

**Statement of Work (SOW)**

**Remote Sensing - Scientific and  
Engineering Research and Development**

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# Statement of Work

## Remote Sensing - Scientific and Engineering Research and Development

### Vision Statement

Provide world class engineering and operational research and development for space, air, and surface-based remote sensor systems used to model and perform scientific analysis of the Earth's ocean and land interface with the atmosphere and improve worldwide weather prediction capabilities.

### 1 Introduction

The Remote Sensing Division, NRL Code 7200, has an active program of research in the remote sensing, modeling, and scientific analysis of the Earth's atmosphere and ocean and land surfaces, as well as astronomy and astrometry. The Division designs, tests and operates space-based, air-based, subsurface, and land and ocean surface-based sensors, and develops new remote sensing capabilities and new ways of analyzing data.

### Mission

The Remote Sensing Division conducts a program of basic research, science, and applications aimed at the development of new concepts for sensors and imaging systems for objects and targets on the Earth, in the near-Earth environment, and in deep space. The research, both theoretical and experimental, deals with discovering and understanding the basic physical principles and mechanisms that give rise to emissions and control the response to active illumination. Such emissions are subject to absorption and emission by the intervening medium – be that, interstellar space, the earth's atmosphere, or ocean waters. The accomplishment of this research sometimes requires the development of sensor system technologies. The development effort includes active and passive sensor systems. Division scientists use these systems to study and analyze the physical characteristics of phenomena that give rise to reflected or emitted radiation, such as that caused by the Earth's atmosphere and oceans, as well as anthropogenic phenomena, such as ship or structural hydrodynamic effects. The research includes theory, laboratory- and field-experiments leading to ground-based, airborne, or space systems for use in such areas as remote sensing, astrometry, astrophysics, surveillance, and improved meteorological support systems for the operational Navy. Special emphasis is given to developing space-based platforms and exploiting existing space systems.

### 1.2 Background

Current projects include: spectral imaging for the remote sensing of coastal water and of land surfaces; passive polarimetric microwave sensing of the ocean and land surfaces (APMIR, and

follow-on sensors); passive ultraviolet, visible, near-infrared, and short wave infrared optical sensors and passive microwave sensing of the atmosphere; bistatic reflectometry; synthetic aperture radar (SAR); radio, IR and optical astronomy; and laboratory and field studies of aerosols, foam and bubbles, and fluid flow. The Division performs modeling, field and laboratory experiments, calibrates and validates sensors, carries out feasibility studies, and performs simulations and scientific analyses.

## **2.0 Scope**

The purpose of this Statement of Work (SOW) is to acquire scientific and engineering research and development efforts in support of the Remote Sensing Division's development and application of new and existing techniques for remote sensing. This includes the formulation, design, development, fabrication, integration, testing, verification, operation, and data analysis of hardware and software that is used in laboratory, field, spaceflight (including ground system) efforts. This work includes the development and validation of technologies to enable future science missions. Tasks range from supporting mission concept design and feasibility analyses through to laboratory, in-field or flight (including on-orbit operation) of deployed systems, the analysis of science and engineering data obtained from them, and the development and operation of algorithms for analyzing data. The efforts include theoretical analysis and modeling necessary to develop or optimize remote sensing techniques. The requirement also includes providing on/off-site multi-disciplinary scientific, engineering and management efforts to support the development, implementation and use of components, subsystems, systems, and scientific instruments for NRL laboratory and "field experiments". Field experiments may include ground-based experiments, in-water experiments, experiments on spacecraft, and experiments on suborbital craft such as UAVs, balloons, and aircraft. Hardware to be developed may include instruments, Ground Support Equipment (GSE), simulators, non-flight models and prototypes.

The work conducted by the chosen contractor will often be conducted in coordination with Principal Investigator (PI) led research teams that may include Government scientists and other Contractors. The quality and timeliness of the provider's contribution to the work will be evaluated in terms of its impact on the success of the overall project.

## **3. Requirements**

### **3.1. General Requirements**

The Naval Research Laboratory (NRL) Requirements for On-Site Contractors (ROSC) dated 8 December 2008 provides general instructions for Contractors conducting business at/on NRL property. Compliance with specific paragraphs of the NRL ROSC cited in the Section 2 - General Requirements and Section 4 - Special Requirements is mandatory, other requirements in the NRL ROSC are provided for information purposes only.

#### **3.1.1. Non-Personal Services**

The Government will neither supervise contractor employees nor control the method by which the contractor performs the required tasks.

The Government will not assign tasks to, or prepare work schedules for, individual contractor employees.

The Contractor **shall** be responsible for managing its employees and guarding against any actions that are of the nature of personal services, or give the perception of personal services as defined in FAR-Part 37, Service Contracting, dated 31 May 2011.

The Contractor **shall** notify the Contracting Officer (KO) if any Government requested actions constitute, or are perceived to constitute personal services.

### **3.1.2. Business Relations**

The contractor **shall** integrate and coordinate all activity needed to execute this contract.

### **3.1.3. Contract Administration and Management**

The following subsections specify requirements for contract management and contractor personnel administration.

#### **3.1.3.1. Contract Management**

The Contractor **shall** establish clear organizational lines of authority and responsibility to ensure effective management of the resources assigned to this contract.

The Contractor **shall** incorporate proprietary hardware or software in deliverables only after being authorized, in writing, by the Contracting Officer (e.g. requires an exception to 2.3.2 below).

The Contractor **shall** provide a Monthly Cost Report on the schedule and in the format defined in **[CDRL A001]** to report current and cumulative Contractor (and subcontractor) labor (both on-site and off-site), material, and travel expenditures charged against this contract.

The Contractor **shall** provide a separate monthly Contractor On-Site Labor Report on the schedule and in the format defined in **[CDRL A003]** to report the total labor hours and costs billed to each assigned task for all Contractor (and subcontractor) personnel working on-site at NRL.

#### **3.1.3.2. Personnel Administration**

The Contractor **shall** maintain the currency of their employees by providing initial and refresher training as required to meet the SOW requirements.

The Contractor **shall** make necessary travel arrangements for employees.

#### **3.1.3.3. Contract Administration**

The Contractor **shall** establish processes and assign appropriate resources to effectively administer this contract.

The Contractor **shall** respond to Government requests for contractual actions within five work days.

The Contractor **shall** assign work effort and maintain proper and accurate time keeping records of personnel assigned to work on this contract.

#### **3.1.4. Contractor Furnished Equipment, Materials, Subcontracts and Supplies**

Equipment and unexpended materials and supplies purchased by the contractor under this contract become the property of the Government at the end of the performance period, including all options.

The Contractor **shall** provide supplies for contractor personnel.

The Contractor **shall** provide any other equipment, material, and supplies, not furnished by the Government, but required to perform the work defined under Paragraph 3, Performance Requirements, below.

The Contractor **shall** be responsible for any subcontract management necessary for performing efforts described in Paragraph 3, Performance Requirements, below.

#### **3.1.5. Contractor Personnel, Disciplines, and Specialties**

The minimum education, training, and experience required by contractor personnel to perform tasks identified in this SOW are defined in the labor category descriptions provided in Attachment (2) of the Request for Proposal (RFP)

#### **3.1.6. Travel / Temporary Duty (TDY)**

Travel to other government facilities or contractor facilities may be required for conduct of experimental research or attendance at government reviews or scientific meetings and seminars.

The Contractor **shall** submit all travel requirements (including plans, agenda, itinerary and dates) for pre-approval to the Government and is on a strictly cost reimbursable basis.

The Contractor **shall** bill costs for travel in accordance with FAR 31.205-46 Travel Costs (subject to local policy & procedures).

#### **3.1.7. Facilities and Staffing**

The Contractor **shall** have office space and meeting facilities within the Washington, DC local area.

The Contractor **shall** provide and staff facilities for the fabrication, test, and storage of unique fixtures and support equipment required to perform tasks delineated in Section 3 below. Support equipment may include aircraft equipment racks, electrical test equipment (e.g., spectrum analyzers, oscilloscopes), test computers, and test fixtures for mounting instrumentation. Specific equipment lists will be provided with the issuance of task orders.

The Contractor **shall** participate in periodic and informal working group meetings and discussions held at the direction of NRL as required.

## **3.2. Specific Tasks**

### **3.2.1. Task 1 - Radio, Infrared (IR), and Optical Astronomy Sensor Systems Engineering and Operations**

Systems engineering, in addition to the specified effort required by the following tasks, includes development of mechanical, electrical and functional test documents; development of test plans and procedures for integration and test of experiments, payloads, and subsystems; performance of system level environmental and functional testing and implementation of corrective actions where necessary; conduct of natural environmental stress (thermal, vacuum, EMC, shock and vibration, and calibration) tests; provision of personnel and material resources for integration of flight instruments with host vehicle/platforms; and design and development of pre-launch, post-launch, and flight operations test procedures and manuals for both GFE supplied or Contractor supplied instruments.

The Contractor shall perform optical, electronic, mechanical, and thermal design analysis of instruments and support equipment for space-based, airborne, and ground-based multispectral astronomic sensors.

The Contractor shall perform engineering tasks to fabricate, test, calibrate, and integrate multispectral astronomic sensors for installation in at field sites and on host vehicles/platforms.

The Contractor shall design, acquire, and modify ground support equipment (GSE) for use in conducting integration and test of astronomical sensors. Typical GSE elements include electronics for remote command, control, and data acquisition, and the associated interfaces; mechanical support structures; wiring harnesses; and test equipment articles.

The Contractor shall conduct operations to install remote sensing instruments for conducting radio, infrared, and optical astronomy. Operations efforts include coordinating with host platform/vehicle operations centers, conduct of general troubleshooting and resolution of anomalies, monitoring and reporting on instrument state-of-health, and providing output data to users/customers.

### **3.2.2. Task 2 – Passive Sensing of Physical Processes from Earth’s Surface to Upper Atmosphere**

Overview: The Remote Sensing Division uses passive microwave (as well as other passive techniques) to make measurements that allow the quantified and qualitative understanding of natural and anthropogenic processes. These processes cover land, cryosphere, and sea surfaces (and near surfaces), atmosphere including the troposphere, stratosphere, mesosphere, ionosphere, and space. This task may involve the development of new sensing techniques. The maintenance and operation of current sensors, as well as the development of new sensors is included. Development of algorithms and data processing/analysis/interpretation/assimilation tools to support measurements, whether NRL-owned/developed or externally-owned/developed is included. *APMIR* is an airborne passive microwave polarimeter. Component channels and

radiometers of *APMIR* are often used in field campaigns for model development and validation. Passive radar, using noncooperative illumination, is an area of significant current interest.

**Systems Engineering:** In addition to the specified efforts required by the following tasks, this task may require development of mechanical, electrical and functional test documents; development of test plans and procedures for integration and test of experiments, payloads, and subsystems; performance of system level environmental and functional testing and implementation of corrective actions where necessary; conduct of natural environmental stress (thermal, vacuum, EMC, shock and vibration, and calibration) tests; provision of personnel and material resources for integration of flight instruments with host vehicle/platforms; and design and development of pre-launch, post-launch, and flight operations test procedures and manuals for both GFE-supplied or Contractor-supplied instruments.

**Engineering Design:** The Contractor shall perform mechanical, RF, optical electronic, electrical, and software design analysis of instruments and support equipment for ground-based, shipborne, airborne, and space-based passive remote sensors.

**Engineering Development:** The Contractor shall perform engineering tasks to build passive microwave remote sensors and their associated subsystems. This may include the Contractor's acquisition of specific materials required to support these efforts.

**Engineering Support:** The Contractor shall design, acquire, and modify ground support equipment (GSE) for use in conducting integration, test, and development of passive microwave remote sensing instruments. Typical GSE elements include electronics for remote command, control, and data acquisition, and the associated interfaces; mechanical support structures; wiring harnesses; and test equipment articles. *This may include the Contractor arranging for specialized field sites and/or host vehicles/platforms as required to support these efforts. For instance, some experiments will involve use of local commercial vessels, such as fishing vessels, to allow sensors to take the required measurements. The Contractor will arrange for such platforms.*

**Sensor operation:** The Contractor shall perform engineering tasks to test, calibrate, and integrate passive microwave remote sensors and their associated subsystems for installation at field sites and on host vehicle/platforms.

The Contractor shall conduct operations to install remote sensing instruments for monitoring the upper atmospheric environment. Operations efforts include coordinating with host platform/vehicle operations centers, conduct of general troubleshooting and resolution of anomalies, monitoring and reporting on instrument state-of-health, and providing output data to users/customers.

**Data processing/assimilation:** The Contractor shall develop, maintain, and run data processing software for calibration and processing of passive microwave data. Data processing software for this task includes conversion of raw passive microwave measurements into calibrated, geo-located brightness temperatures, retrieval of selected environmental parameters from brightness temperature data, and integration of the "brightness temperature data" algorithms/software into



passive microwave instrument software. The Contractor shall develop, maintain, and run data assimilation software.

Data analysis: The Contractor shall develop, maintain, and run data processing software for analysis of passive microwave data products. Data processing software in this task includes software for sensor calibration, environmental parameter data product validation, geo-location validation, and sensor state of health (SOH) trending and evaluation.

The Contractor shall implement software configuration management and control for passive microwave data handling software developed under this task.

### **3.2.3. Task 3 – Maritime and Terrestrial Science**

The Division makes use of hyperspectral sensors, line scanners, lidars, thermal cameras, polarimetric cameras, RGB cameras, ground truthing equipment (field spectrometers, water quality instruments, etc) among other sensors. The Contractor shall participate in the optical, mechanical, electronic, electrical, thermal, and software development for the full range of instruments. Additionally, this task includes design, fabrication, characterization, testing and design analysis of instruments and support equipment for ground-based, airborne, and space-based remote use of these sensors as needed. *The Contractor may need to arrange for specialized field sites and/or host vehicles/platforms as required to support these efforts.* For instance, some experiments will involve use of local commercial vessels, such as fishing vessels, to allow sensors to take the required measurements. The Contractor will arrange for such platforms.

Remotely sensed data of the Earth requires significant pre-processing before it can be analyzed. The contractor shall work in the areas of pre-processing steps including spatial, spectral, radiometric calibration, and correction for atmospheric contributions.

All of these instruments generate large amounts of data. Data collection is often limited to specific target areas, necessitating careful control of collections. In addition, efficient data handling schemes are needed.

The Contractor shall develop data processing software for the creation of remote sensing data products. Data processing software in this task includes software for sensor calibration, environmental parameter data product validation, geolocation validation, and sensor state of health trending and evaluation.

The Contractor shall implement software configuration management and control for remote sensing data software developed under this task and well as participate in the general documentation of this work.

#### *Radar and Reflectometry*

The Remote Sensing Division conducts field experiments involving ground and airborne radar systems. These experiments include monostatic and bistatic radars, as well as passive bistatic systems that make use of signals of opportunity as transmitters.

The contractor shall provide engineering efforts for the development of monostatic and bistatic radar systems, including electrical and mechanical systems necessary for field deployment of these systems.

Deployments may be on ground-based platforms, sea-based platforms, ships, or aircraft.

The contractor shall supply scientific and programming efforts to assist in the operation of these sensors during field experiments and to analyze the resulting data, and shall assist in the preparation, setup, and operation of the relevant sensors and ground-truth instruments.

#### *Fluid Flow Phenomena Research*

The Contractor shall conduct laboratory test tank and field experiments to analyze, model, and verify fluid flow phenomena for oceans and other natural bodies of water.

#### *Aerosol and Cloud Processes Research*

The Contractor shall conduct research and development studies to evaluate, improve, and expand computer models of marine aerosols and cloud processes. Studies include assessment of both contractor-developed and GFE models.

The Contractor shall develop or modify GFE provided aerosol and cloud process algorithms for use in Visible Infrared Imager Radiometer Suite (VIIRS) and other future visible/infrared/ultra-violet instruments.

The Contractor shall conduct marine aerosol and cloud processes field measurement experiments for determining their effects on natural and artificial optical radiation. Field measurements include surface measurements of sky radiance and direct solar irradiance.

### **3.2.4. Task 4 - Synthetic Aperture Radar (SAR)/Interferometric Synthetic Aperture Radar (ISAR) Systems Efforts**

SAR/ISAR techniques are used to measure radar backscatter from the ocean surface. The radars are mounted on both ground-based and airborne platforms.

The Contractor shall maintain mechanical and electrical/electronic systems for airborne and ground-based SAR/ISAR radar mounts.

The Contractor shall modify, design, and acquire equipment for use in conducting integration and test of SAR/ISAR sensors. Typical elements include electronics for remote command, control, and data acquisition, and the associated interfaces; mechanical support structures; wiring harnesses; and test equipment articles.

### **3.2.5. Task 5 – R&D Information Technology – Code 7200**

The Contractor shall perform maintenance and administration of information systems owned and operated by the Remote Sensing Division that compose the research and development technology enterprise of the programs described under this statement of work. These systems include, but are not limited to information systems used to operate lab and field instrumentation,

and servers, disk arrays, and network devices used for remote sensing data analysis; retrieval algorithm development; modeling; and remote sensing data archival. The Contractor shall provide hardware and software maintenance for selected computational systems and shall recommend, acquire, and implement hardware and software solutions required to meet performance and capability need of the research and development projects. Currently used platforms include, but are not limited to, Windows, Linux, VMware, ESXi, Apple OS, and ZFS. The Contractor shall comply with all applicable NRL Information Security requirements.

### **3.2.6. Task 6 - Technical Documentation Development and Program Management Support**

The Contractor shall assist in program management including development of project schedules, budgets, and program documentation. Program documentation includes but is not limited to program management plans, risk assessment plans, and quality assurance plans.

The Contractor shall assist in developing system design documentation for use at assigned system design reviews. System design documentation includes Hardware/Software Design Specifications, Interface Control Documents (ICS), Test Plans, Test Procedures, Test Reports, Parts Lists, and Drawing Packages describing system baselines prior for major system design reviews such as System Requirements Review (SRR), Preliminary Design Reviews (PDR), Critical Design Reviews (CDR), Test Readiness Reviews (TRR) and other technical reviews as required. 3.1.12.2 The Contractor shall attend system design reviews to present technical assessments of design solutions and recommend a preferred design solution for assigned systems.

The Contractor shall assist in developing acquisition technical documentation and requests for proposals for new programs of opportunity.

The Contractor shall create computer graphic illustrations, drawings, and other graphic material for inclusion in studies, proposals, and program and technical presentations.

The Contractor shall design and develop test procedures and manuals for instrument pre-launch, post-launch, and flight operations.

### **3.2.7. Task 7 – R&D Information Technology – Code 7100**

The Contractor shall perform maintenance and administration of information systems owned and operated by the Acoustics Division that compose the research and development technology enterprise of the programs described under this statement of work. These systems include, but are not limited to information systems used to operate lab and field instrumentation, and servers, disk arrays, and network devices used for remote sensing data analysis; retrieval algorithm development; modeling; and remote sensing data archival. The Contractor shall provide hardware and software maintenance for selected computational systems and shall recommend, acquire, and implement hardware and software solutions required to meet performance and capability need of the research and development projects. The Contractor shall comply with all applicable NRL Information Security requirements.

## **4. Special Requirements**

This section describes the special requirements for this effort. The following sub-sections provide details of various considerations on this effort.

### **4.1. Security**

All Contractor personnel shall possess a favorably completed DoD investigation and a final DoD granted Secret security at time of proposal submission. Detailed security requirements are delineated in the issued DD 254s relevant to this contract. The Contractor shall ensure that all classified material is handled in accordance with the issued DD 254, the National Security Program Operating Manual (NISPOM) (DoD 5220.22M and all NRL and applicable Security Program Guides/Directives.

#### **4.1.1. Information Assurance and Systems Security**

The Contractor shall comply with the requirements of NRLINST 5239.1 Information Systems Security Plan (as revised) when using the NRL Integrated Communications Environment Network (NICE net) and other local area networks and wide area networks (LAN/WAN).4.1.2 Identification (ID) Badges and Vehicle Passes

The Government will issue ID badges and vehicle passes to Contractor personnel working at NRL and the BPTF site in accordance with the requirements of Paragraph 1(b) BADGES AND VEHICLE PASSES of the NRL ROSC. A favorable trustworthiness determination is required in order for nominated contractor personnel to be granted access to NRL facilities and issued an NRL badge. NRL issued Contractor badges will be worn and readily visible at all times while contractor personnel are on NRL facilities.

The Contractor shall provide all requested information required to facilitate the use and possession of badges and vehicle passes.

The Contractor shall ensure the immediately return all ID badges issued to Contractor employees under any of the following conditions completion of contract, relocation or termination of an employee, or upon request of the Contracting Officer or Contracting Officer's Representative.

### **4.2. Safety**

The contractor shall comply with safety requirements contained in NRL ROSC document, dated 8 December 2008.

### **4.3. Applicable Directives**

The Mandatory document list is a list of documents that have been cited by specific paragraph reference in Sections 2, 3, and 4 above for compliance. Compliance with documents listed as non-mandatory and non-referenced sections of the mandatory documents is at the contractors' option.