Performance Work Statement (PWS)

R&D Services for Chemical/Materials R&D and Sensors/Systems Development

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Performance Work Statement (PWS)

R&D Services for Chemical/Materials R&D and Sensors/Systems Development

Vision Statement

Advancement of the frontiers of synthetic chemistry and materials science through research and development, development of definitive solutions to Navy needs in areas of critical material deficiencies, and the transition of that work to the field.

1 Introduction

The Naval Research Laboratory (NRL) anticipates negotiation of a competitive, level of effort contract for research and development (R&D) in chemistry/materials and sensors/systems. NRL seeks technical support for in-house R&D work and the transition of that work to the field. The high-level objectives are to perform basic and applied research and development; to characterize materials; to design, synthesize, process, test, and characterize materials; and to design, fabricate, and test sensors and systems in the laboratory and field.

1.1 Mission

The US Naval Research Laboratory's Chemistry Division conducts basic research, applied research, and development studies in the broad fields of diagnostics, dynamics, synthesis, materials, surface/interfaces, environment, combustion, and fuels. Specialized programs currently within these fields include the synthesis and characterization of organic and inorganic materials, coatings, composites; nondestructive evaluation; surface/interface modification and characterization; nanometer structure science/technology; chemical vapor processing, tribology, solution, and electrochemistry; mechanisms and kinetics of chemical processes; analytical chemistry; theoretical chemistry; decoy materials; radar-absorbing materials/radar-absorbing structures (RAM/RAS) technology; chemical/biological warfare defense; atmosphere analysis and control; environmental remediation and protection; personnel protection; and safety and survivability.

In areas relevant to this contract, the Division has a mission to advance the frontiers of synthetic chemistry and materials science and to provide definitive solutions to Navy needs in areas of critical material deficiencies. In addition, the Division provides direct support of current/future fleet concerns and provides long-term engineering solutions and evaluation of materials for improved performance, cost savings, and life-cycle management. Support includes expertise in areas of seawater cathodic protection design, biofouling mitigation/antifouling coatings, marine coating development/qualification/evaluation, and material exposure testing/evaluation/certification. This work is applied to both (1) short-range Navy problems—

environmental issues of both Department of Defense (DoD) and national concern—and the (2) long-range development of scientific expertise and knowledge relevant to future Navy and DoD missions.

1.2 Background

The NRL is responsible for a wide range of research efforts that involve both basic and applied research in the physical, chemical, and biological sciences, as well as in chemical materials and engineering. Recent efforts also include a number of multidisciplinary research programs in chemical/biological sensing and nanoscience/nanotechnology. An increasing number of research initiatives within the Navy and DoD have program elements that require the successful integration of numerous technologies. Accordingly, the Navy seeks to use an interdisciplinary approach to developing state-of-the-art analytical diagnostic techniques and instrumentation and the characterization of the hardware and materials associated with their use. These studies include the application and development of computational modeling tools for analytical analysis and predictive tools for chemically and/or biologically derived materials and engineering studies. Environmental issues also form a large component of NRL R&D efforts. Active areas include the development of environmental monitoring methodologies and instrumentation, site characterization, and advanced technology demonstrations. The surface science research tasks have environmentally related components, i.e., applications to marine surface corrosion, development of fuel cell component concepts, and biological sensors for screening microbiological contamination of environmental materials and for defending against biological warfare agents.

1.3 Scope

These research efforts require the expertise of skilled, highly technically qualified contractor scientists and engineers with high technical qualifications to carry out the work. The range of skills required include analytical diagnostics in chemistry and biology; molecular biology and immunological methods; surface chemistry and the characterization of surface phenomena; development of materials for device applications; physics and materials engineering; optical spectroscopies; detailed knowledge of energetic materials, explosives and propellant chemistry; modern computational graphics and modeling; information technology; electronics and instrumentation prototyping; and software development capabilities. Persons are required with the following skills: biochemistry, biophysics, molecular and cell biology, analytical and physical chemistry, surface chemistry and physics, materials science and engineering, nanoscience and nanotechnology, computer science and information technology, and sensor technology.

The R&D requirements include tasks that vary considerably in their scope and in the complexity of the deliverable products. However, the tasks are interrelated in that they support the central mission of the NRL and will significantly benefit from coordination with each other.

The contractor/contractors will provide on a level-of-effort basis, an estimated total of 177,000 person-hours of scientific, technical, and engineering work (including any consultants and subcontractors). Specific categories of personnel to perform work will consist of those direct labor classifications proposed by the contractor that are included in the resulting contract. The

required personnel qualifications and level of clearances to perform individual tasks are defined with each task description.

2 General Requirements

This section describes the general requirements for this effort. The following subsections provide details of various considerations on this effort.

The place of performance of work will be at NRL and at various contractor, subcontractor, and Government facilities (mainly in the continental United States).

The contractor shall comply with the attached Requirements for On-Site Contractors dated 08 December 2008, Exhibit C.

The period of performance of this contract will be one year from the date the contract is awarded, with two one-year options.

2.1 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 1 July 2012.

The contractor shall notify the contracting officer if any Government requested actions constitute or are perceived to constitute personal services.

2.2 Business Relations

The contractor shall successfully integrate and coordinate all activity needed to execute the requirement.

The contractor shall manage the timeliness, completeness, and quality of problem identification.

The contractor shall provide corrective action plans, proposal submittals, timely identification of issues, and effective management of subcontractors.

The contractor shall seek to ensure customer satisfaction and professional and ethical behavior of all contractor personnel.

2.3 Contract Administration and Management

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

2.3.1 Contract Management

The contractor shall establish clear organizational lines of authority and responsibility to ensure effective management of the resources assigned to the requirement.

The contractor shall maintain continuity between the support operations at NRL and the contractor's corporate offices.

2.3.2 Contract Administration

The contractor shall establish processes and assign appropriate resources to effectively administer the requirement.

The contractor shall respond to Government requests for contractual actions in a timely fashion.

The contractor shall have a single point of contact between the Government and contractor personnel assigned to support contracts and/or task orders.

The contractor shall assign work effort and maintaining proper and accurate time keeping records of personnel assigned to work on the requirement.

2.3.3 Personnel Administration

The contractor shall provide the following management and support as required:

● The contractor shall provide for employees during designated Government non-work days or other periods where Government offices are closed due to weather or security conditions.

● The contractor shall maintain the currency of their employees by providing initial and refresher training as required to meet the PWS requirements.

● The contractor shall make necessary travel arrangements for employees.

● The contractor shall provide necessary infrastructure to support contract tasks at NRL or during technology demonstrations in the field.

● The contractor shall provide administrative support to employees in a timely fashion (e.g., time keeping, leave processing, pay, emergency needs).

2.4 Subcontract Management

The contractor shall be responsible for any subcontract management necessary to integrate work performed on this requirement.

The contractor shall be responsible and accountable for subcontractor performance on this requirement.

The prime contractor will manage work distribution to ensure there are no organizational conflict of interest (OCI) considerations. Contractors may add subcontractors to their team after notification to and approval by the contracting officer or the contracting officer's representative (COR). The Government reserves the right to permit or not permit cross teaming.

2.5 Contractor Personnel, Disciplines, and Specialties

The contractor shall accomplish the assigned work by employing and using qualified personnel with appropriate combinations of education, training, and experience.

The contractor shall match personnel skills to the work or task.

The contractor shall ensure the labor categories as defined in the labor categories document (see Attachment 2), labor rates, and person-hours used in the performance of each PWS line item issued hereunder will be the minimum necessary to accomplish the task.

The contractor shall provide the necessary resources and infrastructure to manage, perform, and administer the contract.

Given the technical nature and varied scope of the contract, the contract provides provisions for program management.

2.6 Location and Hours of Work

Accomplishment of the results contained in this PWS requires work at NRL-DC and at various contractor, subcontractor, and Government facilities (mainly in the continental United States). Normal workdays are Monday through Friday except US federal holidays. Workers typically work eight (8) hours per day, 40 hours per week. Flextime workers start not earlier than 0530, but not later than 1000, and finish no later than 2000. Core hours of work are from 1000 to 1100 and 1300 to 1400 daily. All employees are expected to be available during core hours. In the advent of severe weather conditions, the contractor should refer to the top banner of the NRL website (www.nrl.navy.mil) for the NRL-DC operating status or refer to the Office of Personnel Management website (www.opm.gov) for the operating status of the U.S. Government offices in Washington, DC, area and for additional information. In the event that the government facility where the contractor normally works is closed, the contractor should not report to work until the facility reopens.

2.7 Travel / Temporary Duty (TDY)

Travel to other government facilities or other contractor facilities may be required during the period of performance of this contract.

The contractor shall submit all travel requirements (including plans, agenda, itinerary, and dates) for preapproval 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 and procedures).

3 Task Performance Requirements

The following section specifies the performance objectives and performance elements for the contract.

3.1 Conduct Basic and Applied Research and Development.

3.1.1 The contractor shall conduct basic and applied research and development in chemistry, materials, sensors, and systems.

Performance Standards

a) STD: Publication of applicable books, journal articles, or conference papers

AQL: High-quality, publishable research results

b) STD: Timely

AQL: 90% of schedule objectives met

c) STD: Cost effective

AQL: 95% of cost objectives met

Deliverables

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3.1.2 The contractor shall conduct experimental and theoretical studies in controlled combustion, deflagration, and detonation processes.

The NRL is responsible for conducting both basic and applied research focusing on the development and application of new materials and devices for DoD applications. NRL has for many years been involved in basic and applied research in combustion and detonation of explosives, fuels, propellants, pyrophorics, and energetic materials.

Performance Standards
a) STD: Publication of applicable books, journal articles, or conference papers

AQL: High-quality, publishable research results

b) STD: Timely

AQL: 90% of schedule objectives met

c) STD: Cost effective

AQL: 95% of cost objectives met

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3.1.3 The contractor shall perform fundamental research on non-energetic materials.

Fundamental research includes performance of experiments to study chemical/materials synthesis of new bulk and thin film materials, studies of electron, ion and proton beam modification of materials, characterization of defects in films and materials, and establishment of materials composition/structure/property relationships.

Performance Standards
a) STD: Publication of applicable books, journal articles, or conference papers

AQL: High-quality, publishable research results

b) STD: Timely

AQL: 90% of schedule objectives met

c) STD: Cost effective

AQL: 95% of cost objectives met

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3.1.4 The contractor shall conduct basic and applied research centering on design, synthesis, and validation of nanostructured materials for energy generation, storage, and conversion (batteries, capacitors, fuel cells) and filtration of vapor-phase toxins.

This work involves application of analytical methods (voltammetry, potentiometry, amperometry, impedance), solgel synthesis, scanning electron microscopy, UV-vis spectroscopy, N_2-sorption porosimetry, chemisorption, thermal analysis, electroless and electrochemical deposition, and carbonization of polymeric solids to synthesize/fabricate materials of interest. Electrochemical methods are used to assess activity, energetics, and stability for charge–storage and electrocatalytic turnover. Specific projects include the development and testing of electrochemical capacitors and metalair batteries (e.g., zincair) using in-house-synthesized and commercial materials and the development of nanostructured carbons and metal oxides as high-capacity sorbents and catalysts for abatement of vapor-phase threat agents.

<u>Performance Standards</u>

a) STD: Publication of applicable books, journal articles, or conference papers

AQL: High quality, publishable research results

b) STD: Timely

AQL: 90% of schedule objectives met

c) STD: Cost effective

AQL: 95% of cost objectives met

<u>Deliverables</u>

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3.1.5 The contractor shall perform research on fuels chemistry.

As a member of the Navy Fuels & Lubes Cross-Functional Team (NF&LCFT), NRL researchers conduct basic and applied research and provide science and technology support for a wide range of Navy fleet fuel issues. This includes basic and applied research in the reaction

mechanisms of fuels; metal catalyzed autoxidation mechanisms; high-energy fuel additives; fuel microbiological contamination; additive detection; biofuel characterization; synthetic fuel feed stocks from the sea; sensors and modeling technologies; lubricity of alternative fuels and blends with petroleum fuels; long-term materials compatibility/durability; applicability of current test specifications for synthetic fuels and blends; impact of metal contamination (copper, synthesis catalyst carryover); new additive technologies for alternative fuels; design and evaluation of chemical systems for hydrogenation of CO and CO_2 to hydrocarbons; and thermochemical processes to produce hydrogen using different solvent media. NRL is actively pursuing research that will lead to the development of new and basic understanding of chemical reactions and data analysis methods as applied to fuel properties and stability. Research thrusts encompass chemical sensing, mobility fuel utilization, and synthesis.

Performance Standards

a) STD: Publication of applicable books, journal articles, or conference papers

AQL: High-quality, publishable research results

b) STD: Timely

AQL: 90% of schedule objectives met

c) STD: Cost effective

AQL: 95% of cost objectives met

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3.1.6 The contractor shall research alternative fuels, efficient energy and power conversion, energy storage, and portable power.

NRL conducts highly innovative, interdisciplinary research and development in the field of energy sciences with emphasis on providing alternative energy solutions for a variety of naval platforms and missions that include a highly expeditionary, mobile fighting force. Our research programs provide the Navy and DoD with scientific leadership in this critical area and identifies opportunities for advances in future defense energy technology.

Performance Standards
a) STD: Publication of applicable books, journal articles, or conference papers

AQL: High-quality, publishable research results

b) STD: Timely

AQL: 90% of schedule objectives met

c) STD: Cost effective

AQL: 95% of cost objectives met

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3.1.7 The contractor shall perform research on physical, electrochemical, and environmental behavior of materials in a marine environment.

A complete range of research activities, from basic mechanistic studies through equipment prototyping, is performed. Extensive research is conducted in areas of cathodic protection design, materials performance evaluation, high-performance fasteners, sensor development, coating performance testing, biofouling/biological control/remediation, aquatic nuisance species, and many related R&D tasks focused towards twenty-first-century ship/submarine design engineering.

Performance Standards
a) STD: Annual publication of an applicable book, journal article, or conference paper

AQL: High-quality, publishable research results

b) STD: Timely

AQL: 90% of schedule objectives met

c) STD: Cost effective

AQL: 95% of cost objectives met

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3.2 Characterize material.

3.2.1 The contractor shall characterize electronic and geometric structure, mass, reactivity, molecular weight, or optical/electronic properties for materials.

Performance Standards
a) STD: Materials Characterized

AQL: 90% of prescribed characteristics fully determined and documented

b) STD: Timely

AQL: 90% of schedule objectives met

c) STD: Cost effective

AQL: 95% of cost objectives met

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3.2.2 The contractor shall use characterization tools for materials surface analysis, growth, and micro/nanofabrication.

NRL employs a variety of characterization tools including gas chromatography (GC), high-performance liquid chromatography (HPLC), gas chromatography/mass spectrometry (GC/MS), two-dimensional gas chromatography/mass spectrometry (GCxGC/MS), liquid chromatography/mass spectrometry/mass spectrometry (LC/MS/MS), polymerase chain reaction (PCR), reverse transcription polymerase chain reaction (RT-PCR), enzyme-linked immuno-sorbent assay (ELISA), calorimetry, electroanalytical methods (voltammetry, potentiometer, amperometry, impedance), X-ray photoelectron spectroscopy, Auger electron spectroscopy, and secondary ion mass spectrometry, various optical and electron microscopes, UV-vis spectroscopy, N_2-sorption porosimetry, chemisorption and thermal analysis, scanning

probe microscopy, micro/nanofabrication and lithography equipment, micro/nanofluidics systems, mechanical test equipment, etching and deposition equipment, and other equipment.

Performance Standards

a) STD: Materials Characterized

AQL: 90% of prescribed characteristics fully determined and documented

b) STD: Timely

AQL: 90% of schedule objectives met

c) STD: Cost effective

AQL: 95% of cost objectives met

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3.2.3 The contractor shall conduct studies of fundamentally new approaches for characterization and analysis of material structures and surfaces.

Often this involves new particle scattering geometries, new detection schemes, new electronics advances for improved energy, spatial and temporal resolution, new compact instrument designs, and enhancements in detection sensitivity and selectivity.

Performance Standards

a) STD: Materials Characterized

AQL: 90% of prescribed characteristics fully determined and documented

b) STD: Timely

AQL: 90% of schedule objectives met

c) STD: Cost effective

AQL: 95% of cost objectives met

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3.2.4 The contractor shall characterize materials for DoD applications.

These materials may include pyrotechnic materials, fuels, propellants, explosives, metals, organics, polymers, biomaterials, inorganics, ceramics, ionic liquids, superconductors, semiconductors, nanoparticles, nanomaterials, and other functional materials for a variety of DoD applications including energetic materials, catalysts, batteries, capacitors, fuel cells, and other energy generation/storage/conversion devices, electronic and optical materials, sensors, coatings, composites, armor, and structural materials.

Performance Standards
a) STD: Materials Characterized

AQL: 90% of prescribed characteristics fully determined and documented

b) STD: Timely

AQL: 90% of schedule objectives met

c) STD: Cost effective

AQL: 95% of cost objectives met

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3.2.5 The contractor shall characterize nonlithographic functional patterns comprised of metal, dielectrics, polymers, and/or biomolecules.

Performance Standards
a) STD: Materials Characterized

AQL: 90% of prescribed characteristics fully determined and documented

b) STD: Timely

AQL: 90% of schedule objectives met

c) STD: Cost effective

AQL: 95% of cost objectives met

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3.3 Design, synthesize, process, and test materials.

3.3.1 The contractor shall design, synthesize, and test materials for DoD applications.

These materials may include pyrotechnic materials, fuels, propellants, explosives, metals, organics, polymers, biomaterials, inorganics, ceramics, ionic liquids, superconductors, semiconductors, nanoparticles, nanomaterials, and other functional materials for a variety of DoD applications including energetic materials, catalysts, batteries, capacitors, fuel cells, and other energy generation/storage/conversion devices, electronic and optical materials, sensors, coatings, composites, armor, and structural materials.

Performance Standards
a) STD: Novel materials developed

AQL: Development sufficient for transition to the next prescribed state (i.e., funding category, test environment, or product development phase)

b) STD: Timely

AQL: 90% of schedule objectives met

c) STD: Cost effective

AQL: 95% of cost objectives met

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3.3.2 The contractor shall conduct research of nonlithographic techniques to fabricate 2-D and 3-D structures comprised of metal, dielectrics, polymers, and/or biomolecules for use in micro/nanoelectronic systems.

NRL is actively pursuing fundamental and applied research in new materials and methods for the micro/nanofabrication of structures and devices not feasible through present lithographic techniques. Application areas where nonlithographic processes will play a key role include tissue engineering, flexible electronics, embedded power sources, conformal antennas, radio-frequency transponders, development of materials and novel geometries for low observable treatments, and rapid prototyping of embedded micro/nanoelectronics for distributed autonomous systems.

Performance Standards
a) STD: Novel materials developed

AQL: Development sufficient for transition to the next prescribed state (i.e., funding category, test environment, or product development phase)

b) STD: Timely

AQL: 90% of schedule objectives met

c) STD: Cost effective

AQL: 95% of cost objectives met

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3.3.2.1 The contractor shall build proof of concept micro/nanoelectronic components and devices using nonlithographic techniques assessed in preceding paragraph.

Performance Standards
a) STD: Novel materials developed

AQL: Development sufficient for transition to the next prescribed state (i.e., funding category, test environment, or product development phase)

b) STD: Timely

AQL: 90% of schedule objectives met

c) STD: Cost effective

AQL: 95% of cost objectives met

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3.3.2.2 The contractor shall test and evaluate novel nonlithographic processing approaches to digital micro/nanofabrication of micro/nanoelectronic devices and systems.

Performance Standards
a) STD: Novel materials developed

AQL: Development sufficient for transition to the next prescribed state (i.e., funding category, test environment, or product development phase)

b) STD: Timely

AQL: 90% of schedule objectives met

c) STD: Cost effective

AQL: 95% of cost objectives met

d) STD: Test or evaluation report completed

AQL: Fully documents technical results of test or evaluation

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3.3.2.3 The contractor shall develop new materials for fabrication of 2-D and 3-D micro/nanostructures with unique properties and behavior.

Performance Standards
a) STD: Novel materials developed

AQL: Development sufficient for transition to the next prescribed state (i.e., funding category, test environment, or product development phase)

b) STD: Timely

AQL: 90% of schedule objectives met

c) STD: Cost effective

AQL: 95% of cost objectives met

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3.3.2.4 The contractor shall develop novel methods for fabrication of 2-D and 3-D micro/nanostructures.

Performance Standards
a) STD: Novel materials developed

AQL: Development sufficient for transition to the next prescribed state (i.e., funding category, test environment, or product development phase)

b) STD: Timely

AQL: 90% of schedule objectives met

c) STD: Cost effective

AQL: 95% of cost objectives met

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3.3.3 The contractor shall develop and test new fuels suitable for use by the US Navy's ships and aircraft.

Activities include defining fit for purpose criteria for synthetic fuels; combustion characterization and model development; fuel identification and shipboard quality surveillance; fuel storage and thermal stability assessment; design, test, and evaluate technologies to extract carbon dioxide from seawater; formulation of novel chemometric algorithms to enable sensing technologies to perform automated fuel quality diagnostics and prognostics; and development of novel analytical methods for alternative fuel certification. Projects include hazardous chemical detection; intelligent data fusion; alternative fuel certification, utilization analytics and synthesis; and chemometrics applied to sensor systems and trace analytical methods.

Performance Standards
a) STD: Novel materials developed

AQL: Development sufficient for transition to the next prescribed state (i.e., funding category, test environment, or product development phase)

b) STD: Timely

AQL: 90% of schedule objectives met

c) STD: Cost effective

AQL: 95% of cost objectives met

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3.3.3.1 The contractor shall conduct tests to determine the properties and stability of traditional Navy mobility fuels.

Performance Standards
a) STD: Novel materials developed

AQL: Development sufficient for transition to the next prescribed state (i.e., funding category, test environment, or product development phase)

b) STD: Timely

AQL: 90% of schedule objectives met

c) STD: Cost effective

AQL: 95% of cost objectives met

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3.3.3.2 The contractor shall develop, test, and certify fuels produced from nonpetroleum sources.

Performance Standards
a) STD: Novel materials developed

AQL: Development sufficient for transition to the next prescribed state (i.e., funding category, test environment, or product development phase)

b) STD: Timely

AQL: 90% of schedule objectives met

c) STD: Cost effective

AQL: 95% of cost objectives met

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3.3.4 The contractor shall provide research and engineering support to develop and field test materials to control anti-fouling, adhesion, friction, wear, and corrosion.

The Navy is working to improve the performance service life, affordability, maintainability, survivability, and safety of a wide variety of materials/systems while reducing life-cycle costs and manning requirements of naval platforms.

Performance Standards
a) STD: Novel materials developed

AQL: Development sufficient for transition to the next prescribed state (i.e., funding category, test environment, or product development phase)

b) STD: Timely

AQL: 90% of schedule objectives met

c) STD: Cost effective

AQL: 95% of cost objectives met

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3.4 Design, fabricate, and test sensors and systems in the laboratory and/or field.

3.4.1 The contractor shall design, fabricate and test chemical and biological sensors and systems (hardware and software) to detect, identify, and quantify single-component and/or mixtures of analytes in gas, liquid, or solid forms as applied to the detection of drugs of abuse, explosives, pollutants, and other environmental contaminants, pathogenic organisms, chemical/biological warfare agents, and other analytes.

These emerging technology investigations encompass a diverse technical spectrum within the physical, chemical, biological, and environmental arenas. Accordingly, specialized research and development support to evaluate emerging technologies in areas that include micro/molecular/cell biology; molecular recognition and identification; chemical and biological sensors; and biomedical devices. The object of the sensor studies is primarily the detection, identification, and quantification of trace chemical and biological species. Chemically based sensors include technologies based on chemical or electrochemical reactions that produce heat, light, or new products that can be detected by physical, chemical, optical, electrical, or electromagnetic means. Biological-based sensors and assays include technologies based on biomolecular recognition—such as antibodies, deoxyribonucleic acid and peptide nucleic acid probes, enzymes, aptamers, cells, and other biomolecules—that can be incorporated as the recognition element.

Performance Standards
a) STD: New sensors and systems developed

AQL: Development sufficient for transition to the next prescribed state (i.e., funding category, test environment, or product development phase)

b) STD: Timely

AQL: 90% of schedule objectives met

c) STD: Cost effective

AQL: 95% of cost objectives met

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3.4.1.1 The contractor shall support the development of simulants and training aids based on chemical and biological sensors and systems.

Performance Standards
a) STD: New sensors and systems developed

AQL: Development sufficient for transition to the next prescribed state (i.e., funding category, test environment, or product development phase)

b) STD: Timely

AQL: 90% of schedule objectives met

c) STD: Cost effective

AQL: 95% of cost objectives met

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3.4.1.2 The contractor shall miniaturize analytical and bioanalytical tools to meet Navy requirements.

Performance Standards
a) STD: New sensors and systems developed

AQL: Development sufficient for transition to the next prescribed state (i.e., funding category, test environment, or product development phase)

b) STD: Timely

AQL: 90% of schedule objectives met

c) STD: Cost effective

AQL: 95% of cost objectives met

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3.4.2 The contractor shall support scientific computing activities.

NRL has a long history of supporting third-party sensor development as well as in forming and leading teams to assemble and evaluate multisensor detection devices. Specific examples include the multicriteria fire detector developed under the Navy Future Naval Capabilities (FNC) Damage Control Automation for Reduced Manning (DC-ARM) program and the Volume Sensor component of the FNC Advanced Damage Countermeasures (ADC) program. Each of these programs involved (1) selecting component sensors from commercial-off-the-shelf technology,

(2) evaluating individual sensor algorithms and working with subject matter experts to develop new algorithms as necessary, (3) development of a data fusion strategy and system architecture, (4) production of a hardware prototype, and (5) full-scale testing in several damage control scenarios. The prototype systems developed in each program were shown to successfully enhance autonomous detection of fire and damage control events by simultaneously decreasing the false alarm rate and increasing the event detection rate. NRL is currently working with industrial partners to transition this technology to commercial products. In other programs, NRL has worked with industrial partners to validate the performance of novel sensors and to develop new sensor algorithms.

Performance Standards
a) STD: New sensors and systems developed

AQL: Development sufficient for transition to the next prescribed state (i.e., funding category, test environment, or product development phase)

b) STD: Timely

AQL: 90% of schedule objectives met

c) STD: Cost effective

AQL: 95% of cost objectives met

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3.4.2.1 The contractor shall support scientific computing activities associated with data acquisition, measurements, data processing, and graphics.

Performance Standards
a) STD: New sensors and systems developed

AQL: Development sufficient for transition to the next prescribed state (i.e., funding category, test environment, or product development phase)

b) STD: Timely

AQL: 90% of schedule objectives met

c) STD: Cost effective

AQL: 95% of cost objectives met

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3.4.2.2 The contractor shall support scientific computing activities associated with instrument control, networking, and communications.

Performance Standards
a) STD: New sensors and systems developed

AQL: Development sufficient for transition to the next prescribed state (i.e., funding category, test environment, or product development phase)

b) STD: Timely

AQL: 90% of schedule objectives met

c) STD: Cost effective

AQL: 95% of cost objectives met

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3.4.2.3 The contractor shall support scientific computing activities associated with data fusion, multivariate analysis, and modeling and simulation.

Performance Standards
a) STD: New sensors and systems developed

AQL: Development sufficient for transition to the next prescribed state (i.e., funding category, test environment, or product development phase)

b) STD: Timely

AQL: 90% of schedule objectives met

c) STD: Cost effective

AQL: 95% of cost objectives met

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3.4.2.3.1 The contractor shall apply artificial intelligence techniques to data interpretation problems associated with hazardous material detection and improved situational awareness.

NRL is actively pursuing research to provide future ships with advanced systems for fire safety through autonomy including improved situational awareness, novel sensors, and robotics to enable a revolutionary approach to shipboard recoverability action.

Performance Standards
a) STD: New sensors and systems developed

AQL: Development sufficient for transition to the next prescribed state (i.e., funding category, test environment, or product development phase)

b) STD: Timely

AQL: 90% of schedule objectives met

c) STD: Cost effective

AQL: 95% of cost objectives met

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3.4.2.3.2 The contractor shall analyze sensor array data using multivariate mathematical and statistical methods, such as pattern recognition algorithms, neural networks, and machine vision.

Novel data fusion methods are being used to convert data into information that can be more effectively used for the detection of trace chemicals(such as explosives), the characterization of complex mixtures (such as fuels), and the acquisition of situational awareness (such as recognition of shipboard damage control events). For example, NRLs Volume Sensor is a real-time, multisensory detection system that provides early warning detection of flames, smoke, thermally hot objects, pipe ruptures, and gas leaks through improved shipboard situational awareness.

Performance Standards

a) STD: New sensors and systems developed

AQL: Development sufficient for transition to the next prescribed state (i.e., funding category, test environment, or product development phase)

b) STD: Timely

AQL: 90% of schedule objectives met

c) STD: Cost effective

AQL: 95% of cost objectives met

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3.4.2.3.3 The contractor shall develop methods for fusion of disparate data sources.

For example, a multisensory, fused-data system is under development for explosives detection. Current work is aimed at elucidating performance metrics for fused-data chemical detection and identification systems. This effort is essentially focused on the role data fusion plays in enhancing chemical selectivity in chemical detection technologies. The end result of this program will be an algorithmic capability to accurately model performance of theoretical fused data systems, incorporating information about data quality and specific sensing contexts with the inherent information contained within a given detection method. The goal will be to give the end user a systematic knowledge of the tradeoffs inherent between analytical performance and instrument choice for a given chemical sensing task, and thus direct formulation of new fused-data systems.

Performance Standards
a) STD: New sensors and systems developed

AQL: Development sufficient for transition to the next prescribed state (i.e., funding category, test environment, or product development phase)

b) STD: Timely

AQL: 90% of schedule objectives met

c) STD: Cost effective

AQL: 95% of cost objectives met

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3.4.3 The contractor shall provide research and engineering support to assist in the transition of sensors to autonomous systems.

NRL has many ongoing research and development programs for physical, chemical, and biological sensors. For these sensors to evolve from component technologies to fielded systems, the research groups must become vertically integrated or develop teaming relationships with other researchers including industrial partners.

Performance Standards
a) STD: New sensors and systems developed

AQL: Development sufficient for transition to the next prescribed state (i.e., funding category, test environment, or product development phase)

b) STD: Timely

AQL: 90% of schedule objectives met

c) STD: Cost effective

AQL: 95% of cost objectives met

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3.4.4 The contractor shall provide research and engineering support to assist in the transition of power and energy systems to autonomous systems.

Performance Standards
a) STD: New sensors and systems developed

AQL: Development sufficient for transition to the next prescribed state (i.e., funding category, test environment, or product development phase)

b) STD: Timely

AQL: 90% of schedule objectives met

c) STD: Cost effective

AQL: 95% of cost objectives met

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3.4.4.1 The contractor shall integrate the research results of two separate research efforts—unmanned vehicles (air, ground, and underwater) and fuel cell systems.

This will significantly improve battlefield surveillance and communications capabilities. Across the board, the military is seeking quieter and more efficient sources of energy. Fuel cell research is being conducted for an operational spectrum of technologies including ground, air, and undersea vehicles and man-portable power for Marine expeditionary missions. Small unmanned vehicles are growing in importance for naval missions, as they provide capabilities ranging from surveillance collection to communication links. Electric unmanned aerial vehicles have the additional feature of being nearly undetectable from the ground.

Performance Standards
a) STD: New sensors and systems developed

AQL: Development sufficient for transition to the next prescribed state (i.e., funding category, test environment, or product development phase)

b) STD: Timely

AQL: 90% of schedule objectives met

c) STD: Cost effective

AQL: 95% of cost objectives met

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3.4.4.2 The contractor shall develop methods for the precise placement and control of sensors to enable real-time situational awareness and support the battlespace management needs of Navy autonomous systems.

NRL's research activities to create fully autonomous systems expanded with the 2012 opening of its new Laboratory for Autonomous Systems Research, which provides specialized facilities to support highly innovative, multidisciplinary research in autonomous systems, including intelligent autonomy, sensor systems, power and energy systems, human-system interaction, networking and communications, and platforms. The Laboratory capitalizes on the broad multidisciplinary character of NRL, bringing together scientists and engineers with disparate training and backgrounds to attack common goals in autonomous systems at the intersection of their respective fields. The Laboratory provides unique facilities and simulated environments (e.g., littoral, desert, tropical) and instrumented reconfigurable high-bay spaces to support integration of science and technology components into research prototype systems.

Performance Standards
a) STD: New sensors and systems developed

AQL: Development sufficient for transition to the next prescribed state (i.e., funding category, test environment, or product development phase)

b) STD: Timely

AQL: 90% of schedule objectives met

c) STD: Cost effective

AQL: 95% of cost objectives met

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3.4.5 The contractor shall design, fabricate, and test physical sensors and systems (hardware and software) to detect buried ordnance from vehicular, man-portable, airborne, and/or marine platforms.

NRL's Multi-sensor Towed Array Detection System (MTADS) has been exploring issues of detection and classification of unexploded ordnance (UXO) and clutter for over a decade. NRL has recently constructed a new time-domain electromagnetic induction (EMI) sensor that has formed the core of three systems. Each is operated as part of a two-step process, where the system is used for cued investigation of previously identified anomalies. Target features are estimated from the data using a standard point-dipole EMI response model. The data processing methodology allows for the mitigation of overlapping target signatures.

Performance Standards
a) STD: New sensors and systems developed

AQL: Development sufficient for transition to the next prescribed state (i.e., funding category, test environment, or product development phase)

b) STD: Timely

AQL: 90% of schedule objectives met

c) STD: Cost effective

AQL: 95% of cost objectives met

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3.4.5.1 The contractor shall support laboratory and field operations to evaluate buried ordnance sensor systems.

Performance Standards
a) STD: New sensors and systems developed

AQL: Development sufficient for transition to the next prescribed state (i.e., funding category, test environment, or product development phase)

b) STD: Timely

AQL: 90% of schedule objectives met

c) STD: Cost effective

AQL: 95% of cost objectives met

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3.4.5.2 The contractor shall provide accurate and efficient data acquisition, preprocessing, and target analysis using prototype systems.

Performance Standards
a) STD: New sensors and systems developed

AQL: Development sufficient for transition to the next prescribed state (i.e., funding category, test environment, or product development phase)

b) STD: Timely

AQL: 90% of schedule objectives met

c) STD: Cost effective

AQL: 95% of cost objectives met

Deliverables
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3.4.5.3 The contractor shall process and analyze data in the field in support of target selection, reacquisition, and remediation.

The MTADS systems typically are involved in three to five field demonstration activities each year in association with ongoing Environmental Security Technology Certification Program (ESTCP), Strategic Environmental Research and Development Program (SERDP), and other DoD-sponsored programs. Often, unique activities form an integral part of the demonstrations requiring adaptations of the software and analysis approaches in response to particular challenges.

Performance Standards
a) STD: New sensors and systems developed

AQL: Development sufficient for transition to the next prescribed state (i.e., funding category, test environment, or product development phase)

b) STD: Timely

AQL: 90% of schedule objectives met

c) STD: Cost effective

AQL: 95% of cost objectives met

Deliverables
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3.4.5.4 The contractor shall provide surge UXO/ Hazardous Waste Operations and Emergency Response (HAZWOPR) field personnel and UXO remediation support as required to validate system performance.

Performance Standards
a) STD: New sensors and systems developed

AQL: Development sufficient for transition to the next prescribed state (i.e., funding category, test environment, or product development phase)

b) STD: Timely

AQL: 90% of schedule objectives met

c) STD: Cost effective

AQL: 95% of cost objectives met

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4 Special Requirements

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

4.1 Security and Safety

DD Form 254: Overarching security requirements and contractor access to classified information are specified in the DD Form 254, Exhibit D.

The contractor shall ensure all personnel with access to unclassified information systems, including e-mail have at a minimum a favorable national agency check (NAC).

``This effort may require contractor personnel to have access to military installations and specifically to classified ranges and operations, as well as classified information pertaining to specific materials and/or ordnance.

The contractor shall provide personnel with an active SECRET clearance when it is required by the task.

4.2 Transition

The contractor shall submit a draft transition plan as part of the proposal and a transition plan within 30 days of contract award.

As applicable, this plan should describe the contractor's transition in to service at the beginning of the contract and how work would be transitioned to a different contractor or contract vehicle at the end of the contract. It should include a staffing and training plan for new personnel. The contractor should plan for the transfer of work control and information, addressing any security issues, the transfer and accountability of government-furnished equipment, inspections and acceptance, and delineating the method for processing and assigning tasks during the phase-in/phase-out periods. The plan should address how the contractor will implement adequate

measures to coordinate communications with the incumbent contractor and NRL staff in order to ensure uninterrupted workflow and minimal mission impact during the transition process.

The contractor shall follow the transition plan and keep the Government fully informed of status throughout the transition period.

4.3 Government Furnished Equipment

The Government will make available the materials, office space, communications capability, and information for use by the contractor in the performance of this contract at Government facilities. It is anticipated that Government property will be used by the contractor in the performance of that portion of the contract performed on site at NRL, at the contractor's facilities, or at NRL field sites, or designated demonstration sites. Such use will be on a rent-free basis and all such property shall be considered to remain in the possession and control of the NRL for property responsibility and accountability purposes.

4.4 Environmental Requirements

Reserved

4.5 Applicable Directives

Reserved

5 Deliverables

Deliverables are specified with format instructions and delivery schedule in the DD 1423, Exhibit A.

Identifier	Name	Description
A001	Monthly Progress and Funds Status Report	Indicates the progress of the contractor's work and the status of the program and of the assigned tasks, reports costs, and informs of existing or potential problem areas per format of DI-MGMT-80227 Contractor's Progress, Status and Management Report.
A002	Studies Final Report	Provides fully documented results of studies or analysis performed per format of DI-MISC-80508B Technical

		Report-Study/Services
A003	Contract Summary Technical Report	Provides report of all technical work accomplished during the period of performance per format of DI-MGMT-80447A Contract Summary Report
A004	Oral briefings and other interim progress reports as required	

6 Related Documents

The following documents are related to this project:

● NRL Requirements for On-site Contractors dated 08 December 2012—Provides basic requirements for contractor access to and use of NRL facilities.

● DI-MGMT-80227 Contractor's Progress, Status and Management Report—Indicates the progress of the contractor's work and the status of the program and of the assigned tasks, reports costs, and informs of existing or potential problem areas.

● DI-MISC-80508B Technical Report-Study/Services—Provides fully documented results of studies or analysis performed.

● DI-MGMT-80447A Contract Summary Report—Summarizes all work performed under the contract.

● FAR Part 37, Service Contracting dated 1 July 2012—Provides definition and description of personal services in support of Government entities.

● FAR 31.205-46, Travel Costs—Provides instructions on per diem rates and allowability of travel.

Performance Requirement Summary (PRS)

Statements (Tasks)		Standards/AQLs	Incentive/Remedy
3.1	Conduct Basic and Applied Research and Development.		
3.1.1	The contractor shall conduct basic and applied research and development in chemistry, materials, sensors, and systems.	a) Publication of applicable books, journal articles, or conference papers AQL: High-quality, publishable research results b) Timely AQL: 90% of schedule objectives met c) Cost effective AQL: 95% of cost objectives met	
3.1.2	The contractor shall conduct experimental and theoretical studies in controlled combustion, deflagration, and detonation processes.	a) Publication of applicable books, journal articles, or conference papers AQL: High-quality, publishable research results b) Timely AQL: 90% of schedule objectives met c) Cost effective AQL: 95% of cost objectives met	
3.1.3	The contractor shall perform fundamental research on non-energetic materials.	a) Publication of applicable books, journal articles, or conference papers AQL: High-quality, publishable research results b) Timely AQL: 90% of schedule objectives met c) Cost effective	

		AQL: 95% of cost objectives met	
3.1.4	The contractor shall conduct basic and applied research centering on design, synthesis, and validation of nanostructured materials for energy generation, storage and conversion (batteries, capacitors, fuel cells) and filtration of vapor-phase toxins.	a) Publication of applicable books, journal articles, or conference papers AQL: High-quality, publishable research results b) Timely AQL: 90% of schedule objectives met c) Cost effective AQL: 95% of cost objectives met	
3.1.5	The contractor shall perform research on fuels chemistry.	a) Publication of applicable books, journal articles, or conference papers AQL: High-quality, publishable research results b) Timely AQL: 90% of schedule objectives met c) Cost effective AQL: 95% of cost objectives met	
3.1.6	The contractor shall research alternative fuels, efficient energy and power conversion, energy storage, and portable power.	a) Publication of applicable books, journal articles, or conference papers AQL: High-quality, publishable research results b) Timely AQL: 90% of schedule objectives met c) Cost effective AQL: 95% of cost objectives met	
3.1.7	The contractor shall perform research on	a) Annual publication of an applicable book, journal article, or	

physical, electrochemical, and environmental behavior of materials in a marine environment.	conference paper AQL: High-quality, publishable research results b) Timely AQL: 90% of schedule objectives met c) Cost effective AQL: 95% of cost objectives met	

Statements (Tasks)		Standards/AQLs	Incentive/Remedy
3.2	Characterization of materials.		
3.2.1	The contractor shall characterize electronic and geometric structure, mass, reactivity, molecular weight, or optical/electronic properties for materials.	a) Materials Characterized AQL: 90% of prescribed characteristics fully determined and documented b) Timely AQL: 90% of schedule objectives met c) Cost effective AQL: 95% of cost objectives met	
3.2.2	The contractor shall use characterization tools for materials surface analysis, growth, and micro/nanofabrication.	a) Materials Characterized AQL: 90% of prescribed characteristics fully determined and documented b) Timely AQL: 90% of schedule objectives met c) Cost effective AQL: 95% of cost objectives met	
3.2.3	The contractor shall conduct studies of fundamentally new approaches for	a) Materials Characterized AQL: 90% of prescribed characteristics fully determined	

	characterization and analysis of material structures and surfaces.	and documented b) Timely AQL: 90% of schedule objectives met c) Cost effective AQL: 95% of cost objectives met	
3.2.4	The contractor shall characterize materials for DoD applications.	a) Materials Characterized AQL: 90% of prescribed characteristics fully determined and documented b) Timely AQL: 90% of schedule objectives met c) Cost effective AQL: 95% of cost objectives met	
3.2.5	The contractor shall characterize non-lithographic functional patterns comprised of metal, dielectrics, polymers, and/or biomolecules.	a) Materials Characterized AQL: 90% of prescribed characteristics fully determined and documented b) Timely AQL: 90% of schedule objectives met c) Cost effective AQL: 95% of cost objectives met	

Statements (Tasks)		**Standards/AQLs**	**Incentive/Remedy**
3.3	Design, synthesis, processing, and test of materials.		
3.3.1	The contractor shall design, synthesize, and test materials for DoD applications.	a) Novel materials developed AQL: Development sufficient for transition to the next prescribed state (i.e. funding category, test environment, or product	

		development phase) b) Timely AQL: 90% of schedule objectives met c) Cost effective AQL: 95% of cost objectives met	
3.3.2	The contractor shall conduct research of non-lithographic techniques to fabricate 2D and 3D structures comprised of metal, dielectrics, polymers, and/or biomolecules for use in micro/nanoelectronic systems.	a) Novel materials developed AQL: Development sufficient for transition to the next prescribed state (i.e. funding category, test environment, or product development phase) b) Timely AQL: 90% of schedule objectives met c) Cost effective AQL: 95% of cost objectives met	
3.3.2.1	The contractor shall build proof of concept micro/nanoelectronic components and devices using non-lithographic techniques assessed in preceding paragraph.	a) Novel materials developed AQL: Development sufficient for transition to the next prescribed state (i.e. funding category, test environment, or product development phase) b) Timely AQL: 90% of schedule objectives met c) Cost effective AQL: 95% of cost objectives met	
3.3.2.2	The contractor shall test and evaluate novel non-lithographic processing approaches to digital micro/nanofabrication	a) Novel materials developed AQL: Development sufficient for transition to the next prescribed state (i.e. funding category, test environment, or product development phase)	

	of micro/nanoelectronic devices and systems.	b) Timely AQL: 90% of schedule objectives met c) Cost effective AQL: 95% of cost objectives met d) Test or evaluation report completed AQL: Fully documents technical results of test or evaluation	
3.3.2.3	The contractor shall develop new materials for fabrication of 2D and 3D micro/nanostructures with unique properties and behavior.	a) Novel materials developed AQL: Development sufficient for transition to the next prescribed state (i.e. funding category, test environment, or product development phase) b) Timely AQL: 90% of schedule objectives met c) Cost effective AQL: 95% of cost objectives met	
3.3.2.4	The contractor shall develop novel methods for fabrication of 2D and 3D micro/nanostructures.	a) Novel materials developed AQL: Development sufficient for transition to the next prescribed state (i.e. funding category, test environment, or product development phase) b) Timely AQL: 90% of schedule objectives met c) Cost effective AQL: 95% of cost objectives met	
3.3.3	The contractor shall develop and test new fuels suitable for use by the U.S. Navy's	a) Novel materials developed AQL: Development sufficient for transition to the next prescribed	

	ships and aircraft.	state (i.e. funding category, test environment, or product development phase) b) Timely AQL: 90% of schedule objectives met c) Cost effective AQL: 95% of cost objectives met	
3.3.3.1	The contractor shall conduct tests to determine the properties and stability of traditional Navy mobility fuels	a) Novel materials developed AQL: Development sufficient for transition to the next prescribed state (i.e. funding category, test environment, or product development phase) b) Timely AQL: 90% of schedule objectives met c) Cost effective AQL: 95% of cost objectives met	
3.3.3.2	The contractor shall develop, test, and certify fuels produced from non-petroleum sources.	a) Novel materials developed AQL: Development sufficient for transition to the next prescribed state (i.e. funding category, test environment, or product development phase) b) Timely AQL: 90% of schedule objectives met c) Cost effective AQL: 95% of cost objectives met	
3.3.4	The contractor shall provide research and engineering support to develop and field test materials to	a) Novel materials developed AQL: Development sufficient for transition to the next prescribed state (i.e. funding category, test	

	control anti-fouling, adhesion, friction, wear and corrosion.	environment, or product development phase) b) Timely AQL: 90% of schedule objectives met c) Cost effective AQL: 95% of cost objectives met	

Statements (Tasks)		Standards/AQLs	Incentive/Remedy
3.4	Design, fabrication, and test of sensors and systems in the laboratory and/or field.		
3.4.1	The contractor shall design, fabricate and test chemical and biological sensors and systems (hardware and software) to detect, identify and quantify single-component and/or mixtures of analytes in gas, liquid or solid forms as applied to the detection of drugs of abuse, explosives, pollutants and other environmental contaminants, pathogenic organisms, chemical/biological warfare agents, and other analytes.	a) New sensors and systems developed AQL: Development sufficient for transition to the next prescribed state (i.e. funding category, test environment, or product development phase) b) Timely AQL: 90% of schedule objectives met c) Cost effective AQL: 95% of cost objectives met	
3.4.1.1	The contractor shall support the development of simulants and training aids based on chemical and	a) New sensors and systems developed AQL: Development sufficient for transition to the next prescribed state (i.e. funding category, test	

	biological sensors and systems.	environment, or product development phase) b) Timely AQL: 90% of schedule objectives met c) Cost effective AQL: 95% of cost objectives met	
3.4.1.2	The contractor shall miniaturize analytical and bioanalytical tools to meet Navy requirements.	a) New sensors and systems developed AQL: Development sufficient for transition to the next prescribed state (i.e. funding category, test environment, or product development phase) b) Timely AQL: 90% of schedule objectives met c) Cost effective AQL: 95% of cost objectives met	
3.4.2	The contractor shall support scientific computing activities.	a) New sensors and systems developed AQL: Development sufficient for transition to the next prescribed state (i.e. funding category, test environment, or product development phase) b) Timely AQL: 90% of schedule objectives met c) Cost effective AQL: 95% of cost objectives met	
3.4.2.1	The contractor shall support scientific computing activities associated with data	a) New sensors and systems developed AQL: Development sufficient for	

	acquisition, measurements, data processing and graphics.	transition to the next prescribed state (i.e. funding category, test environment, or product development phase) b) Timely AQL: 90% of schedule objectives met c) Cost effective AQL: 95% of cost objectives met	
3.4.2.2	The contractor shall support scientific computing activities associated with instrument control, networking and communications.	a) New sensors and systems developed AQL: Development sufficient for transition to the next prescribed state (i.e. funding category, test environment, or product development phase) b) Timely AQL: 90% of schedule objectives met c) Cost effective AQL: 95% of cost objectives met	
3.4.2.3	The contractor shall support scientific computing activities associated with data fusion, multivariate analysis, and modeling and simulation.	a) New sensors and systems developed AQL: Development sufficient for transition to the next prescribed state (i.e. funding category, test environment, or product development phase) b) Timely AQL: 90% of schedule objectives met c) Cost effective AQL: 95% of cost objectives met	
3.4.2.3.1	The contractor shall	a) New sensors and systems	

	apply artificial intelligence techniques to data interpretation problems associated with hazardous material detection and improved situational awareness.	developed AQL: Development sufficient for transition to the next prescribed state (i.e. funding category, test environment, or product development phase) b) Timely AQL: 90% of schedule objectives met c) Cost effective AQL: 95% of cost objectives met	
3.4.2.3.2	The contractor shall analyze sensor array data using multivariate mathematical and statistical methods, such as pattern recognition algorithms, neural networks, and machine vision.	a) New sensors and systems developed AQL: Development sufficient for transition to the next prescribed state (i.e. funding category, test environment, or product development phase) b) Timely AQL: 90% of schedule objectives met c) Cost effective AQL: 95% of cost objectives met	
3.4.2.3.3	The contractor shall develop methods for fusion of disparate data sources.	a) New sensors and systems developed AQL: Development sufficient for transition to the next prescribed state (i.e. funding category, test environment, or product development phase) b) Timely AQL: 90% of schedule objectives met c) Cost effective AQL: 95% of cost objectives met	

3.4.3	The contractor shall provide research and engineering support to assist in the transition of sensors to autonomous systems.	a) New sensors and systems developed AQL: Development sufficient for transition to the next prescribed state (i.e. funding category, test environment, or product development phase) b) Timely AQL: 90% of schedule objectives met c) Cost effective AQL: 95% of cost objectives met	
3.4.4	The contractor shall provide research and engineering support to assist in the transition of power and energy systems to autonomous systems.	a) New sensors and systems developed AQL: Development sufficient for transition to the next prescribed state (i.e. funding category, test environment, or product development phase) b) Timely AQL: 90% of schedule objectives met c) Cost effective AQL: 95% of cost objectives met	
3.4.4.1	The contractor shall integrate the research results of two separate research efforts - unmanned vehicles (air, ground and underwater) and fuel cell systems.	a) New sensors and systems developed AQL: Development sufficient for transition to the next prescribed state (i.e. funding category, test environment, or product development phase) b) Timely AQL: 90% of schedule objectives met c) Cost effective	

		AQL: 95% of cost objectives met	
3.4.4.2	The contractor shall develop methods for the precise placement and control of sensors to enable real time situational awareness and support the battlespace management needs of DoN autonomous systems.	a) New sensors and systems developed AQL: Development sufficient for transition to the next prescribed state (i.e. funding category, test environment, or product development phase) b) Timely AQL: 90% of schedule objectives met c) Cost effective AQL: 95% of cost objectives met	
3.4.5	The contractor shall design, fabricate and test physical sensors and systems (hardware and software) to detect buried ordnance from vehicular, man-portable, airborne, and/or marine platforms.	a) New sensors and systems developed AQL: Development sufficient for transition to the next prescribed state (i.e. funding category, test environment, or product development phase) b) Timely AQL: 90% of schedule objectives met c) Cost effective AQL: 95% of cost objectives met	
3.4.5.1	The contractor shall support laboratory and field operations to evaluate buried ordnance sensor systems.	a) New sensors and systems developed AQL: Development sufficient for transition to the next prescribed state (i.e. funding category, test environment, or product development phase) b) Timely AQL: 90% of schedule objectives met c) Cost effective AQL: 95% of cost objectives met	
3.4.5.2	The contractor shall	a) New sensors and systems	

	provide accurate and efficient data acquisition, preprocessing, and target analysis using prototype systems.	developed AQL: Development sufficient for transition to the next prescribed state (i.e. funding category, test environment, or product development phase) b) Timely AQL: 90% of schedule objectives met c) Cost effective AQL: 95% of cost objectives met	
3.4.5.3	The contractor shall process and analyze data in the field in support of target selection, reacquisition, and remediation.	a) New sensors and systems developed AQL: Development sufficient for transition to the next prescribed state (i.e. funding category, test environment, or product development phase) b) Timely AQL: 90% of schedule objectives met c) Cost effective AQL: 95% of cost objectives met	
3.4.5.4	The contractor shall provide surge UXO/HAZWOPR field personnel and UXO remediation support as required to validate system performance.	a) New sensors and systems developed AQL: Development sufficient for transition to the next prescribed state (i.e. funding category, test environment, or product development phase) b) Timely AQL: 90% of schedule objectives met c) Cost effective AQL: 95% of cost objectives met	