (ODS) convened by MIT/Lincoln Laboratory on 20 Mar 1984. One of the conclusions of the ODS was that the database of target measurements for laser imagers was non-existent. An objective of the AMOR is to provide that database.

## 2.0 OBJECTIVES

2.1 The contractor shall efficiently assign the appropriate team capable of meeting the following specific objectives:

2.1.1 Provide operation, maintenance, calibration and repair services relating to the laboratory laser target measurement equipment as needed to obtain high quality total cross section and spatially resolved cross section data.

2.1.2 Perform technical assessments in the areas of technology evaluation, data analysis and system analysis. Perform conversion of digital and analog laboratory data to digital formats, suitable for use by the standard desktop computers provided in AMOR.

2.1.3 Design, fabricate and test active and passive electro-optical measurement hardware as required by the Government.

2.1.4 Integrate Product and Process Management into an effective management system through a cooperative process using a joint Contractor and Government Integrated Product Team (IPT).

2.1.5 Gather data for databases using ladars and other equipment.

## 3.0 SCOPE

### 3.1 Measurement Facilities and Capabilities

3.1.1 Measurement Hardware Location: The AMOR is located in Building 7768 and Labs 7 & 9 of Building 7770, Redstone Arsenal, AL. AMOR shall be the primary location for measurement activities but measurements may be conducted at other geographic locations on a short-term basis as required. The Contractor shall be capable of operating, maintaining and repairing all AMOR ladar and IR equipment at the AMOR facility or at other locations.

### 3.1.2 AMOR Test Capability

3.1.2.1 Background and Current Capability: The AMOR facility has the capability to characterize 0.532, 1.06, and 10.6 micron wavelength ladars and passive sensor wavelengths between 3 and 5 microns using calibration objects, actual targets and target replicas.

[REDACTED] These target microdynamics allow the ladar characteristics to accurately simulate far-field measurements that are highly representative and repeatable,

without the expense of field-testing. The data collected at the AMOR facility is useful in analysis of the ladar responses from the target and in algorithm development for interceptor and sensor discrimination applications. Classified portions of the AMOR capability will be supplied to the successful offeror after contract award.

3.1.2.2 Ladar capability: The AMOR facility has the following ladar capability:

- CO2 Laser - 10.6 micron laser (coherent)
- Solid state Laser - 1.06 micron laser (coherent) which is also frequency doubled to [REDACTED] (non-coherent) when required

These lasers are capable of continuous wave (CW) and pulse waveforms. They are integrated into the AMOR optical train and may both be used to characterize targets. Each laser can only be used individually, as the facility configuration does not permit the simultaneous use of more than one of these lasers at one time.

3.1.2.3 Collimated Beam: The [REDACTED] (diameter) mirror at AMOR is a key element in the AMOR optical train. It is used with the [REDACTED] laser waveforms to provide the two meter collimated beam. This mirror, along with the multiple range bin receiver, enables the far field measurement capability.

3.1.2.4 Infrared (IR) Capability: The IR capability at AMOR is more limited than the ladar capability; however it does permit simultaneous IR and ladar characterization of targets. The passive IR band is between [REDACTED].

3.1.2.5 Target Mount: The target mount has the following capabilities:

Target weight [REDACTED]

Spin rate [REDACTED]

Precession [REDACTED]

Translation [REDACTED]

3.2 Measurement Actions: The Contractor shall perform measurement actions as stated in paragraphs 3.2, 3.3, and 3.4 of this SOW, using the equipment referenced in paragraph 3.1 of this SOW. The design and fabrication actions specified in paragraph 3.2.5 of this SOW shall be optional, and will not be required until notice of exercise, when additional funding has been secured.

3.2.1 Measurement Operations: The Contractor shall conduct laser signature and passive IR signature measurements of Government provided (as well as Contractor fabricated) test objects at the U.S. Army Space and Missile Defense Command (USASMDC)'s AMOR or at other specified locations. "The Contractor shall operate and maintain, in sound working order, the following equipment: the laser imager, passive IR sensor, optics and other equipment presently located in the AMOR facility (Building 7768 and Labs 7 and 9 of Building 7770 on Redstone Arsenal). When the Contractor performs the Option Efforts required in paragraph 3.2.5 of this SOW, the Contractor shall also operate, repair and maintain that equipment. The Contractor will undertake measurement operations to include the following: configure laser radar equipment; align laser radar optical components; calibrate laser radars and associated equipment; mount and configure test objects; perform tests for stray light suppression; plan tests and provide written test plans; collect data according to test plans and experimental judgment; collect data on specified targets, analyze the data, provide oral test reports of results; design and fabricate test targets; perform measurement actions as required; and provide the additional written data reports as required. Analysis of the needed modernization shall be performed and delivered to the Government as required. (CDRL 001).

3.2.3 Test Target Fabrication: The Contractor shall design and fabricate targets as required to include the emulation of foreign threat targets using Government approved intelligence data. Targets may also be supplied to the Contractor for testing and may be either simulated or the actual hardware. Targets may require construction of mounting adapters by the Contractor.

3.2.4 Measurement Systems Maintenance: The Contractor shall provide all necessary maintenance and repair for all test equipment and other equipment currently at the facility or which is later provided to the AMOR by either the Government or the Contractor. This maintenance and repair shall cover all AMOR measurement systems and equipment, including the ladar and IR systems. The Contractor shall perform fault isolation on all measurement systems and equipment; maintain and repair commercial test equipment, as practical, considering the capability of AMOR in-house equipment and knowledge. The Contractor shall maintain and repair the present equipment at AMOR including, but not

limited to the following specific systems and items: the multi-channel synchronously gated receiver, the CO2 multifolded lasers, and the IR measurement system. When required by catastrophic failure where simple component replacement is not possible, the Contractor shall design and fabricate appropriately selected replacement equipment and components for each of the present AMOR measurement systems. These replacement items (both equipment systems and components) shall have the same electrical/electronic functionality as the original and shall match the original's form, fit and function. Replacement items shall include but not be limited to: individual components as well as the more complex multiple range bin receivers, special purpose test equipment, wideband detectors, target mounts, and multifolded CO2 lasers.

3.2.5 Design and Fabrication: The Contractor shall design, fabricate or purchase, test, and integrate new electrical, electronic, mechanical and optical hardware for use by the Department of Defense and its Contractors in signature measurement and laser radar component evaluation at the AMOR or other locations. The Contractor shall also provide the associated software/firmware for the hardware items provided under this paragraph. (OPTION EFFORT)

3.2.5.1 Modernization: The Contractor shall perform modernization activities relating to AMOR or other laser and ladar measurement systems, as directed by the Government. Modernization shall use either specially designed and fabricated or purchased equipment and will be based on recommendations of the joint Contractor and Government IPT. As part of the projected modernization, the Contractor shall develop and validate the appropriate software as directed by the Government, in order to best operate the laser imager and to improve analysis of the collected data. The Contractor shall design; build or purchase; integrate and test; and/or improve lasers and ladar systems, to include but not be limited to, CO2 multifolded lasers and portable laser imagers. This may include, but is not limited to, one to all of the following:

- o Recoat primary mirror with [REDACTED]
  - Diameter: [REDACTED]
  - Clear aperture: [REDACTED]
  - Spherical Radius of curvature: [REDACTED]
  - Coating: [REDACTED]

- o Recoat secondary & tertiary mirrors (we have good substrates) with [REDACTED]

2 Secondary mirrors: [REDACTED]

2 tertiary mirrors: [REDACTED] (Option Effort)

3.2.5.2 Multiple Range Bin Receivers: The Contractor shall perform the design, fabrication or purchase, integration and testing of new multi-channel synchronously gated receivers as required by the Government. These receivers may replace the present receivers at AMOR, help extend AMOR's capabilities or be used at other specified locations. They will enable the simultaneous collection of data from several successive target range bins and other related tasks as required by the Government. (OPTION EFFORT)

3.2.5.3 Special Purpose Test Equipment: The Contractor shall design, build or purchase, integrate and test new special purpose test equipment including, but not limited to, portable laser surface characterization instruments as required by the Government. (OPTION EFFORT)

3.2.5.4 Wideband Detectors: New wideband detectors shall be designed and fabricated or purchased as directed. Further, the Contractor shall design and fabricate or purchase new detector test instruments, including those for use with wideband HgCdTe detector arrays. The instruments shall have a capability to measure: heterodyne efficiency, uniformity of response, cross talk between array elements and other similar capabilities as required. (OPTION EFFORT)

3.2.5.5 Laser Development: The Contractor shall design, fabricate or purchase, integrate and test new CO2 stable lasers, and other new gas lasers, at frequencies and power levels as required by the Government. The Contractor shall design, fabricate or purchase, integrate, test and demonstrate new laser technologies based on other than CO2 lasers and CO2 multi-folded lasers for Government specified applications. The Contractor shall design, fabricate or purchase, integrate, and test new folded laser technologies as required by the Government. The technologies to be investigated shall include but not be limited to the following under US patents 4,815,094 4,870,654 and 5,610,936. (OPTION EFFORT)

3.2.5.6 Target Mount Development: The Contractor shall assess the present target mount equipment at the AMOR to determine what parameters should be modified to change its present capabilities to meet present and future needs. Modifications shall be made such that variable spin rates, precession rates, and coning angles can be simultaneously changed, either manually or by

computer control. The Contractor shall perform the necessary design, fabrication or purchase, integration and testing of new target mount equipment as required by the Government to produce additional improved target mounts or modifications to the existing AMOR mount. Target mounts shall incorporate all improvements as required by the Government, such as a design that is electrically/electronically controllable with built in safety considerations to prevent damage to the mount, target and the AMOR facility. (OPTION EFFORT)

### 3.3 Technical Analysis and Data Processing

3.3.1 Technical Assessments: The Contractor shall perform technical assessments of all aspects of AMOR operations and measurements, including but not limited to: laser signature data, related ladar performance parameters, and ladar transceiver hardware performance. These efforts shall include analysis of measurement data from AMOR or from other sources as required. Results of these analyses shall be used to define the need for improvements to laser imager hardware designs and ladar designs as well as software. Analyses considerations shall include but not be limited to spectra of doppler signatures, technical performance, vibration spectra, cost, risk, and schedule. The analysis shall be reported in a formal analysis report (CDRL \*001).

#### 3.3.2 Data Processing

3.3.2.1 Data Processing General: The Contractor shall appropriately process all digital and analog data recorded at AMOR. The Contractor shall ensure high data quality, shall convert data to a digital format compatible with the standard desktop computers supplied to AMOR, and shall prepare data reports of the test results (CDRL \*001).

3.3.2.2 Data Processing Software Development: The Contractor shall develop, or purchase as appropriate, any software required to excerpt data from specified target measurements, determine the validity and quality of the data, and integrate measurement data into a form easily useable (by either the Government or by other Contractors). The joint Contractor-Government IPT shall determine the electronic format for delivery of such software to the Government. All software and source code developed by the Contractor shall be delivered, in the electronic format as determined by the joint Contractor-Government IPT as an attachment to the descriptive technical reports (CDRL \*008).

3.3.2.3 Software: The Contractor shall deliver a software development plan that provides insight into, and a viable

approach for monitoring the process for all software development and sustainment activities performed under this contract. The methods to be used, the approach to be followed for each activity, and software project schedules, organization, and resources shall be addressed. This plan shall be based on recommendations from the joint Contractor-Government IPT. The software development plan shall be delivered to the Government attached to a technical report giving a one-page summary of the plan. (CDRL \*007)

3.3.2.4 Real Time Display: The Contractor shall develop, test and install software for displaying signatures in "real time", utilizing Government provided computers and data collection instrumentation. "Real time" for this purpose shall be defined as closest to real time as is reasonably practical, considering the capability of the Government supplied hardware.

### 3.4 General Hardware Requirements

3.4.1 Hardware Documentation: For modernization activities, the Contractor shall provide useable engineering drawings and specifications for all hardware fabricated and/or purchased by the Contractor.

3.4.2 Hardware Ownership: All AMOR measurement hardware which has either been: furnished by the Government, or purchased by the Contractor and direct charged to the contract, or designed and fabricated by the Contractor and direct charged to the contract shall become strictly the property of the Government. The Contractor may also use the hardware supplied by the Government or by other contractors for tests and assessments. None of the items furnished by the Government or other contractors for tests/assessments shall become the property of the contractor.

### 3.5 Coordination and Management Products

3.5.1 Approvals in the Measurement Process: The Contractor shall participate in the joint Contractor-Government IPT. The IPT approve all plans at required points in the measurement process. As a minimum, approval by the Government shall be required for all test plans and safety plans.

3.5.2 Safety: The Contractor shall identify any hazards associated with this effort and the controls needed to protect personnel from the identified hazards. Significant items shall be addressed in status meetings and included in safety reports as necessary. The Contractor, in its role under the joint Contractor-Government IPT, shall develop an appropriate Safety Plan for AMOR. (CDRL \*005)

3.5.3 Test Plans: The Contractor, in its role under the joint Contractor-Government IPT, shall develop all test plans as required by the Government. (CDRL \*003)

3.5.4 OPSEC Approach: The contractor shall develop and submit their OPSEC Approach for all SOW requirements and shall submit during proposal submission to the government. The OPSEC Approach shall be in accordance with Army Regulation 530-1, Operations Security.

3.5.5 Meetings and Briefings: The Contractor shall participate in all meetings as required by the Government. The Contractor shall prepare all required briefings on specific AMOR operations and analysis issues as well as all other required briefings on AMOR and other laser related topics.

#### 4.0 DOCUMENTATION

The Contractor shall deliver all technical data and information strictly in accordance with the requirements, quantities, and schedules set forth in the Contracts Data Requirements List (DD Form 1423).