SPECIFICATIONS

VOLUME SCATTERING FUNCTION METER

INTRODUCTION:

The Naval Research Laboratory at Stennis Space Center, MS (NRLSSC) has a requirement for a Volume Scattering Meter (VSM) to support the remote sensing and in-water optical programs for its Oceanographic Sciences Division. Since there is currently limited systems that can measure the near-backward function and since this instrument is being used for remote sensing validation and analysis, the backward direction is considered a critical aspect of this system. The major function of this instrument is to provide NRLSSC with in-situ measurements of the Volume Scattering Function (VSF) over the largest possible dynamic and angular range for coastal and open water applications.

This system will be used in a "hold at depth" mode where the system will be lowered to a specified depth and the VSF measured. The time constraints and depth requirements are outlined below.

REQUIREMENTS:

The system should measure the VSF over the range of <0.5 to >178 degrees. Systems that meet the minimal performance specifications and have more than one wavelength and measure continuously over the largest angular range will be rated accordingly.

The most critical range for this system is from 170 to >178 degrees (the near backward direction). The system should measure the VSF over this range to at least a 1degree angular resolution. Maximum ratings will be given to those instruments that measure higher angular resolutions and can measure the VSF above 178 degrees.

The system should measure the VSF in the near-forward scattering interval (defined as the region <0.5 degrees to 5.0 degrees) to no more than 1.0 degree increments, with 0.25 degree increments or less, desired. For the angular range from 10 to 170, at least 10 angles should be measured with a minimum separation between each angle of no less than 6 degrees over the specified range; preference will be given to those instruments with additional angles and those that approach 5 and 170 degrees.

The VSF measuring system shall have a sufficient dynamic range capable of measuring the VSF over a minimal range in total volume scattering coefficient of 0.1 to 5 m^{-1}. Instruments that can cover a larger range (<0.05 to > 10 m^{-1}) with automatic control (i.e. no manual adjustment necessary) are highly desired and rated accordingly. In order to use the instrument effectively, the contractor must indicate whether or not a separate instrument is required to measure total beam scattering in waters with high attenuation (c >6 m^{-1}), or high absorption (total volume absorption, a, > 2 m^{-1}). If a separate instrument is required for the correction of the VSF due to absorption, then the contractor must indicate how this data must be integrated into measurements and its effect and error on the calculated VSF. The required instrument will be used predominately in coastal waters so instruments that can measure the VSF in turbid waters (b> 5 m^{-1}) will rated accordingly. Systems with no or minimal manual control over all wavelengths and the entire scattering range are desired.

Because the system is required to measure water in highly dynamic environments, The Government requires a single unit that can measure the entire scattering function at multiple wavelengths. The desired configuration is a system that measures the VSF at depth with a constrained volume (all measurements close together). However, this procurement will consider instrument packages that are a combination of subunits integrated together into a total system that weighs less than 150 pounds and can be deployed from a research vessel by no more than two people, or laboratory systems that require less than 10 liters of continuously flowing water for the measurement of the VSF. In the combined subunits configuration, all subunits must be able to measure the complete VSF within no more than a 25 cm depth separation (i.e. a total of 25 cm separation in depth is allowed for the integrated package). For systems that are in-situ, preference will be given to those that can measure the VSF to depths greater than 100 meters. To minimize changes in “water mass” during measurements, instruments must make the complete set of measurements within five minutes for each wavelength proposed.

As a tool for oceanographic lidar and remote sensing research the requested system benefits from having multiple wavelengths. Due to the lidar application, the system should measure the VSF for at least one wavelength at a desired 532 nm or within the range of 510 nm to 555 nm, with a band width of no greater than 12 nm Full Width Half Maximum (FWHM). Multiple wavelengths extending from the blue portion of the spectrum (approx: 443 nm) to the red portion of the spectrum (approx: 650 nm) are desired. The priority of wavelengths (within plus or minus 3 nm) are, (1) 532 nm, (2) 443 nm, (3) 620 nm, and (4) 650 nm. Any additional wavelengths are considered important with priorities given to systems that include measurements at or near 412 nm, and 490 nm or those that can be matched to present Ocean Color satellites in the visible portion of the spectrum.

The system will be used under a wide range of environmental conditions. As such the system needs to show in-situ operational capabilities extending over the range of 5 to 35 degrees centigrade. For extreme environments an operating range of <2 to >36 degrees centigrade is desired. The system should be functional within the contractors specified range without changes in the stability or calibration of the instrument. For in-situ deployments the instrument must maintain stability within the specified operating range. The instrumentation shall be functional at all depths less than 50 meters with desired operational capabilities down to 200 meters.

OPTIONAL CAPABILITY:

Polarization measurement capabilities will benefit future research conducted utilizing this instrument. Additional incorporation of polarization capabilities will be rated accordingly.

HARDWARE/SOFTWARE:

The contractor must supply complete hardware and software for system control, data acquisition, system diagnostic checking, data storage, and processing of raw data to engineering units and a calibrated VSF. The Government requires a deck control, data storage, and diagnostic software that are written in a Windows environment and includes a graphical user interface. Both "raw" data files and files processed to the VSF must be available and stored with all calibration information maintained for any future reprocessing or data analysis. If a proposed system requires system configuration be predetermined as opposed to in-situ control, then all system information must be available in a metafile that can be used and identified with the data file collected. Automatic data processing is preferred, however separate software that requires user manipulation will be considered. All data files must be easily converted to an ASCII file for use in common software packages such as Excel, Origin, Matlab, LabView, or IGOR. The functionality of the deck control unit and software inspection will be completed by designated Government personnel. Automatic data processing with ingestion of measured total volume scattering coefficient from the system is desired.

The user must be able to determine the operating condition of the instrument and the validation of data collection while in use. The diagnostic software should be windows compatible using standard menu and dialog boxes. Control functions should include error checking, data flow indicators, and data storage confirmation. The Government requires diagnostic capabilities that also show the status of each wavelength and the prevention of illegal operations and formats that will cause data collection to cease. Software and functional displays that show the operator measured signals that are converted to meaningful units, such as the scattering at each angular interval, and that are in near-real time are strongly preferred.

TRAINING:

The contractor shall participate in at least two days of training of Government personnel and/or their representatives. The contractor shall provide procedures and demonstrate complete calibration, user instructions, maintenance, and system requirements for deployment to Navy personnel inspecting and confirming instrument performance specifications. This includes demonstration and documentation of calibration and measurement protocols and the stability of the instrument for collection of sequential data at-sea over a two week period, or means to monitor these changes, over a two to four week deployment period.

DOCUMENTATION:

The contractor must supply a user's manual and documentation on cleaning, system adjustments, maintenance, calibration, and any other alignment required for the system. A manual with all data formats, conversion routines, and application of calibrations must be provided by the contractor.
The contractor shall provide all documentation of the systems performance capabilities.

INSPECTION AND ACCEPTANCE:

System inspection and acceptance shall be performed by the Navy Air Systems Command (AIR 456). The inspection period shall extend forty-five (45) days from date of system delivery. The contractor shall provide the required documentation including any software, firmware, and hardware information with completed documentation on instrument calibration to NAVAIR. This includes any equations or information required to validate instrument performance in meeting the specifications outlined.

The contractor shall provide the necessary support to ensure that the system can be deployed in vessels greater than 35 feet. The contractor shall assist NAVAIR in providing occasional information during the 45 day evaluation/inspection and system testing period. The contractor shall demonstrate to the Government representative, the control system, processing software, and acquisition and data storage system.

DELIVERY OR PERFORMANCE:

The contractor shall deliver progress reports each three month period beginning three months from date of contract award.

The contractor shall deliver all instrumentation, documentation, hardware, and software no later than nine (9) months from date of award of the contract.

PAST PERFORMANCE:

The Contractor must demonstrate that they have a past record of providing scattering instrumentation for oceanographic applications or have demonstrated in either peer-reviewed publications or conference proceedings instrumentation that measures the volume scattering function or some part of it. The past experience may include all or only part of the measurement of the VSF.

WARRANTY:

The Contractor shall provide a standard commercial warranty to include parts and labor .