

SECTION C Descriptions and Specifications

**STATEMENT OF WORK (SOW)
PROTOTYPE PHOTONIC SENSORS****1. Background**

The objective of the Navy's Adapted Photonic Sensor Program is to integrate photonic sensor systems into marine gas turbine engines in order to maximize system operation, diagnostics and control. This will require deployment of photonic sensors small enough and durable enough to measure pressure and temperature in the harsh high temperature, high pressure and corrosive environment of a marine gas turbine engine. This Statement of Work involves acquisition of the following items from the contractor in support of the goal of developing an Advance Development Model photonic sensor system:

Item 0001: Development, fabrication and testing of a photonic sensor (Phase I Sensor) with demonstrated ability to measure compressor outlet discharge pressure in an operating marine gas turbine engine, together with accessories.

Item 0002: Development, fabrication and testing of a photonic sensor (Phase II Sensor) with demonstrated ability to measure bleed air flow in an operating marine gas turbine engine, together with accessories.

Item 0003: Technical Data for Items 0001 and 0002

2. Requirements

2.1 Contractor shall deliver four (4) each of Items 0001 and 0002, each meeting the requirements set forth in System Specification #1 (Attachment 1 to this SOW) and fabricated in accordance with a design approved by the Government.

2.2 Contractor shall deliver four (4) interrogation units capable of decoding Item 0001 and four (4) interrogation units capable of decoding Item 0002.

2.3 Contractor shall supply all required accessories to create a functioning sensor system, to include a data acquisition system to record data during operation of the sensors and required software for the sensor system.

2.4 Before fabricating Item 0001 to be delivered to the Government, contractor must perform the following tasks with respect to Item 0001. After delivery of Item 0001 and before fabricating Item 0002 for delivery to the Government, contractor must perform the following tasks with respect to Item 0002.

(a) Contractor shall provide to the Government a detailed design analysis of the sensor, exploring design alternatives and the ramifications thereof. Design analysis shall include risk assessments and descriptions of trade-offs made between performance, reliability, maintainability, supportability, producibility and life costs;

(b) Contractor shall participate in design reviews with the Government, as required, and shall incorporate Government feedback in finalizing the design for fabrication of each type of sensor;

(c) Contractor shall provide to the Government final design documentation, including a final design study for the item as well as discussions of the trade-offs made and alternatives explored, and obtain Government's written approval of the final design study for that item; and

(d) Contractor shall provide a prototype of the item to the Government.

2.5 Contractor shall provide the following incidental services in support of the hardware items to be delivered:

(a) Contractor shall perform environmental screening/acceptance testing of sensors, including mechanical vibration testing for shipboard equipment as set forth in MIL-STD-167-1 tests and all analyses necessary to allow testing on the turbine. This testing must be completed before contractor may proceed to operational testing described in paragraph (b) below.

(b) Contractor shall perform operational testing of the sensors onsite at NSWCCD – Philadelphia. The sensors must function to specifications during testing while installed on a marine gas turbine engine operating in temperatures up to 900 degrees Fahrenheit and pressure ranges up to 275 psi.

(c) Contractor shall provide On-Site Technical Support for a minimum period of two weeks following delivery of Item 0001 and shall provide On-site Technical Support for a minimum period of two weeks following delivery of Item 0002. On-Site Support shall include installation support, system configuration and calibration of delivered hardware and software.

3. Travel/Schedule (POA&M)

3.1 As soon as possible following contract award, the Government and the Contractor will collaborate to finalize the Plan of Action and Milestone (POA&M) proposed by contractor, setting forth target dates for various contract objectives, including dates for the progress meetings and delivery dates for the deliverables described in Section 4 of this SOW. The POA&M shall be subject to adjustment throughout the period of performance of the contract to reflect progress made and difficulties encountered. (reference CDRL Item A001)

3.2 Contractor will be required to travel to accomplish the contract objectives. Travel required under this contract is expected to be as follows: Contractor personnel will be required to travel to NSWCCD-Philadelphia for the following events: (a) Monthly progress meetings to review status and update POA&M; (b) Final design presentations for Items 0001 and 0002 by contractor; and (c) onsite testing of Items 0001 and 0002.

4. Deliverables

4.1 Contractor shall deliver the following hardware items in accordance with Section 2 of this SOW, together with accessories necessary for the functioning of these hardware items:

4.1.1 Prototype of Item 0001 (Phase I Sensor) and prototype of Item 0002 (Phase II Sensor)

4.1.3 Four (4) of each of the following items:

Item 0001 – Phase I Sensors

Item 0002 – Phase II Sensors

Interrogation Units for Phase I Sensors

Interrogation Units for Phase II Sensors

4.2 In accordance with the attached Form DD 1423 “Contract Data Requirements List” (CDRL), contractor shall deliver the following items to the Government:

4.2.1 Monthly Progress Reports (reference CDRL Item A002)

4.2.2 Final Design Study for Item 0001 (Phase I Sensors) and Final Design Study for Item 0002 (Phase II Sensors) (reference CDRL Item A003)

4.2.3 Design Specifications and drawings for each of the following items:

Item 0001 - Phase I Sensors

Item 0002 - Phase II Sensors

(reference CDRL Item A004)

4.2.4 At time of delivery of Item 0001 and of Item 0002, contractor shall provide a complete technical manual to guide the user in the testing and operation of the applicable type of sensor. Each manual must include hardware and software versions of the information. (reference CDRL Item A005)

4.2.5 Before commencing operational tests referred to in paragraph 2.5(b), contractor shall deliver a test report including results of all environmental screening/acceptance testing of sensors, including MIL-STD-167-1 tests and all analyses necessary to allow testing on the turbine conducted as required by paragraph 2.5(a). (reference CDRL Item A006)

4.2.6 Within 15 working days after conclusion of the operational tests referred to in paragraph 2.5(b), contractor shall deliver a written report containing all test results, analyses and recommendations for further development of the sensor system. (reference CDRL Item A007)

4.2.7 Contractor must provide three (3) installation CDs containing all software necessary to allow the end user to completely re-install a working sensor system. Contractor must also supply the following with respect to all software developed for the sensor system:

- (a) Source Code Documentation
- (b) Requirements Management Plan
- (c) Software Development Plan
- (d) Test Plan, Test Procedures
- (e) Software Quality Assurance Plan
- (f) System Flow Diagrams
- (g) Configuration Management Plan

(reference CDRL Item A008)

5. Government Furnished Information and Materials

The Government will provide contractor with on-site access at NSWCCD - Philadelphia to a marine gas turbine engine for operational testing of sensors.

6. Place of Performance/Deliveries

6.1 Period of Performance: The period of performance for this contract will commence on the date of contract award and end one year after the date of contract award.

6.2 Place of Performance: The primary place of performance will be the contractor's facilities, but travel will be required as stated in paragraph 3.2. Operational testing of sensors will take place at NSWCCD-Philadelphia.

6.3 Place of Delivery:

6.3.1 All deliverables under this contract consisting of reports, data and other contract data items are to be delivered to:

Naval Surface Warfare Center
5001 South Broad Street
Philadelphia, PA 19112-1403
Marked for: Code 9533 (Mr. Joe McGillian)

6.3.2 Sensors and related hardware shall be delivered to NSWCCD-Philadelphia where onsite testing will be conducted. Contractor shall confirm exact location and schedule for delivery of hardware to the Government not later than 30 days before the proposed delivery date.

7. Government POC

Technical Point of Contact: The Technical Point of Contact (TPOC) for this contract is Mr. Joe McGillian, Code 9533, Phone No. (215) 897-7705.

8. Security Requirements

Performance of this contract will not require access to classified materials/spaces.

ATTACHMENT 1 TO SOW

System Specification #1

- a. The sensor must be fabricated completely from glass with no other materials, unless Contractor can demonstrate proposed material(s) outperform glass with respect to prevention of environmental degradation, thermal instability, viscoelastic creep and micro-cracking under cyclic pressure loading.
- b. No epoxy, high temperature ceramic adhesive or metal alloys shall be used in the assembly process, unless Contractor can demonstrate that incorporation of these elements will not pose a higher risk of environmental degradation, thermal instability, viscoelastic creep, and micro-cracking under cyclic pressure loading than would result from using only glass.
- c. Micro-Electro-Mechanical Systems (MEMS) technology shall be used to create the monolithic sensor design.
- d. The pressure range of the sensor shall be from 250 psi to 3000 psi, with sensor resolution and accuracy better than 0.1 percent of full scale.
- e. The sensor pressure operating range must be freely adjustable during sensor fabrication.
- f. The sensor system must withstand vibration testing in accordance with MIL-STD-167.
- g. The readout system must be based on a self-calibrated interferometric -intensity-based (SCIIB) Fabry-Perot demodulation system.
- h. The self-calibrating signal demodulation system must combine the advantages of both intensity- and interferometric- based Fabry-Perot interferometer sensing schemes.
- i. The system should maintain the Q-point at the optimal setting even in the event of out-of-tolerance sensor fabrication.
- j. The system should use active feedback from the signal channel to implement servo control of optical filter's central passband.